INNOVATIONS IN CIRCULAR ECONOMY – ENVIRONMENTAL LABELS AND DECLARATIONS

Edited by Bożydar Ziółkowski, Boris Agarski and Juraj Šebo

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Authors of the chapters

1. **Bożydar Ziółkowski, PhD, Eng., Assistant Prof.**
   Rzeszow University of Technology, Faculty of Management, Poland
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   Challenges

2. **Dariusz Wyrwa, PhD, Eng., Assistant Prof.**
   Rzeszow University of Technology, Faculty of Management, Poland
   The model of circular economy
   LEED

3. **Janusz Strojny, DSc, PhD, Eng., Associate Prof.**
   Rzeszow University of Technology, Faculty of Management, Poland
   ISO type I environmental labelling
   LEED

4. **Juraj Šebo, doc., PhD, Eng., Associate Prof.**
   Technical University of Košice, Faculty of Mechanical Engineering, Slovakia
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5. **Marek Moravec, PhD, Eng., Assistant Prof.**
   Technical University of Košice, Faculty of Mechanical Engineering, Slovakia
   Blue Angel

6. **Marzena Jankowska-Mihułowicz, PhD, Eng., Assistant Prof.**
   Rzeszow University of Technology, Faculty of Management, Poland
   Environmental Choice

7. **Monika Karková, PhD, Eng., Assistant Prof.**
   The Institute of Technology and Business in České Budějovice, Faculty of Technology, Czech Republic
   ENERGY STAR®

8. **Boris Agarski, PhD, Assistant Prof.**
   University of Novi Sad, Faculty of Technical Sciences, Serbia
   Preface
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   Self-declared environmental claims
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9. **Milana Ilić Mićunović, PhD, Assistant Prof.**
   University of Novi Sad, Faculty of Technical Sciences, Serbia
   ISO type II environmental labelling. Self-declared environmental claims in the form of statements
   ISO type III environmental declarations
   Green Seal
   FSC
   Self-declared environmental claims
   Environmental product declarations based on life cycle assessment

10. **Igor Budak, PhD, Full Prof.**
    University of Novi Sad, Faculty of Technical Sciences, Serbia
    ISO type II environmental labelling. Self-declared environmental claims in the form of statements
    ISO type III environmental declarations
    Green Seal
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Preface

Health, safety, and environmental performance[1] are three factors which attract wide interest in environmental labels and declarations. Many problems and crises require effective solutions. The diet-related[2] and reproductive health problems[3] but mainly civilizational diseases (such as diabetes, obesity pandemic[4], depression, cancer, allergies, respiratory and cardiovascular problems[5]) are a consequence of industrial pollution i.e. the long-lasting accumulation of toxic chemicals in the environment and living organisms[6].

The public concern regarding environmental issues, motivated to a large extent, by safety satisfaction, started in the 1960s, with the emergence of the first ecological movements in the USA. These customer initiatives are considered to be a "gesture of protest against the destructive activity of business and industry and the lack of care for the environment and the main ethical principles"[7]. Nowadays, those groups have evolved towards "the Lifestyles of Health and Sustainable (LOHAS) consumers" (e.g. "Good Neighbors, Tree Huggers, and Eco-Village"[8]) who demonstrate their "sustainable lifestyle practices" or "ethical consumption"[9] in the form of e.g. green purchase and recycling intention, considering clothing care, adopting eco-citizenship (eco-friendly behavior), fair

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1 D. Xu, M.H. Karray, B. Archimède, *A semantic-based decision support platform to assist products' eco-labeling process*, "Industrial Management & Data Systems" 2017, Vol. 117, No 7, pp. 1340–1361.

2 E. Kasapidou, E. Sossidou, P. Mitlianga, *Fruit and vegetable co-products as functional feed ingredients in farm animal nutrition for improved product quality*, "Agriculture-Basel" 2015, Vol. 5, No 4, pp. 1020–1034.

3 M. Makarow, L. Højgaard, *Male reproductive health*, "Science Policy Briefing" 2010, No 40, pp. 1–12.

4 M. Vasiljevic, R. Pechey, T.M. Marteau, *Making food labels social: The impact of colour of nutritional labels and injunctive norms on perceptions and choice of snack foods*, "Appetite" 2015, Vol. 91, pp. 56–63.

5 J. Persson, T. Wang, J. Hagberg, *Indoor air quality of newly built low-energy preschools - Are chemical emissions reduced in houses with eco-labelled building materials?*, "Indoor And Built Environment" 2019, Apr., Vol. 28, No 4, pp. 506–519.

6 M. Vasiljevic, R. Pechey, T.M. Marteau, *Making food labels social: The impact of colour of nutritional labels and injunctive norms on perceptions and choice of snack foods...*, op. cit.

7 M. Malczyńska-Biały, *Konsumeryzm w Stanach Zjednoczonych*, "Polityka i Społeczeństwo" 2012, Nr 10, ss. 104–105.

8 S.H.-N. Lee, H. Kim, K. Yang, *Impacts of sustainable value and business stewardship on lifestyle practices in clothing consumption*, "Fashion And Textiles" 2015, Vol. 2, No 1, pp. 1–18.

9 T.P.L. Nghiem, L.R. Carrasco, *Mobile applications to link sustainable consumption with impacts on the environment and biodiversity*, "Bioscience" 2016, Vol. 66, No 5, pp. 384–392.

trade choices and pro‑environmentalism[10]. The introduction of the first ecolabels as policy measures, "to offset the information asymmetry between manufacturers/providers and consumers in various domains"[11] satisfied, to some extent, the needs of those communities. Environmental labels and environmental declarations are defined as claims which show the environmental aspects of a product or service[12].

So far, the situation has changed greatly, and the number of ecolabelling programs has officially increased across the world to over 456 in the year 2021[13]. Moreover, the existence of ecolabels alongside bio-labels and social labels confuses consumers[14] in many countries. Subsequently, the need for better education, development of learning tools, organisation of campaigns, raising of public awareness in the field of environmental labels and declarations was evident long ago. The aim of this handbook is the presentation of the contemporary environmental labelling programs, which are tools in environmental management. This book contributes to knowledge promotion in applying ecolabelling as an innovation in the circular economy. Deposition of this educational tool on e-learning platforms will increase its internationalisation and availability for all interested parties. The presented publication should be of interest to university lecturers and students but also to governments, companies, and civil society organizations that face the prospect of "teaching the consumers"[15] and "hybrid governance"[16]. For the sake of human health and environmental resources, the cooperation of all social actors is a constant need for the proliferation of ecolabelling programs.

The book comprises five main parts, which embrace 19 numbered subchapters. The first two chapters present the idea of the circular economy, as well as the general literature on ecolabels and ISO-type environmental labels and declarations. The following three chapters discuss in detail the previously introduced and also other types of ecolabelling schemes. In the last 13 subchapters on environmental labels and declarations, the case studies or

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10 S.H.-N. Lee, H. Kim, K. Yang, *Impacts of sustainable value and business stewardship on lifestyle practices in clothing consumption*..., op. cit.

11 C. Codagnone, G.A. Veltri, F. Bogliacino, F. Lupianez-Villanueva, G. Gaskell, A. Ivchenko, P. Ortoleva, F. Mureddu, *Labels as nudges? An experimental study of car eco-labels*, "Economia Politica" 2016, Vol. 33, No 3, pp. 403–432.

12 ISO 14020:2000, Environmental labels and declarations – General principles.

13 Ecolabel Index, http://www.ecolabelindex.com, 10.02.2021.

14 S.H.-N. Lee, H. Kim, K. Yang, *Impacts of sustainable value and business stewardship on lifestyle practices in clothing consumption*..., op. cit.

15 K.M.R. Taufique, C. Siwar, N. Chamhuri, F.H. Sarah, *Integrating general environmental knowledge and eco-label knowledge in understanding ecologically conscious consumer behavior*, "Procedia Economics and Finance" 2016, Vol. 37, pp. 39–45.

16 C. Tayleur, A. Balmford, G.M. Buchanan, S.H.M. Butchart, H. Ducharme, R.E. Green, J.C. Milder, D. H. L. Thomas, J. Vickery, B. Phalan, *Global coverage of agricultural sustainability standards, and their role in conserving biodiversity*, "Conservation Letters" 2017, Vol. 10, No 5, pp. 610–618.

examples of the use of the analysed programs and systems in business practice are presented. The case studies and examples of ecolabelling schemes were selected according to the defined methodological rules based on the document research method. In the conducted research, the rigour of approaching the practical case studies from management practice was applied. The empirical work was conditioned by the variety, importance and educational potential of the problems presented in case studies but also by the availability of online materials retrieved by the purposive sampling technique.

We hope, this book will add variety to the curricula of many universities both by supporting the lectures already delivered, and by implementing the idea of a new course on environmental labels and declarations in the circular economy, mainly in the area of quality and management, environmental management, economics domain.

Editors

Introduction

(*Bożydar Ziółkowski*)

The scientific debate regarding the role of man on Earth includes extreme environmental ethics. There are different environmental ethics such as human-centered anthropocentrism, nature exploitation-oriented resourcism, or ecology balance-oriented biocentrism. Despite existing divergences across those ethics, they all express nowadays a common understanding about the lack of sustainability in the linear economy system (the traditional economy of the last decades). There is ample evidence in this matter, both in terms of resource extraction and unsustainable consumption. On the one hand, according to general calculations, in the last 0.2 seconds of the Earth's geological history, humans "have used 33% of Earth's entire natural resources"[17]. On the other hand, the expected increase in plastics production will result in "more plastics than fish (by weight)" in oceans by the year 2050[18]. After supplementing such picture with additional scientific data – e.g. about the predicted male infertility predominant in the United States of America (US) and Europe by 2060, caused in male fetuses by endocrine disrupters (polychlorinated biphenyls – PCBs, parabens, phthalates, bisphenol-A, ultraviolet (UV) filters, dioxin, pesticides, polyfluorinated chemicals), present in plastics, paints, food, cosmetics, clothes[19] – the coming crisis of reproductive health and the subsequent demographic demise appear to be a real public policy problem.

The negative effects of the traditional economic model have exerted a globally powerful impact on the environment, society, and economy. The concern about the contemporary situation has been articulated by the representatives of the research and development (R&D) sector for a long time. In the year 2017, over 15000 scientists representing 184 countries and assembled in the Alliance of World Scientists signed together with the "World Scientists' Warning to Humanity: the second notice". The signatories called for a fast implementation of the 13 strategic actions aimed at the transition to sustainability development, similarly as in the year 1992 when the Union of Concerned Scientists and over 1700 scientists appealed for the stopping of environmental destruction.

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[17] The World Counts, *About the project*, https://www.theworldcounts.com/about/the_project, 28.10.2020.

[18] Ellen Macarthur Foundation, *The New Plastics Economy: Rethinking the future of plastics & catalysing action*, [in] *Ellen Macarthur Foundation 2017*, p. 13.

[19] M. Makarow, L. Højgaard, *Male reproductive health*..., op. cit.

The long-lasting environmental pressures of the traditional consumption and production models caused severe effects of overexploitation of resources along with devastation and degradation of landscapes. In order to reduce the anthropopressure, the paradigm of industrial civilization has been replaced by a more effective management model, called circular economy. This concept recognizes the human economy as one of many ecosystems in the environment (i.e. biosphere)[20]. Thus, according to the circular economy concept, the biosphere is a group of ecosystems, including the human ecosystem too.

In the European Union, the role of the circular economy has gained momentum since the year 2015, when the Circular Economy Package of the European Union was introduced with the objectives for closed-loop economy[21]. The trend of growing interest in the transition to the circular economy is also noticeable internationally. In May 2017, there was introduced by British Standards Institution (BSI) the first standard on circular economy, BS 8001:2017[22]. The latest example is the initiative of 74 countries that voted for the development of the International Organization for Standardization (ISO) standards regarding the circular economy. In the year 2018, the new ISO Technical Committee (ISO/TC 323 Circular economy) was established. It initiated the creation of standards contributing to the Sustainable Development Goals of the UN Agenda 2030[23]:

1. ISO/WD 59004 – Circular economy – Framework and principles for implementation,
2. ISO/WD 59010 – Circular economy – Guidelines on business models and value chains,
3. ISO/WD 59020 – Circular economy – Measuring circularity framework,
4. ISO/CD TR 59031 – Circular economy – Performance-based approach – Analysis of cases studies.

The success of transition to sustainability and circularity depends on governmental initiatives[24]. In national policies, one of the tools aimed at

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[20] T. Wautelet, *The concept of circular economy: Its origins and its evolution*, Working Paper 2018, http://rgdoi.net/10.13140/RG.2.2.17021.87523, 05.02.2019.

[21] European Commission, Closing the loop - An EU action plan for the circular economy, communication from the Commission to the European Parliament, the Council, the European Economic and social Committee and the Committee of the Regions, COM(2015) 614 final.

[22] BS 8001:2017 – Framework for implementing the principles of the circular economy in organizations. Guide.

[23] ISO, *Standards by ISO/TC 323 – Circular economy*, https://www.iso.org/committee/7203984/x/catalogue/p/0/u/1/w/0/d/0, 13.11.2020.

[24] M.A. Delmas, T.P. Lyon, J.W. Maxwell, *Understanding the role of the corporation in sustainability transitions. Introduction to the Special Issue*, "Organization & Environment" 2019, Vol. 32, No 2, SI, pp. 87–97.

promoting sustainability is ecolabelling[25]. In all the policy mechanisms used for the promotion of circular economy in the European Union, these are:

1. "Environmental Management System (EMS),
2. Green Public Procurement (GPP),
3. Eco-design Directive,
4. Ecolabel and Energy Label,
5. Environmental Technology Verification (ETV)"[26].

Similarly, at the company level, the strategic approach to the transition to sustainability includes ecolabels, which represent some of many mechanisms among other information strategies, i.e.: "socially responsible investing, and the public statements of CEOs"[27].

Building a competitive advantage is focused on attracting customers' attention. A good strategy for this includes educational plans tailored to target market niches. Finally, the growing awareness of customers results in an increased in the company's profit too. When designing educational campaigns, enterprises use many communication tools. There are still, however, some not well-captured mechanisms among them. Frequently, the major roadblock is the low awareness of company managers in certain areas. The art of creating a communication strategy is based on similar principles, but it requires in-depth knowledge of the product, sector, and individual customers' characteristics. When implementing the information tools selected from the group of ecolabels, strategists in enterprises must have a good understanding of environmental issues. High managerial knowledge is the starting point for the development of effective ecolabelling strategies and information disclosure policies. Finally, such a reasonable communication strategy is a prerequisite for successful ecolabelling which "must be well communicated and well-understood by the consumers"[28].

The extent to which the ecolabels are disseminated is determined mostly by "customers' attitudes towards environmental issues"[29]. As ecological awareness increases, each consumer "becomes emotionally connected to the product"[30] manufactured according to the environmental standards. The process of

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[25] C. Tayleur, A. Balmford, G.M. Buchanan, S.H.M. Butchart, H. Ducharme, R.E. Green, J.C. Milder, D. H. L. Thomas, J. Vickery, B. Phalan, *Global coverage of agricultural sustainability standards, and their role in conserving biodiversity*, op. cit.

[26] A. Grinnall, S. Burnett, *First catch your fish: Designing a "Low Energy Fish" Label*, "Sustainability" 2015, Vol. 7, No 5, pp. 6086–6101.

[27] M.A. Delmas, T.P. Lyon, J.W. Maxwell, *Understanding the role of the corporation in sustainability transitions. Introduction to the Special Issue*..., op. cit.

[28] K.M.R. Taufique, C. Siwar, B. Talib, F.H. Sarah, N. Chamhuri, *Synthesis of constructs for modeling consumers' understanding and perception of eco-labels*, "Sustainability" 2014, Vol. 6, No 4, pp. 2176–2200.

[29] T. Kijek, *Modelling of eco-innovation diffusion: The EU eco-label*, "Comparative Economic Research-Central and Eastern Europe" 2015, Vol. 18, No 1, pp. 65–79.

[30] T. Paiva, V. Garcia, *ECO2SEIA - low carbon green label products: a green marketing "study case"*, "Holos" 2016, Vol. 32, No 8, pp. 240–254.

consumer's identification with the brand of the product can be short when the environmental criteria of goods are communicated by ecolabels. In this way, "the ecolabel adds value to the product, transforming itself into an asset"[31] for the consumer, who can, for example, reduce the purchasing time, for the seller who reaches many benefits, both financial[32] and without the price premium[33], and for species and habitats, which are better protected through the use of clean technologies[34].

In creating a strategy for ecolabels[35], it is important to gather knowledge on "consumer preferences and willingness to pay higher prices for goods produced in an environmentally responsible way"[36]. This task is very demanding because the perception of ecolabels is determined by many factors, for example:

1. Product type (e.g., shoes, energy, garments, food, water, building materials),
2. Ecolabelling program (EU Ecolabel, Blue Angel, KRAV, FSC),
3. Types of consumers (according to "values, beliefs, norms, situational determinants, and previous experience"[37]),
4. Socio-demographic attributes such as the level of income, level of education, age, biological profile (male or female), place of residence (geographical region, country), level of economic development (developed countries, emerging economies).

The examples of corresponding challenges for the ecolabelling programs are as follows:

1. Consumer segments – there is little interest of young people in reading long information on ecolabels (they prefer short, precise and factual data on ecolabels),
2. The level of income – the people with low incomes are not willing to overpay for quality provided by ecolabels,

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31 Ib.

32 S. Lieng, N. Yagi, H. Ishihara, *Global ecolabelling certification standards and ASEAN Fisheries: Can fisheries legislations in ASEAN countries support the fisheries certification?*, "Sustainability" 2018, Vol. 10, No 11, pp. 1–17.

33 G. Sogn-Grundvag, F. Asche, D. Zhang, J.A. Young, *Eco-labels and product longevity: The case of whitefish in UK grocery retailing*, "Food Policy" 2019, Vol. 88, pp. 1–10.

34 S.J. Chiavacci, E.J. Pindilli, *Trends in biodiversity and habitat quantification tools used for market-based conservation in the United States*, "Conservation Biology" 2020, Vol. 34, No 1, pp. 125–136.

35 K.M.R. Taufique, C. Siwar, B. Talib, F.H. Sarah, N. Chamhuri, *Synthesis of constructs for modeling consumers' understanding and perception of eco-labels...*, op. cit.

36 S.J. Chiavacci, E.J. Pindilli, *Trends in biodiversity and habitat quantification tools used for market-based conservation in the United States...*, op. cit.

37 N. Sonnenberg, B. Jacobs, D. Momberg, *The role of information exposure in female university students' evaluation and selection of eco-friendly apparel in the South African emerging economy*, "Clothing and Textiles Research Journal" 2014, Vol. 32, No 4, pp. 266–281.

3. The level of education – it determines the willingness to look for ecolabelled products,
4. The place of residence – it determines the level of income of inhabitants and the availability of certain types of ecolabels.

Despite the theoretical understanding of the potential in providing solutions to the identified challenges, it seems the ecolabelling is still not a fully utilized tool.

1. The model of circular economy

(*Bożydar Ziółkowski, Dariusz Wyrwa*)

1.1. Theory and evolution of the idea

When consequences of the linear economy, initialized by "the Industrial Revolution of the years 1760-1820"[38] became evident, the reflection on a new economic paradigm started. The principles of the new economic model, termed as the circular economy, entered the framework of environmental or sustainable development policies in various regions. The separate elements of this concept were introduced on the agendas of modern science, companies and governments in the 1970s. However, the literal promotion of the idea under the newly coined name, as a consistent model of production and consumption, dates back to the 2010s in the world.

The initial holistic considerations on the circular economy were made by American educator, economist and philosopher K.E. Boulding. In the article "The Economics of the Coming Spaceship Earth" (1966) the author described the world economy as "econosphere" when presenting two diverse perspectives: the open economy (called by him the open system or the "cowboy economy") and the closed economy (which he termed as the closed system or the "spaceman" economy). K.E. Boulding considered the elements of the open economy to be a natural component in open Earth. He claimed, however, that in order to build the closed Earth, introducing the closed economy principles is a key requirement. These two paradigms remain in noticeable contradiction with each other. The symbolic cowboy economy concept promotes the illimitable exploitation of natural resources. According to the spaceman economy concept, in turn, the Earth is a single spaceship with limited reservoirs of extraction or for pollution. The explanation of differences between these two economic approaches is delivered by analysis of social attitudes on consumption. As illustrated by K. E. Boulding, the cowboy economy is focused on maximizing consumption and production, both of which are considered good phenomena. The success of the cowboy economy is measured using the throughput of production factors in microscale and in macroscale what is expressed in total by the gross national product (GNP) or the gross world product (GWP). Contrary arguments stem from the spaceman economy which appeals to minimize the throughput because the success of the economy depends on the maintenance of the stock in good nature, extent, quality, and complexity. Consequently, the

[38] O. Okorie, C. Turner, F. Charnley, A. Tiwari, M. Moreno, *A Review of Data-Driven Approaches for a Circular Economy in Manufacturing*, [in] *18th European Roundtable for Sustainable Consumption and Production*, Skiathos Island, Greece 2017, pp. 120–131.

lower throughput is the lower stock extraction which means the lower production and consumption, regarded as a gain in the spaceman economy[39].

At present, the economists D.W. Pearce and R.K. Turner[40] are acknowledged as propagators of the circular economy who were the first to introduce[41] this idea in the book published in the year 1990 "Economics of Natural Resources and the Environment".

The international scientific interest in the circular economy started in the year 2003, and since the year 2016 it has started to gain momentum, increasing sharply[42].

The practical application of different elements of the contemporary circular economy idea dates back to the year 1970. Companies and governments used then components of the concept as development strategies supporting competitiveness and resource efficiency of the economy; however, incorporating the phrase "circular economy" into the strategic and legal regulations is assessed by researchers as inconsistent across the world till now[43]. Similarly, the scope of and approach to implementation of the circular economy principles differs globally. For example, China is viewed as the first country in the world which has embedded literally the circular economy into public policies when creating its National Economic and Social Development plans for the years 2006-2010 and 2011-2015[44]. It is also the first country[45] which created the national Circular Economy Promotion Law in 2008[46]. In addition to this, in the year 2005 "the label of circular economy and environmental protection" was introduced as a voluntary policy instrument promoting the development of the eco-transformation of the industrial park in China.

In the EU, the regulatory promotion of the concept has literally emerged in the Circular Economy Package since the year 2015. Nevertheless, in many countries, aspects of the circular economy have previously been implemented in

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39 K.E. Boulding, *The Economics of the Coming Spaceship Earth*, 1966, http://dieoff.org/page160.htm, 30.04.2018.

40 See: D.W. Pearce, R.K. Turner, *Economics of Natural Resources and the Environment*, Johns Hopkins University Press 1990.

41 V. Ferreira Gregorio, L. Pié Dols, A. Terceño, *A Systematic Literature Review of Bio, Green and Circular Economy Trends in Publications in the Field of Economics and Business Management*, "Sustainability" 2018, Vol. 10, p. 1–39.

42 Between the years 2016-2020, the number of annually published papers increased from 396 to 1753 (the results of the bibliometric analysis of peer-reviewed journal works on "circular economy", retrieved in September 2020 from the Web of Science platform).

43 T. Wautelet, *The Concept of Circular Economy*…, op. cit.

44 Ib.; E. Aguiñaga, I. Henriques, C. Scheel, A. Scheel, *Building resilience: A self-sustainable community approach to the triple bottom line*, "Journal of Cleaner Production" 2018, Vol. 173, pp. 186–196.

45 T. Wautelet, *The Concept of Circular Economy*..., op. cit.

46 C. Yu, *Eco-transformation of industrial parks in China*, Delft University of Technology, Delft 2014, https://repository.tudelft.nl/islandora/object/uuid%3Af10443ff-78b9-4640-9d31-dbdf65f8e99e, 17.08.2018.

legislation on e.g. waste, energy efficiency, green public procurement, packaging, eco-design, environmental labels, energy labelling. Finally, the scope and structure of the circular economy principles differed in public policies of separate regions. The key determinant of such incoherence was the lack of acceptance for the universal and commonly accepted definition[47] resulting from the fact that the circular economy is rather an umbrella[48] expression for different groups of solutions. During the evolution of the general idea, the primary concept of the circular economy had been influenced by solutions from new schools of thought[49]. The modern circular economy concept evolved from the five approaches featured by many complementary[50] priorities and strategies/ /principles:

1. Industrial Ecology – is a science on the flows of materials and energy in industrial settings[51]. The priorities of this approach include[52]: analysis of materials and energy flow, industrial symbiosis, systems thinking, valorization of by-products, and waste,
2. Cradle to cradle – aims at introducing the principles of reusing, recycling, and refurbishing into the life cycle of the product. This approach embraces such priorities as: design inspired by nature and eco-effectiveness with renewables, waste equals food, respect for diversity (complexity of the system) attributed to its assumptions[53],
3. Performance Economy – aims at lifetime extension and services. The approach includes the following priorities[54]: products as a service, closed-loop economy, sufficiency over efficiency, sustainable taxation,
4. Blue Economy – embraces solutions determined by the local environment. The main priority levels of this approach are[55]: preferences for locally available resources, analysis of materials and energy cascading, inspired by nature, innovative business models, waste is income,

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47 J. Korhonen, C. Nuur, A. Feldmann, S.E. Birkie, *Circular economy as an essentially contested concept*, "Journal of Cleaner Production" 2018, Vol.175, pp. 544–552; G. Moraga, S. Huysveld, F. Mathieux, G. Blengini, L. Alaerts, K. Van Acker, S. De Meester, J. Dewulf, *Circular economy indicators: What do they measure?*, "Resources Conservation and Recycling" 2019, Vol. 146, s. 452–461.

48 F. Ceschin, I. Gaziulusoy, *Evolution of design for sustainability: From product design to design for system innovations and transitions*, "Design Studies" 2016, Vol. 47, pp. 118–163.

49 T. Wautelet, *The Concept of Circular Economy...*, op. cit.

50 L. Milios, *Advancing to a Circular Economy: three essential ingredients for a comprehensive policy mix*, "Sustainability Science" 2017, Vol. 13, pp. 1–19.

51 L. Lindfred, I. Nordeld, *Investigating The Move Towards Circular Economy for Consumer and Retail Companies*, Chalmers University of Technology, Gothenburg 2017.

52 T. Wautelet, *The Concept of Circular Economy...*, op. cit.

53 MBDC, EPEA, *Introduction to the Cradle to Cradle Design Framework*, 2002, http://www.chinauscenter.org/attachments/0000/0001/CradleDesign.pdf, 17.08.2018.

54 T. Wautelet, *The Concept of Circular Economy...*, op. cit.

55 Ib.

5. Biomimicry (biomimetic economy) – in short: design inspired by nature, is a science aimed at using the natures models (ecosystems) to solve human problems in the industry. The priorities of this approach are[56]: systems thinking, nature as a model, nature as a measure, nature as a mentor.

Definitions of the circular economy vary depending on the approaches applied. The examples of interpretations of the circular economy are presented in table 1.

Table 1. Definitions of circular economy

No	Definitions	Bibliography
1.	In the circular economy "the value of products, materials and resources is maintained in the economy as long as possible and the generation of waste minimized" to "develop a sustainable, low carbon, resource efficient and competitive economy"	(European Commission, 2015)[57]
2.	"Circular Economy new way of thinking about material flows, production and patterns of consumption"	(Church, Ahmed, Benifand, 2014)[58]
3.	The circular economy is a regenerative system in which input elements (raw materials) and output elements (waste, emission, and energy leakage) are minimized by closing material and energy loops, by means of proper designing, long-lasting maintenance, repairing, reusing, remanufacturing, refurbishing, and recycling	(Geissdoerfer, 2017)[59]
4.	"Circular economy is seen as a new business model expected to lead to a more sustainable development and a harmonious society"	(Ghisellini, Cialani, Ulgiati, 2016)[60]
5.	Circular economy is "a vision of an economic system without waste that runs on renewable energy"	(Nyström, 2019)[61]
6.	Circular economy is based on: 1. A perfect circle of slow material flows, 2. A shift from the consumer to the user,	(Lazarevic, Valve, 2017)[62]

[56] Ib.

[57] European Commission, *Closing the loop - An EU action plan for the Circular Economy*…, op. cit.

[58] R. Church, N. Ahmed, K. Benifand, *Re-imagining the Future: The Biomimetic Economy*, [in] Proceedings of RSD3, Third Symposium of Relating Systems Thinking to Design Oslo 2014.

[59] M. Geissdoerfer, P. Savaget, N.M.P. Bocken, E.J. Hultink, *The Circular Economy – A new sustainability paradigm?*, "Journal of Cleaner Production" 2017, Vol. 143, pp. 757–768.

[60] P. Ghisellini, C. Cialani, S. Ulgiati, *A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems*, „Journal of Cleaner Production" 2016, Vol. 114, pp. 11–32.

[61] T. Nyström, *Adaptive Design for Circular Business Models in the Automotive Manufacturing Industry*, 2019, https://www.ri.se/sites/default/files/2019-10/Adaptive%20Design%20for%20Circular%20Business%20Models%20in%20%20the%20Automotive%20Manufacturing%20Industry_1.pdf, 02.09.2020.

[62] See: D. Lazarevic, H. Valve, *Narrating expectations for the circular economy: Towards a common and contested European transition*, "Energy Research & Social Science" 2017, Vol. 31, pp. 60–69.

	3. Growth through circularity and decoupling, 4. A solution for the European renewal.	
7.	Circular economy has "the desire to substitute the prevailing traditional linear economic model with a circular one, whose principal aim was to keep the value of products, materials and resources in the economy for as long as possible. This model minimizes waste and the consumption of resources and foresees that goods generate value through their use at the end of their useful life (…). It is based on four principles, the so-called 3Rs—reduce, reuse and recycle—and a fourth principle, sustainable design strategies to achieve greater durability in the designed products (…)"	(Ferreira Gregorio, Pié Dols, Terceño, 2018)[63]
8.	Circular economy "is an economic model wherein planning, resourcing, procurement, production and reprocessing are designed and managed, as both process and output, to maximise ecosystem functioning and human well-being"	(Murray, Skene, Haynes, 2017)[64]
9.	"A circular economy is an industrial system that is restorative or regenerative by intention and design (…). It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models"	(Ellen MacArthur Foundation, 2013)[65]
10.	"A Circular Economy aims at transforming waste into resources and at bridging production and consumption activities"	(Witjes, Lozano, 2016)[66]

Source: own work based on the literature review.

Despite diverse priorities and strategies[67], all circular economy approaches have the same focus because of the addressed sustainability challenges[68] i.e. the

[63] V. Ferreira Gregorio, L. Pié Dols, A. Terceño, *A Systematic Literature Review of Bio, Green and Circular Economy Trends in Publications in the Field of Economics and Business Management...*, op. cit.

[64] A. Murray, K. Skene, K. Haynes, *The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context*, "Journal of Business Ethics" 2017, Vol.140, No 3, pp. 369–380.

[65] Ellen MacArthur Foundation, *Towards the circular economy— economic and business rationale for an accelerated transition*, Ellen MacArthur Foundation 2013, https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf.

[66] S. Witjes, R. Lozano, *Towards a more Circular Economy: Proposing a framework linking sustainable public procurement and sustainable business models*, "Resources, Conservation and Recycling" 2016, Vol.112, pp. 37–44.

[67] Among the strategies increasing circularity (circular economy strategies) there are e.g.: "refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, and recover" (J. Potting, M. Hekkert, E. Worrell, A. Hanemaaijer, *Circular Economy: Measuring Innovation in the Product Chain – Policy Report*, PBL Netherlands Environ. Assess. Agency, Hague 2017).

[68] J. Markard, R. Raven, B. Truffer, *Sustainability transitions: An emerging field of research and its prospects*, "Research Policy" 2012, Vol.41, No 6, Special Section on Sustainability Transitions, pp. 955–967; M.E.B. Seiffert, C. Loch, *Systemic thinking in environmental*

problems in the environmental, social, and economic domain. The mentioned rationale caused the circular economy to be agreed globally as a pathway for sustainable development versus the linear economy model[69], however, sustainability is not considered as equal to the circular economy.

Sustainability, often referred to as sustainable development, "seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future"[70]. Sustainability integrates economic, social, and environmental activities to maintain some kind of a balance between them[71].

The literature review on the international understanding of sustainability and circular economy identified similarities, differences, and eight relationships between them. The similarities between sustainability and circular economy are as follows[72]:

1. Intragenerational and intergenerational commitments driven by environmental hazards,
2. More activity and public deliberation on the multiple and coexisting pathways of socio-economic development,
3. Global models orientation in emphasizing civilizational problems,
4. Integrating non-economic aspects into socio-economic development,
5. System design, system change, and innovation at the core as main drivers for reaching objectives,
6. Multidisciplinary and interdisciplinary research field to better integrate non-economic aspects,
7. Description of potential costs, risks, and importance of diversification to benefit from distinct opportunities in value co-creation,
8. Cooperation of different stakeholders as a necessary condition to accomplish mutual objectives,
9. Design of regulation and incentives as the main implementation tools (guiding stakeholder behaviors),
10. Central role of private business, due to its resources and capabilities advantages over other stakeholders,
11. Business model innovation as the key pathway to industry transformation as the results of unsatisfied expectations after sustainable

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management: support for sustainable development, "Journal of Cleaner Production" 2005, Vol.13, No 12, pp. 1197–1202.

69 L. Marrucci, T. Daddi, F. Iraldo, *The integration of Circular Economy with Sustainable Consumption and Production tools: systematic review and future research agenda*, "Journal of Cleaner Production" 2019, Vol. 240, pp. 1–12.

70 United Nations General Assembly, *Report of the World Commission on Environment and Development. Annex: Our Common Future, Forty-second session. Item 83 (e) of the provisional agenda, A/42/427, Development and international economic co-operation: environment*, 04.08.1987.

71 M. Geissdoerfer, P. Savaget, N.M.P. Bocken, E.J. Hultink, *The Circular Economy – A new sustainability paradigm?...*, op. cit.

72 Ib.

implementation of solutions (constrained by technological capabilities, material, and production technology),

12. Technological solutions are important but often pose implementation problems.

In the group of differences between sustainability and circular economy concepts, there are: origins, goals, motivations, system prioritizations, institutionalizations, beneficiaries, timeframes, and perceptions of responsibilities[73].

According to experts' prognosis, the concept of the circular economy will revolutionize the socio-economic relations in the coming decades. The international policy on sustainability ought to generate deep transformations of the industry processes and public policies of many countries. The spectrum of changes can be expected in many areas, for example, the necessity to introduce new circular economy indicators[74] or to develop a new language (e.g. circular construction, circular fashion, circular transport, circular energy, and circular innovation).

Notwithstanding, the prerequisite of the circular transformation is the proliferation of systems thinking, propagating through national and international policies the function and system innovations based on sustainable innovations.

1.2. Closed loop life cycle assessment in the circular economy

The progress towards the circular economy can be measured using also indicators which take into account the life cycle thinking or not[75]. Life cycle thinking is a general denominator for various socio-economic tools as e.g. life cycle assessment, life cycle design, life cycle management, life cycle policy and life cycle strategy.

The idea of the circular economy builds on the life cycle thinking which is inscribed in the Circular Economy Action Plan of the EU[76]. It is viewed as the state-of-the-art in the impact analysis of products or services[77] and urged by experts to be used for a systemic view of the life cycles[78]. In fact, when

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73 Ib.

74 G. Moraga, S. Huysveld, F. Mathieux, G. Blengini, L. Alaerts, K. Van Acker, S. De Meester, J. Dewulf, *Circular economy indicators*..., op. cit.

75 Ib.

76 Ib.

77 European Commission, *Integrated product policy: building on Environmental Life-cycle Thinking -COM(2003) 302 Final.*, 2003, https://scholar.google.com/scholar_lookup?title=Integrated%20Product%20Policy%3A%20Building%20on%20Environmental%20Life-cycle%20Thinking%20-%20COM(2003)%20302%20Final&author=EC&publication_year=2003.

78 E. Iacovidou, C.A. Velis, P. Purnell, O. Zwirner, A. Brown, J. Hahladakis, J. Millward-Hopkins, P.T. Williams, *Metrics for optimising the multi-dimensional value of resources recovered from waste in a circular economy: A critical review*, "Journal of Cleaner Production" 2017, Vol. 166, pp. 910–938; G. Moraga, S. Huysveld, F. Mathieux, G. Blengini, L. Alaerts, K. Van Acker, S. De Meester, J. Dewulf, *Circular economy indicators*..., op. cit.

analyzing the strategies of recycling and reuse of resources instead of landfill disposal and incineration of materials (which is a traditional strategy in the open loop economy) the life cycle thinking becomes the closed loop life cycle thinking.

The circular economy development is calculated by measuring the environmental impact exerted by materials or whole products and/or services[79] (e.g. construction parts, food products, fuels, packages, appliances, cars, buildings). This process is realised by various methodologies of life cycle assessment (LCA) which since their introduction in the year 1969 aim at measuring and quantifying the total product impact. The overall product impact is made up of its impact in single categories (impact categories) defined as environmental problems[80]. The impact is assessed in terms of the amount of resources consumed and the scale of pollution generated[81] when analyzing certain categories, e.g.: "climate change; acidification; eutrophication, terrestrial; eutrophication, marine; eutrophication, freshwater; particulate matter; photochemical ozone formation; human toxicity, cancer; human toxicity, non-cancer; eco-toxicity, freshwater; land use; water use; resource use, minerals and metals; and resource use, fossils, ionizing radiation, ozone depletion"[82]. The results of the LCA are used to compare the impact of different products according to a single index (total product impact) but also upon the basis of detailed indices, as e.g. human health, ecosystem and resources[83]. Consequently, the LCA provides management with information necessary to take better decisions on the ecological design of material composition.

The life cycle of the product system is its overall time of life which comprises certain stages. The stages of the product life cycle are e.g.[84]: material extraction (raw materials and energy for production), design and manufacturing of the product, packaging, and transportation of the product (distribution to the customer), storage of the product, use and maintenance of the product, disposal (incineration or landfilling) or recovery (recycling, reuse) of the product.

The LCA can be performed in different scopes defined as system boundaries or product systems. Some common scopes for "calculating and

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79 C. Kayo, S. Tojo, M. Iwaoka, T. Matsumoto, *Evaluation of Biomass Production and Utilization Systems*, [in] *Research Approaches to Sustainable Biomass Systems*, Tojo S., Hirasawa T. (eds), Academic Press, Boston 2014, pp. 309–346.

80 Ib.

81 Ib.

82 S. Sala, *Triple bottom line, sustainability and sustainability assessment, an overview*, [in] *Biofuels for a More Sustainable Future*, J. Ren, A. Scipioni, A. Manzardo, H. Liang (eds), Elsevier 2020, pp. 47–72, http://www.sciencedirect.com/science/article/pii/B9780128155813000038.

83 C. Kayo, S. Tojo, M. Iwaoka, T. Matsumoto, *Evaluation of Biomass Production and Utilization Systems*, op. cit.

84 R. M. Feller, *Promoting Sustainable Design Through Life-Cycle Assessment Applications*, https://continuingeducation.bnpmedia.com/courses/tally/promoting-sustainable-design-through-life-cycle-assessment-applications/2/.

communicating the footprint of a product"[85] but also its handprint using the LCA are described as:

1. Cradle to gate – the assessment covers all life cycle stages required to manufacture the product[86], from the time of extraction of the material for production up to the factory gate before the distribution of the product to customers. It is commonly used for interim products among business-to-business (B2B) customers[87]. This scope of calculating the product impact concerns plants and industries from two sectors of economy i.e. primary and secondary sectors. The primary sector is engaged in the production of raw materials based on the extraction of natural resources (e.g. farming, forestry, oil and gas mining or coal and ore extraction industries). The secondary economic sector is concentrated on the production of finished goods i.e. the transformation of the retrieved raw materials into consumable items (e.g. a building, a car, craft, energy, food, textile industries),
2. Cradle to grave – the assessment covers all life cycle stages from the material extraction to the end-of-life of a product which is considered waste for disposal to landfill (symbol of a grave) or waste for recovery/recycling and reuse. This type of description is termed as the open loop assessment[88], applied mainly for products in business-to-consumer (B2C) conditions[89],
3. Cradle to cradle – the assessment covers all product life cycle stages with an exception of waste landfilling, but including recycling processes. The cradle to cradle life cycle assessment is termed also as the closed loop assessment[90] because the introduction of the recycling should eliminate waste streams according to the formula that the whole product is always an indispensable resource for the new production cycle,
4. Gate to gate – this is an approach to the product life cycle assessment including one process in a production site/factory, e.g. the production of each chemical is divided into processes composed of a small number of chemical reactions[91],

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85 Carbon Trust, *Product carbon footprint certification and labelling*, Carbon Trust, https://www.carbontrust.com/what-we-do/assurance-and-certification/product-carbon-footprint-certification-and-labelling, 03.09.2020.

86 A. Sandak, J. Sandak, M. Brzezicki, A. Kutnar, *Biomaterials for Building Skins*, [in] *Bio-based Building Skin*, A. Sandak, J. Sandak, M. Brzezicki, A. Kutnar (eds), Springer, Singapore 2019, Environmental Footprints and Eco-design of Products and Processes, pp. 27–64, http://link.springer.com/10.1007/978-981-13-3747-5_2.

87 Carbon Trust, *Product carbon footprint certification and labelling*, op. cit.

88 Life-Cycle Assessment, 31.05.2017, http://www.archecology.com/2017/05/31/life-cycle-assessment, 02.09.2020.

89 Carbon Trust, *Product carbon footprint certification and labelling*, op. cit.

90 Life-Cycle Assessment, op. cit.

91 C. Jiménez-González, M. Overcash, *Energy sub-modules applied in life-cycle inventory of processes*, "Clean Products and Processes" 2000, Vol. 2, No 1, pp. 0057–0066.

5. Cradle to market[92] (also called cradle to site[93]) – this type of a life cycle assessment goes one step further than the cradle to gate description including the transportation to the market and sales (bonded with the transit to the site of use),
6. Cradle to use – the description evolved from the cradle to market life cycle assessment but covered additionally the consumption stage,
7. Gate to grave – this is the type of an assessment which embraces the "distribution, storage, use, and disposal or recycling stages"[94].

The presented types of assessment are more or less common but the process of setting the system boundaries in LCA is dynamic and depends on the necessity. Thus, the other possible approaches to the product life cycle assessment could be based on any new combination of stages, as e.g.: gate to use, use to use, market to use, use to grave, etc.

LCA solves the problem of costs externalization by allowing the identification of possible impact areas, measuring them, and finally pinpointing the best available solutions, both according to the handprint and footprint of the analysed product. The most comprehensive type of the LCA is the cradle to cradle life cycle assessment. This type of methodology introduces the closed loop thinking, one of the basic priorities in the circular economy.

The mentioned before philosophy of the closed loop economy (also called the "take-make-recycle" model) is against the traditional linear production and consumption model (also termed as: the "take-make-dispose" system or "take-make-waste" pattern or "take–make–use–lose" system).

The closed loop thinking, depicted under the name cradle to cradle by W. McDonough and M. Braungart, assumes the circulation of resources within a closed system and the possibility of complete recycling of all wastes within two closed economy cycles, i.e. the biological (biosphere) and technical (technosphere) ones. The biological cycle is responsible for the recycling of consumption products called biological nutrients or biological materials. The technical cycle is appropriate for service products called technical nutrients or technical materials.

The example of the holistic management of resources is the Swedish waste management system. In Sweden, the process of using municipal waste begins with segregation in the household, i.e. at the consumption stage of the product life cycle, as presented in figure 1. Most products are recycled and those that are

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92 V. Sanderson, N. Bamber, D.N. Pelletier, *Cradle-to-market life cycle assessment of Okanagan (Canada) cherries: Helicopters, seasonal migrant labour and flying fruit*, "Journal of Cleaner Production" 2019, Vol. 229, pp. 1283–1293.

93 Cradle to site, Environmental Glossary of Terms and Definitions, https://circularecology.com/glossary-of-terms-and-definitions.html, 04.09.2020.

94 EC, Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations. OJ L124, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX%3A32013H0179&from=EN, 04.05.2013.

not suitable for this end up in incineration plants (where they are converted into electricity and heat), in a landfill (where biogas can be recovered), or in a biogas plant (where waste is turned into biogas and natural fertilizers, which are sent to farms after liming).

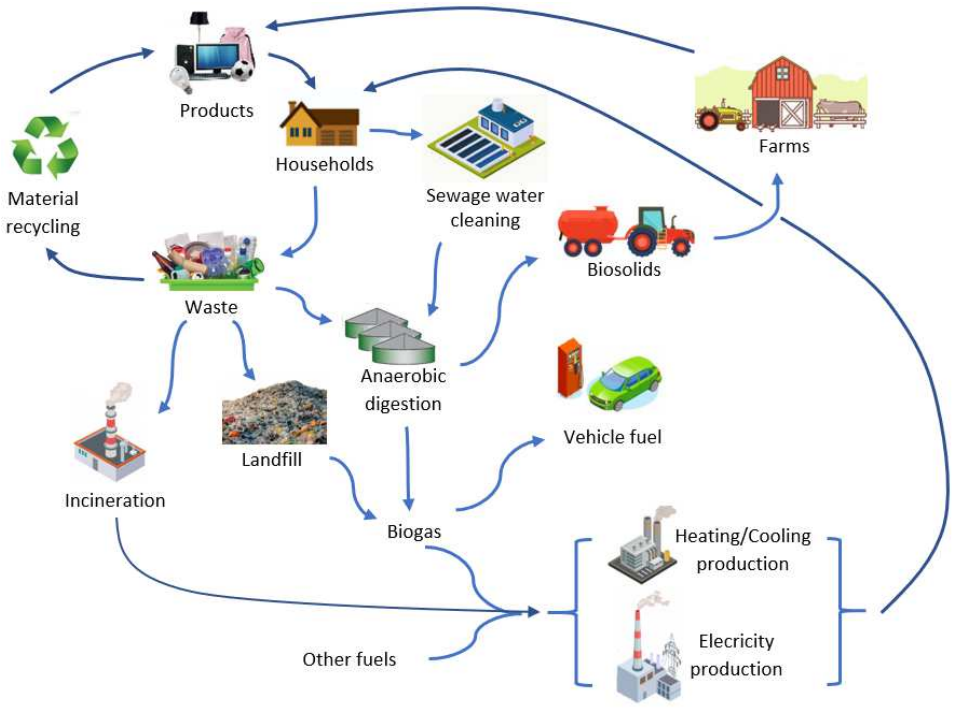

Figure 1. Integrated part of the holistic waste management system

Source: own work based on: J. Aström, *The Swedish Waste Management System*, https://player.slideplayer.com/13/3810889/#, 15.07.2020.

The complementary approach to the closed loop resource management is the concept of zero waste. There are many definitions of this idea, however, the priority of zero waste thinking is the reuse of resources. This eliminates the problem of waste production but requires products and processes to be designed or redesigned of in accordance with all stages of the life cycle, similarly to the closed loop recycling. The initial design of the product system determines the possibility of reusing (repairing, re-manufacturing) or recycling materials[95].

[95] European Commission, *COM(2016) 773 final. Ecodesign Working Plan 2016 to 2019*, Brussels 30.11.2016.

1.3. Circular strategies

Building blocks[96] of the circular economy are circular strategies[97]. The increasing risk of higher resource prices[98] in the linear economy has led the business sector to develop circular economy strategies, business models and then to promote the circularity transition among policy-makers (as e.g. the CE8, the coalition of multinationals: "DSM, IKEA Group, Michelin, Philips Lighting, SUEZ, Tetra Pak, Umicore, and Unilever"[99]).

The spectrum of circular strategies is broad. In a nutshell, the development of the circular economy is based on four strategies, i.e.[100]:

1. Circular Design,
2. New Business Models,
3. Reverse Cycle,
4. Enablers and Favorable System Conditions.

The R-list concept enumerates 10 circularity strategies in a hierarchical ladder i.e.: "refuse, rethink, reduce, reuse, repair, refurbish, re-manufacture, repurpose, recycle, and recover"[101].

According to another taxonomy, six groups of the circular economy strategies should be named:

1. "Preserve the function of products or services provided by circular business models such as sharing platforms, PPS (use- and result-oriented), and schemes promoting product redundancy and multi-functionality,
2. Preserve the product itself by increasing its lifetime with strategies such as durability, reuse, restore, refurbish, and remanufacture,
3. Preserve the product's components through the reuse, recovery, and repurposing of parts,
4. Preserve the materials through recycling and downcycling,
5. Preserve the embodied energy through energy recovery at incineration facilities and landfills,

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96 Circular Economy Business Case Studies - Building blocks, https://www.ellenmacarthurfoundation.org/case-studies/business/building-blocks, 26.05.2020.

97 Circular Economy Accelerator – Zero Waste Scotland, https://ceaccelerator.zerowastescotland.org.uk/, 26.05.2020.

98 Ellen MacArthur Foundation, *Towards the circular economy— economic and business rationale for an accelerated transition...*, op. cit.

99 Umicore, *Umicore calls upon the EU to seize the circular economy momentum*, 02.06.2016, https://www.umicore.com/en/media/press/umicore-calls-upon-the-eu-to-seize-the-circular-economy-momentum, 10.06.2020.

100 Circular Economy Business Case Studies - Building blocks, https://www.ellenmacarthurfoundation.org/case-studies/business/building-blocks, 26.05.2020.

101 J. Potting, M. Hekkert, E. Worrell, A. Hanemaaijer, *Circular Economy: Measuring Innovation in the Product Chain - Policy Report*, PBL Netherlands Environ. Assess. Agency, Hague 2017.

6. Measure the linear economy as the reference scenario or the absence of a preservation strategy to show the status, progress, or regress towards CE. For example, the indicator for waste generation per person during a year (EC, 2018a) might show whether the promotion of CE generates less waste"[102].

There are many typologies of circular economy strategies. One of them includes the following seven circular strategies[103]:

1. Collaborate to create a joint value,
2. Design for the future,
3. Incorporate digital technology,
4. Preserve and extend what's already made,
5. Prioritize regenerative resources,
6. Rethink the business model,
7. Use waste as a resource.

The presented strategies are divided into subcategories (the 2nd level) or even the categories of the 3rd level which additionally can be measured with specific, detailed indicators, for example: when designing for bio-degradability, the indices used can be: the phasing-out of toxics or the application of highly biodegradable materials, etc. Table 2, presents the structure of circular economy strategies created within the framework of the CIRCLELAB initiative.

Table 2. Strategies of circular economy

No	Levels and types of circular strategies		
	I	II	III
1.	Collaborate to create a joint value	Community collaboration	1. Give-back programmes, 2. Joint product development.
		Customer/consumer collaboration	1. Co-creation, 2. Customer dialogue, marketing, 3. Customer programmes, 4. Customization, 5. Take-back programmes.
		Government collaboration	1. Advocacy for circular economy policy, 2. Government programmes.
		Industry collaboration	1. Circular procurement, 2. Cross-industry projects, pilots, 3. Guidance, dialogue with industry stakeholders, 4. Joint industry ventures, projects, pilots.
		Internal collaboration	1. Dialogue with internal stakeholders, 2. Financial incentives tied to circular economy, 3. Training on the circular economy.

[102] G. Moraga, S. Huysveld, F. Mathieux, G. Blengini, L. Alaerts, K. Van Acker, S. De Meester, J. Dewulf, *Circular economy indicators*..., op. cit.

[103] Circle Lab, https://circle-lab.com/knowledge-hub, 26.05.2020.

2.	Design for the future	Design for cyclability	1. Design for bio-degradability, 2. Design for disassembly, 3. Design for modularity, 4. Design for recycling, 5. Design for recycling – mono-materials, 6. Design for recycling – product trimmings and construction (Textile-specific), 7. Design for repair, 8. Design for reuse.
		Design for durability	1. Design for physical durability, 2. Design for product attachment, emotional durability.
		Design out waste	1. Design for minimal waste, 2. Design for resource efficiency.
3.	Incorporate digital technology	Data and insights	1. Advanced robotics, artificial intelligence, 2. Data analytics, modeling, 3. Internet enabled, connected operations, 4. Sensors, monitoring systems.
		Digital platforms	1. Online platforms, 2. Peer-to-peer online marketplaces.
4.	Preserve and extend what's already made	Maximise lifetime of biological products	1. Management, enrichment, 2. Preservation, conservation.
		Maximise lifetime of products after use	1. Own brand second-hand sale, 2. Part recovery, 3. Refurbishment, remanufacturing, renovation, 4. Refurbishment, repair (Textile-specific), 5. Second-hand sale, distribution.
		Maximise lifetime of products in-use	1. Product maintenance, repair, 2. Product upgrade, 3. Self-repair, spare part service.
5.	Prioritise regenerative resources	Regenerative energy	1. Electrification, 2. Energy efficiency, 3. Renewable energy, fuels.
		Regenerative materials	1. Alternative bio-based materials and inputs, 2. Material efficiency, 3. Non-critical materials and inputs, 4. Non-toxic materials and inputs, 5. Reusable, recyclable materials and inputs.
		Regenerative water	1. Alternative water use, 2. Water efficiency.
6.	Rethink the business model	Product business models	1. Leasing, rental, pay per use, 2. Peer to peer sharing, 3. Sale of durable, long-lasting goods, 4. Sale of exchangeable parts, 5. Sale of refillable parts, 6. Subscription-based products.
		Service business models	1. Crowd-based services, 2. Payment per use, 3. Subscription-based services.

7.	Use waste as a resource	Energy recovery from waste	1. Generating energy from waste, 2. Processing waste into fuel, 3. Recovery and reuse of waste energy.
		Valorize waste streams – closed loop	1. Closed loop collection, 2. Closed loop downcycling, 3. Closed loop high value chemical recycling (Textile-specific), 4. Closed loop high value mechanical recycling (Textile- specific), 5. Closed loop upcycling, 6. Using closed loop recycled materials.
		Valorize waste streams – open loop	1. Open loop collection, 2. Open loop downcycling, 3. Open loop high value chemical recycling (Textile-specific), 4. Open loop high value mechanical recycling (Textile-specific), 5. Open loop upcycling, 6. Using open loop recycled materials.

Source: own work based on: Circle Lab, https://circle-lab.com/knowledge-hub, 26.05.2020.

The successful implementation of circular economy strategies results in diverse benefits which are goals of economic transformation. Table 3 presents the group of effects of increased circularity in companies across the world.

Table 3. Benefits of circular strategies

No	Names of circular strategies	Benefits of circular strategies	Types of circular strategies (at level III)
1.	Creating a global circular network of textiles by making the essentials circular (easy essentials) Recycling textile waste into yarn. Recycling cotton waste into fibers Open source co-creation online	Textile waste reduction	1. Use of closed loop recycled materials, 2. Design for recycling – mono-materials, 3. Closed loop high value mechanical recycling (Textile-specific), 4. Closed loop upcycling 5. Customization, 6. Co-creation, 7. Design for product attachment, emotional durability, 8. Online platforms.
2.	Eco-Scraps Transforming surplus food into restaurant dishes Misadventure Vodka – vodka made from unsold baked goods Reusing waste bread to make new bread	Food waste recycling	1. Closed loop downcycling, 2. Closed loop collection, 3. Closed loop upcycling, 4. Preservation, conservation, 5. Open loop upcycling, 6. Closed loop upcycling.

3	Veolia Circular Economy Partnership for E-Waste Recycling	Waste electrical and electronic equipment recycling	1. Open loop collection, 2. Open loop downcycling.
4.	Resource efficient paper production	Solid waste and water recycling	1. Closed loop downcycling, 2. Design for minimal waste, 3. Recovery and reuse of waste energy, 4. Water efficiency, 5. Renewable energy, fuels, 6. Using closed loop recycled materials.
5.	Digital marketplace for waste materials	Ecological footprint reduction	1. Open loop collection, 2. Peer-to-peer online marketplaces.
6.	Recycling metals from waste ash	Non-ferrous products recovery	Open loop upcycling
7.	Digital marketplace for parking space	Parking space optimization	1. Peer to peer sharing, 2. Peer-to-peer online marketplaces.
8.	Repurposing waste plastics into tiles Recycling waste plastic into filament (Yanko Design) Recycling non-recyclable plastics Recycling plastic into diesel	Plastic solid waste recycling	1. Open loop upcycling, 2. Closed loop upcycling, 3. Closed loop downcycling, 4. Processing waste into fuel.
9.	Repurposing coffee grounds for road construction	Coffee grounds use	Open loop downcycling
10.	Earthquake Debris Management in Haiti: Data-driven Decision-Support	Debris removal	1. Open loop collection, 2. Closed loop collection, 3. Open loop upcycling, 4. Closed loop upcycling, 5. Data analytics, modeling.
11.	Collection and recycling of mobile phones	Waste electrical and electronic equipment recycling, additional income for residents	1. Closed loop collection, 2. Closed loop downcycling.
12.	Repurposing waste flower petals into pigment	Tulip petals use	Open loop upcycling
13.	Generating electricity and heat from cattle waste	Generating energy from waste	Generating energy from waste
14.	Recycling of wastewater Recycling of greywater	Saving water consumption	Closed loop downcycling
15.	ZigZag: Redistributing Returns Optimally	Reduction in the wastage, carbon footprint, cost and transit time of retail returns	1. Rethink the business model, 2. Incorporate digital technology.
16.	Payment per use using the blockchain technology (RWE and Slock.it – Electric cars using Ethereum wallets can	Easier payments for charging cars at traffic lights	Payment per use

	be recharged by induction at traffic lights)		
17.	Subscription-based razor blades	Easier access to care products, saving time	Subscription-based products
18.	Recycled mono-materials	75% less water, 67% less chemicals, 39% less energy, 20% lower carbon footprint	1. Design for recycling – mono-materials, 2. Using open loop recycled materials.
19.	Digital marketplace to utilize wasted space as storage	Optimization of real estate use	1. Closed loop downcycling, 2. Peer-to-peer online marketplaces.
20.	Materials Marketplace	Cost savings, energy savings, new jobs creating	1. Open loop collection, 2. Peer-to-peer online marketplaces.

Source: own work based on: Circle Lab, https://circle-lab.com/knowledge-hub, 26.05.2020.

The economic and environmental benefits are the chief facilitators of the circular economy adoption which are officially promoted in the European Union[104]. Numerous scales and types of benefits generated by circular strategies depend on many macro- and microeconomic factors across market sectors. The decisive determinant, however, in the circularity transition is the awareness of enterprises of the methods of designing the business circular strategies.

[104] D.M. Yazan, D. Cafagna, L. Fraccascia, M. Mes, P. Pontrandolfo, H. Zijm, *Economic sustainability of biogas production from animal manure: a regional circular economy model*, "Management Research Review", 2018, Vol. 41, No 5, pp. 605–624.

2. The idea of environmental declarations and labels

2.1. ISO type I environmental labelling

(Bożydar Ziółkowski, Janusz Strojny)

Ecolabelling[105] is a communication tool that conveys environmental information about products. Symbols, called ecolabels, show that a product (goods or services[106]) meets established standards[107] regarding environmental impacts[108].

In market practice, the term "ecolabel" is also used to describe products with other advantages than the environmental ones. The additional attributes of ecolabels – defined in a broader, more sustainable sense (typical for CSR labelling[109]) – include.:

1. The geographical origin of products or resources[110],
2. The spatial location of production (local manufacturing), e.g. "regional environmental labelling for Gemer-Malohont in Slovakia"[111],
3. The production system, e.g. "family farmed" in the USA[112],
4. Stability of economic value (LEED, BREEM)[113],
5. Social responsibility[114].

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[105] Popular also under the names: environmental labelling, environmental labelling and information schemes, environmental labelling scheme, ecolabelling program, green labelling, environmental certification.

[106] ISO 14020:2000, Environmental labels and declarations – General principles.

[107] L. Witek, *Sustainable consumption: Eco-labelling and its impact on consumer behavior - evidence from a study on Polish consumer*, "Institute of Economic Research Working Papers" 2017, No. 142, pp. 1–10.

[108] S. Baumeister, T. Onkila, *An eco-label for the airline industry?*, "Journal of Cleaner Production" 2017, Vol. 142, No 4, pp. 1368–1376.

[109] M. Koszewska, *Social and eco-labelling of textile and clothing goods as means of communication and product differentiation*, "Fibres & Textiles in Eastern Europe" 2011, Vol. 19, No 4, pp. 20–26.

[110] U. Gołaszewska-Kaczan, M. Kruk, A. Śleszyńska-Świderska, *Challenges for ecolabeling grow*, „Optimum. Studia Ekonomiczne" 2015, No 5(77), pp. 179–192.

[111] A.J. Duff, P.H. Zedler, J.A. Barzen, D.L. Knuteson, *The Capacity-Building Stewardship Model: assessment of an agricultural network as a mechanism for improving regional agroecosystem sustainability*, "Ecology and Society" 2017, Vol. 22, No 1, pp. 1–10.

[112] P.H. Howard, P. Allen, *Beyond organic and fair trade? an analysis of ecolabel preferences in the United States*, "Rural Sociology" 2010, Vol. 75, No 2, pp. 244–269.

[113] R.K. Zimmermann, O. Skjelmose, K.G. Jensen, K.K. Jensen, H. Birgisdottir, *Categorizing building certification systems according to the definition of sustainable building*, [in] *3RD World Multidisciplinary Civil Engineering, Architecture, Urban Planning Symposium (WMCAUS 2018)*, Vol. 471, 2019, pp. 1–8.

[114] Ib.

In an effective environmental regulatory system, ecolabelling can induce advantages "in all three dimensions of sustainability"[115]:

1. Social – the advantage to the consumers is "environmental information about the product" and the chance to "vote with their wallets"[116],
2. Economic – the advantage to the economy is the achievement of "more sustainable track"[117] and to the producer: better image, competitive edge, increased profit, more products sold etc.
3. Environmental – the advantage is the a decrease in the harmful impact.

In the environmental labelling programs the scale of assessment determines the form of the ecolabel, i.e.[118]:

1. Single-tier ecolabel (binary ecolabel) – when the result of the product assessment is in conformance or non-conformance with the program standards (e.g. EU Ecolabel, MSC),
2. Multi-tier ecolabel (or graded ecolabel) – when the result of the product assessment is the level of achievement (e.g. Silver, Gold, and Platinum level in LEED).

The distinction between definitions of ecolabelling is determined by numerous meanings and definitions of the word "sustainability"[119]. This has caused some confusion, as e.g. in the case of MSC and the 20 year-long "controversy about the definition of sustainable fishing"[120].

The general overview of existing definitions on ecolabels and ecolabelling programs is presented in table 4.

Table 4. Definitions of ecolabels

No	Definitions	Bibliography
1.	"Environmental label environmental declaration claim which indicates the environmental aspects of a product or service"	(ISO 14020:2000)[121]
2.	"Eco-label comes from the word eco which means the environment and the label which means a mark on the	(Purwaningsih, Susanty, Wafa, Arvianto, Ariany, 2018)[122]

[115] R. Baranyi, *Criteria groups in the eco-labelling process system – comparative analysis focused on the Hungarian system*, "Periodica Polytechnica Social and Management Sciences" 2008, Vol. 16, No 1, p. 45.

[116] D.E. Adelman, G.W. Austin, *Trademarks and private environmental governance*..., op. cit.

[117] N. Csigéné Nagypál, G. Görög, P. Harazin, R. Péterné Baranyi, "*Future generations" and sustainable consumption*, "Economics & Sociology" 2015, Vol. 8, No 4, pp. 207–224.

[118] V. Prieto-Sandoval, A. Mejia-Villa, M. Ormazabal, C. Jaca, *Challenges for ecolabeling growth: Lessons from the EU ecolabel in Spain*, "The International Journal of Life Cycle Assessment" 2020, Vol. 25, No 12, pp. 856–867.

[119] Ib.

[120] M.A. Delmas, T.P. Lyon, J.W. Maxwell, *Understanding the role of the corporation in sustainability transitions. Introduction to the Special Issue*..., op. cit.

[121] ISO 14020:2000, Environmental labels and declarations – General principles.

	product that differentiates it from other products. Eco-labels help consumers to choose environmentally friendly products as well as serve as a tool for manufacturers to inform consumers that the products they produce are environmentally friendly".	
3.	"Eco-labelling informs consumers of specific characteristics of products and has been used to market greener products."	(Miranda-Ackerman, Azzaro-Pantel, 2017)[123]
4.	"Business stewardship by means of eco-labeling/indices convey the specific information regarding the environmental impacts of a product".	(Lee, Kim, Yang, 2015)[124] (Bruce, Laroiya, 2006)[125]
5.	"Eco-labels for white goods, energy provision, food, etc." are "a signaling method to encourage consumers toward sustainable consumption".	(Codagnone, Veltri, Bogliacino, Lupianez-Villanueva, Gaskell, Ivchenko, Ortoleva, Mureddu, 2016)[126]
6.	"Primarily ecolabels provide consumers with product specific environmental information at the point of purchase to assist consumers in making environmentally informed purchase decision. Moreover eco-labels reduce consumers' information search costs and effort as well as promote recycling behavior".	(Taufique, Siwar, Chamhuri, Sarah, 2015)[127] (Thøgersen, Haugaard, Olesen, 2010)[128]
7.	"Eco-labels provide information about the environmental characteristics of a product".	(Delmas, Grant, 2014)[129]
8.	"Environmental sustainability labels, or eco-labels, are one tool that commercial fishers employ to increase economic viability through product differentiation in terms of sustainability".	(Hilger, Hallstein, Stevens, Villas-Boas, 2019)[130]
9.	"Enterprises can use eco-labels as a means of	(Baranyi, 2008)[131]

[122] R. Purwaningsih, A. Susanty, A.K. Wafa, A. Arvianto, Z. Ariany, *Identification of factors influence to completion of adoption proces of ecolabel in fisheries product*, [in] 5th International Seminar on Ocean and Coastal Engineering, Environmental and Natural Disaster Management (ISOCEEN 2017) 2018, Vol. 177, pp. 1–7.

[123] M.A. Miranda-Ackerman, C. Azzaro-Pantel, *Extending the scope of eco-labelling in the food industry to drive change beyond sustainable agriculture practices*, "Journal of Environmental Management" 2017, Vol. 204, No 3, SI, pp. 814–824.

[124] S.H.-N. Lee, H. Kim, K. Yang, *Impacts of sustainable value and business stewardship on lifestyle practices in clothing consumption...*, op. cit.

[125] C. Bruce, A. Laroiya, *The production of eco-labels*, "Environmental & Resource Economics" 2006, Vol. 36, pp. 275–293.

[126] C. Codagnone, G.A. Veltri, F. Bogliacino, F. Lupianez-Villanueva, G. Gaskell, A. Ivchenko, P. Ortoleva, F. Mureddu, *Labels as nudges? An experimental study of car eco-labels...*, op. cit.

[127] K.M.R. Taufique, C. Siwar, N. Chamhuri, F.H. Sarah, *Integrating general environmental knowledge and eco-label knowledge in understanding ecologically conscious consumer behavior...*, op. cit.

[128] J. Thøgersen, P. Haugaard, A. Olesen, *Consumer Responses to Ecolabels*, "European Journal of Marketing" 2010, Vol. 44, pp. 1787–1810.

[129] M.A. Delmas, L.E. Grant, *Eco-labeling strategies and price-premium: The wine industry puzzle*, "Business & Society" 2014, Vol. 53, No 1, pp. 6–44.

[130] J. Hilger, E. Hallstein, A.W. Stevens, S.B. Villas-Boas, *Measuring willingness to pay for environmental attributes in seafood*, "Environmental & Resource Economics" 2019, Vol. 73, No 1, pp. 307–332.

	communication which shows that the product bearing the eco-label has less impact on the environment during their whole life cycle, 'from cradle to cradle', in comparison with other similar products or services".	
10.	"The goal of eco-labels is to reduce information asymmetry between producers and consumers over the environmental attributes of a product or service".	(Delmas, Lessem, 2017)[132]

Source: own work based on the literature review.

There are different classifications regarding the types of ecolabels available on the market. The most prevailing typology has been developed by the International Organization for Standardization which historically has established standards for three types of voluntary environmental labelling, i.e.:

1. ISO 14024:1999, Environmental labels and declarations – Type I environmental labelling – Principles and procedures,
2. ISO 14021:1999, Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling),
3. ISO/TR 14025:2000, Environmental labels and declarations – Type III environmental declarations.

According to some authors[133], the meaning of environmental labels (ecolabels) and environmental declarations can be unified. There is a salient difference, however, between these expressions, because:

1. ISO type I environmental labelling – satisfies standards "based on an assessment of a product's environmental impacts"[134] including life cycle considerations but does not require the LCA. This type of an ecolabelling program is certified by an independent body that grants a license and usually a logo e.g. Blue Angel, EU Ecolabel, Nordic Swan, Green Seal.
2. ISO type II environmental labelling – is a self-declared environmental claim made by business managers, which has not been certified by an independent third-party. It can be multi-content declaration but usually it takes the form of short advertising as e.g. environmentally safe, pure, organic, biodegradable.
3. ISO type III environmental declarations – provide life cycle assessment data for a product, in the form of e.g. EcoLeaf, Environmental Product Declaration.

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131 R. Baranyi, *Criteria groups in the eco-labelling process system – comparative analysis focused on the Hungarian system*, op. cit.

132 M.A. Delmas, N. Lessem, *Eco-premium or eco-penalty? Eco-labels and quality in the organic wine market*, "Business & Society" 2017, Vol. 56, No 2, pp. 318–356.

133 M.T. Niles, M. Lubell, *Integrative frontiers in environmental policy theory and research*, "Policy Studies Journal" 2012, Vol. 40, No 1, SI, pp. 41–64.

134 EPA, *Evaluation of Environmental Marketing Terms in the United States*, Washington, D.C. 1993.

In this book, the environmental labels and environmental declarations are discussed as separate types.

The comparison of ISO-type environmental labelling is introduced in table 5.

Table 5. ISO-type environmental labelling

Criteria	Ecolabelling		
	Type I	Type II	Type III
Standard	ISO 14024	ISO 14021	ISO 14025
Current version	2018	2016	2006
Independent third-party certification	yes	no	yes
LCA	simplified	no	yes
Voluntary	yes	yes	yes
Verifiability	high	low	high
Efforts to receive	medium-high	low	high

Source: own work based on the modified: M. Koszewska, *Social and Eco-labelling of Textile and Clothing Goods as Means of Communication and Product Differentiation*, "Fibres & Textiles in Eastern Europe" 2011, Vol. 19, No 4 (87), pp. 20–26.

ISO type I schemes are developed by international organizations such as e.g. WTO, UNEP, ISO, and individual countries or regions. The first national ISO type I ecolabelling programs were introduced by: Germany (1978), Sweden (1980), Canada (1988), the Nordic Council States, Japan, USA, Australia, New Zeland (1989)[135]. At the European level, the first legal regulation on ISO type I ecolabelling was issued in the year 2000 and concerned the "Community eco-label award scheme"[136], called today as EU Label. The ISO type I environmental labelling is based on the third-party certification acknowledged as the "third wave in the green trademarks evolution" triggered by globalization and "barriers in national ecolabelling programs"[137]. The possible barriers identified for example for EU Label are as follows:

1. "Cost of the application,
2. Cost of the ecolabel licence,
3. Too much documentation,
4. Complexity of documentation,
5. Requirements are too stringent,

[135] B. Crnobrnja, I. Budak, M. Ilić, J. Hodolič, *Environmental labelling of products with type I labels*, "RMZ - Materials and Geoenvironment" 2009, Vol. 56, No 3, pp. 346–355; U. Gołaszewska-Kaczan, M. Kruk, A. Śleszyńska-Świderska, *Eco-labelling as a tool of CSR...*, op. cit.

[136] Regulation (EC) No 1980/2000 of the European Parliament and of the Council of 17 July 2000 on a revised Community eco-label award scheme.

[137] D.E. Adelman, G.W. Austin, *Trademarks and private environmental governance*, "Notre Dame Law Review" 2017, Vol. 93, No 2, pp. 709–756.

6. Lack of human resources and skills,
7. Lack of technical and information support,
8. Lack of external incentives,
9. Lack of competitive rewards,
10. Lack of stakeholders recognition,
11. Lack of public institutions recognition (green procurement),
12. Lack of international recognition,
13. Too difficult to communicate,
14. Too many individual criteria,
15. Criteria do not address relevant environmental impacts,
16. Lack of economic incentives (including funding),
17. Costs of demonstrating compliance with the criteria requirements,
18. Costs of implementation (including consultants),
19. Costs of testing results and verifications that are necessary to obtain the label,
20. Low understanding the ecolabelling criteria,
21. Slow application procedures,
22. Bureaucratic application procedures,
23. Lack of recognition and rewards by public institutions, customers, consumers, and retailers"[138].

According to the ISO type I environmental labelling, the conformance with the program requirements is a condition for certification by a third-party institution[139]. In this way, the ecolabelling program constitutes a "system for certifying legality and sustainability"[140]. The main purpose of ISO type I environmental labelling is to distinguish and promote products with lower environmental impact than other products in a given category. Such distinguished general properties improve the added value of the product[141] which can be identified as conformed to the strict environmental criteria[142].

There are three following stages in establishing ISO type I ecolabelling program[143]:

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138 F. Iraldo, M. Barberio, *Drivers, barriers and benefits of the EU ecolabel in European companies' perception*, "Sustainability" 2017, Vol. 9, No 5, pp. 1–15.

139 T. Fujiwara, S.A. Awang, W.T. Widayanti, R.M. Septiana, K. Hyakumura, N. Sato, *Effects of national community-based forest certification on forest management and timber marketing: a case study of Gunung Kidul, Yogyakarta, Indonesia*, "International Forestry Review" 2015, Vol. 17, No 4, pp. 448–460.

140 L. Giessen, S. Burns, M.A.K. Sahide, A. Wibowo, *From governance to government: The strengthened role of state bureaucracies in forest and agricultural certification*, "Policy and Society" 2016, Vol. 35, No 1, SI, pp. 71–89.

141 A. Gruszka, E. Niegowska, *Zarządzanie środowiskowe. Komentarz do norm serii ISO 14000*, PKN, Warszawa 2007, s. 54.

142 PN-EN ISO 14024:2002, Etykiety i deklaracje środowiskowe – Etykietowanie środowiskowe I typu – Zasady i procedury.

143 A. Gruszka, E. Niegowska, *Zarządzanie środowiskowe*…, op. cit.

1. Select the product category,
2. Define environmental criteria for the ecolabelled product,
3. Control and certify applicants, supervise the program implementation.

According to ISO 14024, ecolabelling program should be transparent at all stages of its establishing and maintaining. The transparency means that the following information should be available for all stakeholders:

1. "Selection of product categories,
2. Selection and development of product environmental criteria,
3. Product function characteristics,
4. Testing and verification methods,
5. Certification and award procedures,
6. Review period,
7. Period of validity,
8. Nonconfidential evidence on which the awarding of the label is based,
9. Funding sources for the programme development (e.g. fees, government financial support, etc.),
10. Compliance verification" [144].

The process of ISO type I environmental labelling encompasses the following iterative elements:

1. "Consultation with interested parties,
2. The selection of product categories,
3. Development, review and modification of product environmental criteria,
4. The identification of product function characteristics; and
5. The establishment of certification procedures and other administrative elements of the programme"[145].

Every type of ecolabelling program has its own strengths and weaknesses. The critical success factors of ISO type I ecolabelling programs are:

1. "Transparency,
2. Consumer awareness: adequate publicity to ensure recognition of the label and its credibility,
3. Endorsement by key stakeholders,
4. Ensuring stringent, significant and up-to-date criteria developed with stakeholder participation to maintain credibility,
5. Harmonisation of criteria between different type I schemes, to facilitate use by producers,
6. Robust data checks,
7. Visibility of logo on product,
8. Affordable application process,

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[144] ISO 14024:1999, Environmental labels and declarations – Type I environmental labelling – Principles and procedures, p. 4–5.

[145] Ib. p. 6.

9. Appropriate selection of products,
10. Market penetration"[146].

The presented determinants can be considered as best practices, or universal supportive actions which guarantee effectiveness of the majority ISO type I ecolabelling programs.

2.2. ISO type II environmental labelling. Self-declared environmental claims in the form of statements

(Igor Budak, Boris Agarski, Milana Ilić Mićunović)

Increasing environmental awareness among people has put producers in a position that they must offer products with higher environmental standards. Due to the growing interest among consumers, government and employers in the environmental impact of products, product-related issues are becoming an increasingly important part of purchasing decisions. Following these trends, a large number of manufacturers trying to show consumers that their product has certain advantageous features, in order to convince them that, their product is better than the products of the competition in this area of production[147]. For example, consumers may be interested in resources and the amount of energy consumed in the production of a particular product, as well as the form in which the product is designed, or its reusability, recycling or biodegradability, and whether recycled materials are used for its production, etc. This has led to a greater demand for environmental information about products, for consumers, government and industry. The information most frequently highlighted by manufacturers is their investment in reducing negative impacts, i.e. that the product itself has a better environmental impact[148].

The presence of products with environmental attributes has promoted "green" activities in markets all around the world and created the need for systemization and standardization of the use of the environmental claims and labels. A significant stage in the development of the ISO standard related to environmental claims is the development of ISO 14021, an international standard that defines the type II environmental labelling – self-declared environmental claims, from 1999. Following the first version of this standard, the ISO published an addition to the standard in form of an Amendment in 2011, and then a final new revised version ISO 14021: 2016.

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146 C. Allison, A. Carter, *Study on different types of Environmental Labelling (ISO Type II and III Labels): Proposal for an Environmental Labelling Strategy*, "Environmental Resources Management", Oxford 2000, p. IV.

147 Y. Li, *Competing eco-labels and product market competition*, "Resource and Energy Economics" 2020, Vol. 60, Issue C, pp. 1–23.

148 Ib.; P. Demirel, K. Iatridis, E. Kesidou, *The impact of regulatory complexity upon self-regulation: Evidence from the adoption and certification of environmental management systems*, "Journal of Environmental Management" 2018, Vol. 207, pp. 80–91.

Self-declared environmental claims may be created by manufacturers, importers, distributors, retailers or anyone else who believes that they can benefit from such claims, but without certification by an independent third party. Environmental claims made in regard to products may take the form of statements, symbols or graphics on product or package labels, or in product literature, technical bulletins, advertising, publicity, telemarketing, as well as digital or electronic media, such as the Internet[149].

Self-declared environmental claims are statements, labels or symbols that are related to a particular activity, product or service that may have an impact on the environment. This is a special type of advertising. It is related to a product, its components or its packaging. It can be in the form of a statement, label or symbol found on the product or on the product packaging, or in product documentation, technical bulletins, in advertisements and promotions, or through electronic or digital media (TV and Internet). The parameters, which indicate that the product is "environmentally friendly", are chosen by the company itself[150].

The essential factor in all of these environmental claims is to ensure their validity and reliability. It is very important that the verification is carried out properly in order to prevent negative market effects, such as market barriers or unfair competition, which may result from unreliable environmental claims. Also these claims should be clear, transparent, scientifically substantiated and documented so that a buyer or potential buyer of the product can be sure of the validity of the claims. The main advantage of environmental labels type II is their ability to attract the attention of all target groups in a simple way, with very little investment. Other advantages include[151]:

1. Reduction of market confusion (owing to reliability of information),
2. Facilitation of international trade,
3. Greater benefit for the customer, potential customer and users to be better informed when choosing a product.

Self-declared environmental labelling can exist in various forms: as simple claims, such as "recycled" and energy efficiency, or to be multi-content declarations with multiple attributes related to environmental protection.

The final scope of environmental labels and declarations is to encourage, through the use of confidential, accurate information that is not misleading about the environmental aspects of products, the introduction of requirements for products and the use of those products that have a less harmful impact on the

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149 ISO 14021:2016, Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling); J. Hodolič, Đ. Vukelić, M. Hadžistević, I. Budak, M. Badida, L. Šooš, B. Kosec, M. Bosak, *Reciklaža i reciklažne tehnologije*, FTN izdavaštvo, Novi Sad 2011.

150 ISO 14021:2016, Environmental labels and declarations, op. cit.

151 J. Hodolič, Đ. Vukelić, M. Hadžistević, I. Budak, M. Badida, L. Šooš, B. Kosec, M. Bosak, *Reciklaža i reciklažne tehnologije*..., op. cit.

environment, affirming the potential for market-oriented environment improvement[152].

When environmental seal is issued without considering ISO guidelines there is a high risk of greenwashing, greenblushing and greenbashing, which means delivering untruthful information to consumers. This kind of fake news is also referred to as mislabelling, unfair claims, misleading labelling, marketing slogan etc.

Before a manufacturer decides to make use of a self-declared environmental decision, it is important to establish whether there are any specific laws or regulations on how environmental information should be published. The regulations serve to better understand the minimum requirements and to convince potential users that the words, expressed in the claim/label, are used correctly.

The International Organization for Standardization, together with development of ISO 14021, which defines type II environmental labels, has developed voluntary labels and claims that do not require companies to have a permanent link with them. Although they are self-declared, there are some guidelines for issuing these product declarations.

In essence, there are three basic elements that must be considered when using self-declared environmental claims[153]:

1. The quality of current information to be published (content),
2. The way the information is presented (presentation),
3. The steps taken and methods used to verify its accuracy (guarantee of accuracy).

The symbols used for the purposes of self-declared environmental claims should be simple, easily reproducible and appropriate in position and size in relation to the product to which they are applied. The use of environmental labels and symbols serves as a significant source of information about the product or manufacturer. Their use should be avoided in all situations in which they may cause a misinterpretation of the meaning of the symbol by the consumer[154].

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[152] Y. Li, *Competing eco-labels and product market competition...*, op. cit.; M. Ilić Mićunović, Z. Lanc, M. Hadžistević, I. Budak, *The role of environmental labels and claims type II in circular economy development: the study of Republic of Serbia*, [in] 1. ISWA WORLD CONGRESS 2016, Novi Sad, Faculty of Technical Sciences, 19-21 September, 2016, pp. 1847–1847.

[153] J. Hodolič, I. Budak, M. Hadžistević, Đ. Vukelić, M. Majernik, J. Chovancova, J. Pankova-Jurikova, M. Ćulibrk, *Sistemi za upravljanje zaštitom životne sredine*, FTN izdavaštvo, Novi Sad 2013.

[154] J. Hodolič, Đ. Vukelić, M. Hadžistević, I. Budak, M. Badida, L. Šooš, B. Kosec, M. Bosak, *Reciklaža i reciklažne tehnologije...*, op. cit.; J. Hodolič, I. Budak, M. Hadžistević, Đ. Vukelić, M. Majernik, J. Chovancova, J. Pankova-Jurikova, M. Ćulibrk, *Sistemi za upravljanje zaštitom životne sredine*…, op. cit.

If a company chooses to publish their graphic solution of symbol, it must undertake that the specific activity, product or service declared by this symbol has qualitative advantages, which similar products, services or companies do not possess. To avoid confusion, similarities with existing official symbols should be avoided.

More details also can be posted on the website. The possibility to verify the evidence of the use of environmental labels, must be available. The use of labels/symbols for marketing purposes must be in accordance with the national marketing law, as well as with pre-defined criteria on environmental claims[155].

Textual environmental claims should also have a short/simple form and contain accurate information for customers. Within ISO 14021:2016, there are 16 textual statements that are defined with precise specifications on the use of terms, limitations and evaluation methodology. The textual statements defined by the standard are: compostable, degradable, designed for disassembling, extended life product, recovered energy, recyclable, recycled content, reduced energy consumption, reduced resource use, reduced water consumption, reusable and refillable, waste reduction, renewable material, renewable energy, sustainable and claims relating to greenhouse gas emissions[156]. These claims can be used for different stages of the product life cycle.

2.3. ISO type III environmental declarations

(*Igor Budak, Boris Agarski, Milana Ilić Mićunović*)

Introduction

Environmental product declarations (EPD), or type III environmental declarations, are defined by the ISO 14025 standard, and contain quantitative environmental data using the previously defined parameters based on the LCA, and also additional quantitative or qualitative information about the environmental protection[157]. EPDs are third-party verified data sheets developed based on the requirements of ISO 14025, and are governed by Product Category Rules (PCR) – documents developed by program operators that are responsible for rule creation and third party verification[158]. Therefore, the EPDs core information about the environmental impacts generated by products or processes is based on LCA results and both ISO standards are compatible with the ISO 14000 family of standards (figure 2).

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155 ISO 14021:2016, Environmental labels and declarations..., op. cit.

156 Ib.

157 ISO 14025:2006, Environmental Labels and Declarations – Type III Environmental Declarations – Principles and procedures.

158 M.D.C. Gelowitz, J.J. McArthur, *Comparision of type III environmental product declarations for construction products: Material sourcing and harmonization evaluation*, "Journal of Cleaner Production" 2017, Vol. 157, pp. 125–133.

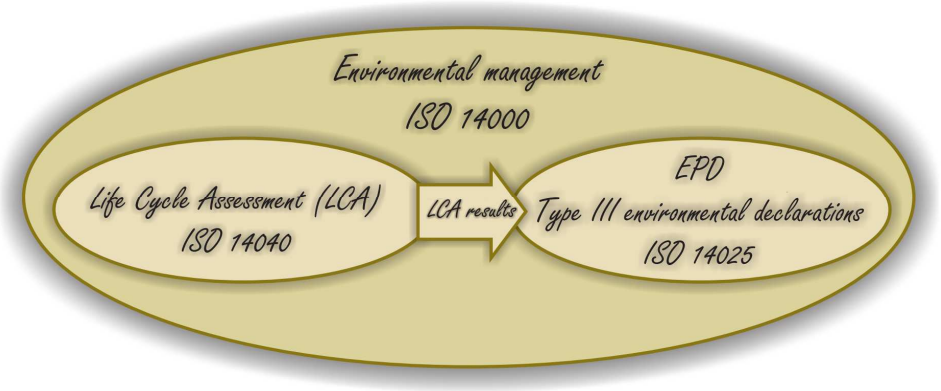

Figure 2. Relationship between the environmental management, LCA and EPD
Source: own work.

EPD is a voluntary program that provides quantified and verifiable environmental information about the product throughout its entire life cycle. EPD enhances communication between the product producers and buyers. By using environmental information from EPDs, consumers can compare product features and choose the one with better environmental performance. Therefore, companies are motivated to improve their products, apply the LCA, and declare their improvements through EPDs. Providing information about the impacts on environment in the form of quantitative statements drives consumers to make environmentally conscious decisions and to prefer more sustainable products. Quantitative environmental statements in the form of EPDs influence the consumers' behavior and prevent possible actions that could have a negative environmental impact. Although the LCA is a complex method and requires time for understanding, EPDs narrow this gap and provide fast and crucial LCA information that is easily available for consumers. In this way the LCA promotes environmentally friendly products, and although it can be used as an optimization tool for production processes, it is also an effective marketing tool . The unique feature of the EPDs is that they allow for the comparison of similar products within the same product categories where magnitude of environmental impacts is quantified and measureable. Quantified information provide the sense of how significant the environmental impact is. Company suppliers, investors, non-governmental organizations, and government institutions are also potential EPD users. Various user groups are motivated to apply EPDs because they provide information that is not available elsewhere.

Currently active standards ISO 14020:2000 and ISO 14025:2006 are the baseline for the development and use of EPDs. ISO 14020:2000 provides general principles for environmental labels and declarations while ISO 14025:2006 provides principles and procedures for EPDs. ISO 14020:1998 was the first standard to regulate environmental labels and was published in 1998.

ISO 14025:2000 was issued in 2000 and is now replaced by ISO 14025:2006. Other ISO standards, technical reports, and working drafts related to EPDs are:

1. ISO 14026:2017 – Environmental labels and declarations – Principles, requirements and guidelines for communication of footprint information,
2. ISO/TS 14027:2017 – Environmental labels and declarations – Development of product category rules,
3. ISO/WD TS 14029 – Mutual recognition agreements between Type III Environmental Declaration (EPD) Program Operators – Principles and procedures (Currently under development),
4. ISO 21930:2017 – Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.

Life cycle assessment

Life cycle assessment (LCA) studies environmental aspects and impacts through the whole life cycle of a product from the extraction of raw materials, through to the production, use, and end of life management, i.e. from "cradle to grave"[159]. The LCA methodology is standardized with several International Organization for Standardization (ISO) standards. The ISO 14040:2006 and 14044:2006 are considered to be essential standards for the LCA, whereby ISO 14040:2006 provides principles and framework while ISO 14044:2006 provides requirements and guidelines for the LCA. Other ISO standards and technical reports related to the LCA are as follows:

1. ISO 14045:2012, Environmental management – Eco-efficiency assessment of product systems – Principles, requirements and guidelines,
2. ISO 14046:2014, Water footprint – Principles, requirements and guidelines,
3. ISO/TR 14047:2012, Environmental management – Life cycle assessment – Illustrative examples on how to apply ISO 14044 to impact assessment situations,
4. ISO/TS 14048:2002, Environmental management – Life cycle assessment – Data documentation format,
5. ISO/TR 14049:2012, Environmental management – Life cycle assessment – illustrative examples on how to apply ISO 14044 to goal and scope definition and inventory analysis,
6. ISO 14067:2018, Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification,

[159] J. Hodolič, I. Budak, M. Hadžistević, Đ. Vukelić, M. Majernik, J. Chovancova, J. Pankova-Jurikova, M. Ćulibrk, *Sistemi za upravljanje zaštitom životne sredine*..., op. cit.

7. ISO/TS 14071:2014, Environmental management – Life cycle assessment – Critical review processes and reviewer competencies: Additional requirements and guidelines to ISO 14044:2006,
8. ISO/TS 14072:2014, Environmental management – Life cycle assessment – Requirements and guidelines for organizational life cycle assessment,
9. ISO/TR 14073:2017, Environmental management – Water footprint – Illustrative examples on how to apply ISO 14046,
10. ISO 21931-1:2010, Sustainability in building construction – Framework for methods of assessment of the environmental performance of construction works – Part 1: Buildings,
11. ISO 21931-2:2019, Sustainability in buildings and civil engineering works – Framework for methods of assessment of the environmental, social and economic performance of construction works as a basis for sustainability assessment – Part 2: Civil engineering works.

The LCA can be used for evaluation of environmental impacts in various fields of engineering, such as: production engineering[160], energy engineering[161], civil engineering[162], chemical engineering[163], metallurgy engineering[164], etc. Although the LCA was developed to evaluate human activities in terms of environmental impacts, later on, it was extended to evaluate other areas. Life cycle costing is used for estimation of costs, social LCA regards evaluation of social issues, working environment LCA is applied for assessment of impacts on a worker. Life cycle sustainability assessment evaluates sustainability through the environmental, social LCA and life cycle costing, whereas organizational LCA is used for evaluation of environmental impacts associated with an organization. Within the environmental LCA, carbon footprint and water

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[160] B. Agarski, I. Budak, M. Ilic-Micunovic, Dj. Vukelic, *Evaluation of the environmental impact of plastic cap production, packaging, and disposal*, "Journal of Environmental Management" 2019, Vol. 245, pp. 55–65; Dj. Vukelic, K. Simunovic, G. Simunovic, T. Saric, Z. Kanovic, I. Budak, B. Agarski, *Evaluation of an environment-friendly turning process of Inconel 601 in dry conditions*, "Journal of Cleaner Production" 2020, Vol. 266, doi:10.1016/ j.jclepro.2020.121919.

[161] B. Milanovic, B. Agarski, Dj. Vukelic, I. Budak, F. Kiss, *Comparative exergy-based life cycle assessment of conventional and hybrid base transmitter stations*, "Journal of Cleaner Production" 2017, Vol. 167, pp. 610–618.

[162] N. Maodus, B. Agarski, T. Kocetov Misulic, I. Budak, M. Radeka, *Life cycle and energy performance assessment of three wall types in South-Eastern Europe region*, "Energy and Buildings" 2016, Vol. 113, pp. 605–614.

[163] Dj. Vukelic, N. Boskovic, B. Agarski, J. Radonic, I. Budak, S. Pap, M. Turk Sekulic, *Eco-design of a low-cost adsorbent produced from waste cherry kernels*, "Journal of Cleaner Production" 2018, Vol. 174, pp. 1620–1628.

[164] B. Agarski, V. Nikolić, Ž. Kamberović, Z. Anđić, B. Kosec, I. Budak, *Comparative life cycle assessment of Ni-based catalyst synthesis processes*, "Journal of Cleaner Production" 2017, Vol. 162, pp. 7–15.

footprint emerge as the most popular single-issue LCAs that evaluate only one impact category.

The implementation of the LCA takes place in the following four phases[165], which are interconnected as shown in figure 3: 1) definition of the goal and scope, 2) life cycle inventory analysis, 3) life cycle impact assessment, 4) interpretation of results.

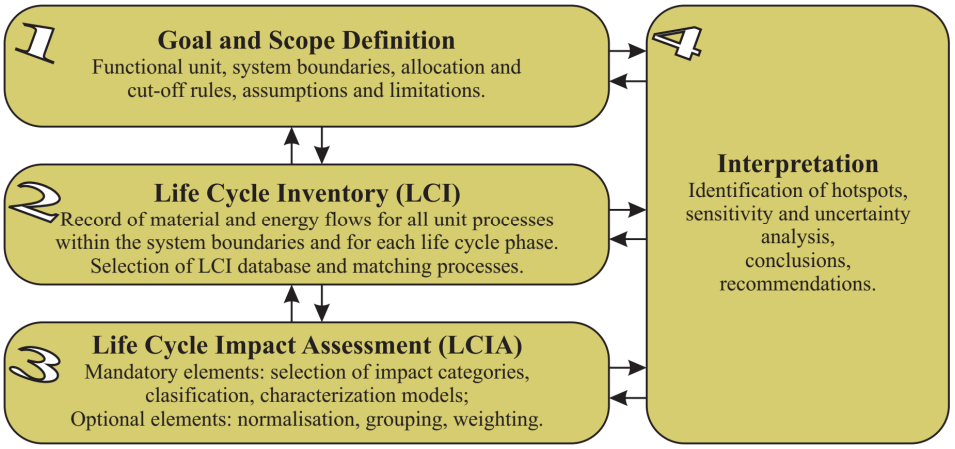

Figure 3. LCA phases

Source: own work based on: ISO 14040:2006, Environmental management – Life cycle assessment – Principles and framework.

In the first phase of the LCA the aim and scope of the study are defined. Defining the functional unit is an important part of the first LCA phase because it impacts the calculation of flows (material and energy inputs and outputs) in the second phase of the LCI. The functional unit quantifies the function of the products and their characteristics. System boundaries define which unit processes and flows are included in analysis and what life cycle stages are considered. Here, unit processes present the smallest process within the system for which inputs and outputs can be defined. Cradle to grave, cradle to gate, gate to gate, and other are frequently used expressions for a short description of the system boundaries. A block diagram is commonly used to visualize the system boundaries in the LCA. The allocation of environmental impacts between the flows is a common practice in the LCA. Frequently, the industrial processes have more than one input or output, therefore, the allocation can be done on mass, energy or other principle. If possible, the allocation through the system expansion or division of the current unit processes should be avoided.

[165] ISO 14040:2006, Environmental management – Life cycle assessment – Principles and framework.

The second LCA phase is about reporting all inputs and outputs for processes within the system boundaries, i.e. LCI. It is common practice to gather the quantitative values first for input and output flows, where tables are used for reporting. Considering the fact that previous LCA studies provide valuable information for the LCI, over time, LCA software and LCI databases have been developed to ease the LCA. Some of the well-known LCI databases are Ecoinvent, GaBi, Agri-Footprint, ELCD, Agribalyse, ProBas and other. The frequently used LCA software includes: SimaPro, GaBi, openLCA, Umberto, and other. Therefore, a LCA practitioner can select and match the appropriate LCI process in LCI databases and use them in their own analysis.

The third LCA phase is the impact assessment (LCIA) where various models can be used to calculate the impact on the environment. Mandatory elements in the LCIA include the selection of impact categories, category indicators, characterization models, assignment of LCI results (classification), and calculation of category indicator results (characterization). Optional elements in the LCIA involve the calculation of magnitude of category indicator results relative to reference information (normalization), grouping of impact categories, and weighting of impact categories. Some of the LCIA methods are: CML, ReCiPe, Impact 2002+, EDIP.

The fourth LCA phase is the interpretation where the results from the previous three phases are discussed. The interpretation takes into account the identification of significant issues, the test of completeness, consistency, sensitivity and uncertainty analysis, the drawing of conclusions, limitations and recommendations.

3. Programs of environmental product declarations and labels

3.1. Blue Angel

(*Marek Moravec*)

History and development of the program

Germany became an environmental policy instrument pioneer when it set up the world's first national ecolabel scheme in 1978. Spray cans free of chlorofluorocarbons (CFC's) became the first products which were awarded the German ecolabel in 1978. The symbol used for Germany's ecolabel scheme was derived from the UN's environmental logo, which the public nicknamed Blue Angel. Germany's ecolabel quickly developed into a well-known, highly successful scheme which became a reference point or even a model for national ecolabel schemes[166].

Blue Angel is a reliable environmental label that provides a clear orientation when it comes to making environmentally friendly purchases. The Blue Angel guarantees that a product does less damage to the environment and thus meets high health protection requirements, and all this while maintaining the same quality and fitness for use. Based on scientific investigations, its own studies, and market research, the German Environment Agency (UBA) creates requirements specific for product groups ("award criteria") as a prerequisite for obtaining the ecolabel certificate. When it comes to making an evaluation, the environmental label takes the entire life cycle of the product into consideration - from its production, through to its use, disposal and recycling. The aim is to identify the key environmentally relevant areas for each group of products in which considerable impacts on the environment can be reduced or even avoided[167].

It can be proven that products with the Blue Angel label meet the specified requirements and thus, they have an environmental advantage over comparable, conventional products. The further development (necessary due to technological developments) and periodic review of the criteria is also carried out by experts at the UBA, partly in collaboration with other independent scientific institutions and assessors, as well as in dialogue with interested parties.

The success of the environmental label is also thanks to the ease of its understanding. Consumers know that the Blue Angel is only awarded to those

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166 https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/uba_40jahre-blauerengel_ publikation_en_web.pdf, 17.08.2020.

167 Ib.

products and services which are better from an environmental perspective. This is exactly the case when it comes to local authorities, public authorities and companies which pay attention to environmental friendliness in public procurements[168].

Thanks to its ambitious requirements, the Blue Angel consistently brings about changes in legislation. Even before environmental problems are regulated by the law, the environmental label sets voluntary standards, giving companies the opportunity to make their pioneering role known. In doing so, the governmental environmental label is also an important, voluntary instrument of environmental policy. And manufacturers know: if they wish to improve the environmental footprint of their products and to develop ecological product innovations, the requirements of the Blue Angel provide good guidelines.

The beginnings of the Blue Angel idea started when "the German Federal Government presented its first environment program in autumn 1971, forming the German Advisory Council on the Environment. In 1972, the Club of Rome made the whole world aware of "the limits to growth". The newly-founded environmental department in the German Federal Ministry of the Interior had been working on a trademarked identification label for environmentally-friendly behavior since 1972. Corresponding memos inform us that, even at this early stage, a "labelling of the object" was envisaged as a "commendation for enterprises which promote environmental protection". A logo was found quickly: the emblem of the United Nations Environment Programme (UNEP), founded in 1972. The United Nations indicated its basic approval in a letter from Geneva on 5th October 1972. No objections were raised by the office for environmental protection against the use of the UN environmental symbol in west Germany. Later, a permission was also granted to make use of the emblem as a label on products"[169].

"The first step had been taken. The German Environment Agency, founded in 1974, gave environmental protection a strong position in administration and politics. The guidelines for the first environmental label were determined. In his answer to a question from representative Hermann Biechele on 26th April 1974, Minister of Interior Affairs Hans-Dietrich Genscher summarized these as follows: the labelling of environmentally-friendly products is desired, but "a statutory regulation is not our intention". Instead, it was planned that the labelling scheme would "at first be left to the initiative of the private sector". But the business world was up in arms about it. This resistance did not stop Blue Angel. One year later, the Minister of Interior Affairs and the Ministers of Environment from the federal states decided to introduce the label. In 1978, the

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168 Ib.

169 R.K.W. Wurzel, A.R. Zito, A.J. Jordan, *Environmental governance in Europe*, *Comparative analysis of new environmental policy instruments*, Edward Elgar Publishing, Cheltenham, Northampton 2013, pp. 80–83; https://www.blauer-engel.de/en/blue-angel/what-is-behind-it/an-environmental-label-with-a-long-history, 17.08.2020.

newly-formed jury approved the award criteria for the first six groups of products. On 5 June 1979, German Minister of Interior Affairs Gerhart Baum was finally able to award the first Blue Angels for environmentally-friendly spray cans, toilet paper made from recovered paper, low-noise lawnmowers, retreated tires, returnable bottles and bottle banks. In his speech, he highlighted the voluntary nature of the environmental label, as well as its conformity with the market. Now, the Blue Angel began to build up momentum when it came to the environmental awareness of a wider public, becoming a driving force for the rollout of more environmentally-friendly products"[170].

"The environmental label was created in 1978 on the initiative of the German Federal Minister of Interior Affairs and approved by the Ministers of the Environment for the German federal states. Since then the Blue Angel has been a market-based, voluntary instrument of environmental policy. Its scientific and holistic approach, as well as its independence thanks to the broad-based involvement of professional and commercial groups and the Environmental Label Jury, provide the foundations for the trust that consumers have placed in the environmental label"[171].

The popularity of the Blue Angel achieved its peak in the 1990s when the scheme was widely known amongst German consumers and present on more than 4000 product groups. Its popularity moderately declined in the late 1990s when it was overtaken by the Nordic Swan, which is a multi-national ecolabel scheme created by the Nordic Council states (Denmark. Finland, Iceland. Norway and Sweden), as Europe's most widely used ecolabel scheme. However, public relations campaigns and an increase in the number of eligible product and service groups have reversed the decline of the Blue Angel scheme in the late 2000s. The number of the Blue Angel ecolabel licenses granted to products/services was 3385 (from 492 suppliers) in 2006 and rose to 3786 (from 990 suppliers) in 2007. This meant that almost 10 (MM) products and services carried the Blue Angel label in 2007. By 2010 the number of the Blue Angel labelled products and services had further risen to 11500 (from 1050 suppliers). In 2011 more than 11500 products and services (from about 90 product categories) carried the Blue Angel label[172].

The standards set by the Blue Angel provide clear guidance for manufacturers and commercial companies when they want to improve the environmental performance of their products and services. Consumers can base their purchasing decisions on the Blue Angel and consciously choose a better environmentally-friendly alternative.

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170 Ib.
171 Ib.
172 Ib.

The Blue Angel celebrated its 40th anniversary in 2018. It has achieved numerous successes in the areas of environmental and consumer policy and has become a recognized label delivering a high level of guidance[173].

The Blue Angel was used as the role model for the ISO 14024 standard – an international standard upon which many new global environmental labels are based today. Environmental label programmes that operate in accordance with ISO 14024 (so-called type I ecolabels) fulfil the highest requirements when it comes to standards they set and also with regards to the relevance of their award criteria, as well as the independence of their control systems and the transparency of their development and award processes[174].

Additionally, the Blue Angel is also constantly able to focus in advance on anticipated changes to legal regulations. Before legal regulations are introduced to address environmental issues, the environmental label can set voluntary standards and thus provide companies with the opportunity to highlight their pioneering role in this area[175].

Blue Angel institutions

The Blue Angel institutions are as follows:

1. Owner of the label: "The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) defines the fundamental guidelines for the award of the Blue Angel and appoints the members of the Environmental Label Jury. (…) (BMU) is the owner of the Blue Angel and thus carries a high level of responsibility when it comes to using the label for providing reliable product information. It promotes the Blue Angel to the public, companies and associations, as well as within the political arena. In the course of interdepartmental government agreements, such as in the area of public procurement, the BMUB endorses greater consideration of the Blue Angel environmental label. (…) BMU also has an advisory role (without its own voting rights) for the Environmental Label Jury" [176].
2. Independent decision makers: "Environmental Label Jury is an independent, impartial and voluntary body that ensures the reliability of the Blue Angel. It decides which new product groups are added and discusses and approves the Basic Award Criteria proposed by the UBA. This decision-making body comprises 16 representatives from environmental and consumer associations, trade unions, industry, the trade, crafts, local authorities, academia, the media, churches, young people and the German federal states". (…) 14 members of the jury are appointed for a period of three years in agreement with the Chairman of

[173] Ib.
[174] Ib.
[175] Ib.
[176] https://www.blauer-engel.de/en/blue-angel/who-is-behind-it, 17.08.2020.

the German Conference of Environment Ministers (UMK). Two other members of the jury are representatives of the German federal states. One state representative is taken from the environment ministry of the state that currently holds the position of chairman of the UMK. The second is taken from the state that previously held the position of chairman of the UMK. In contrast to the other members, these state representatives are only appointed for a period of two years. The jury meets at least twice a year at their scheduled meetings. In between these meetings, the chairman represents the jury at events and discussions. In the first meeting for the relevant term of office, the jury elects a chairman from amongst the Environmental Label Jury and decides on their work program for their term of office. The jury will generally refrain from using airplanes when travelling to the meetings or other Blue Angel events within Germany"[177].

3. Specialist experts: the specialist department III 1.3 at the Federal Environmental Agency (UBA) develops the technical "criteria that a product or service must comply with in order to be certified with a Blue Angel. It also regularly checks the criteria to ensure they conform to the latest technological standards (…) answers general questions about the environmental labelling, (…) acts as the office of the Environmental Label Jury and thus supports the work of the non-salaried jury. (…) The Federal Environment Agency receives all proposals for new environmental labels (so-called "new proposals"). The new proposals are presented by the Federal Environment Agency together with a specialist evaluation to the Environmental Label Jury in order to take a decision. The Environmental Label Jury selects those product groups that are particularly suitable and returns them to the Federal Environment Agency for closer examination in the form of an investigative order. Once the required investigations have been completed, the Federal Environment Agency develops proposals for the specialist criteria that the product or service will need to fulfil to be awarded the environmental label. These award criteria are then discussed in the subsequent expert hearing that includes representatives from all relevant social groups: On the one hand, the criteria need to set strict standards, while on the other hand it is also important that they can actually be implemented in practice. The catalogue of criteria (Basic Award Criteria) are then presented to the Environmental Label Jury for ratification together with a proposal on the period of validity, the circumscription around the logo and its allocation to a particular protection goal. (…) In the case of existing environmental labels, the Federal Environment Agency has the task of reviewing the specialist

[177] Ib.

criteria at regular intervals and further developing the environmental label. The Federal Environment Agency presents the revised award criteria to the Environmental Label Jury for ratification"[178].

4. Tester: RAL gGmbH (a non-profit private limited company) is the awarding body for the Blue Angel. As an independent organization it "checks compliance with the requirements after the submission of the product-specific application by a company and concludes contracts on the use of the Blue Angel with the companies. (…) RAL gGmbH also obtains a statement from the federal state that is home to the applicant about the company's compliance with the environmental requirements. When all basic award criteria have been fulfilled, RAL gGmbH concludes a contract on the use of the environmental label with the applicant. Furthermore, RAL gGmbH organizes and carries out expert hearings as part of the development process for new environmental labels and the revision of existing labels"[179].

Benefits and costs of participation in the program

The requirements set by the Blue Angel place a particular emphasis on examining the impact that products and services have on the environment: on the climate, resources, water, soil and air. These tests also focus on their impact on people.

Products and services awarded with the Blue Angel cause less damage to the environment and, at the same time, protect people's health by e.g.[180]:

1. Saving resources during their production,
2. Being manufactured from sustainably produced raw materials,
3. Using less resources during their use or disposal because they are, for example, particularly energy efficient,
4. Avoiding dangerous substances for the environment or people's health or limiting them to a minimum,
5. Being especially durable and easy to repair,
6. Being easy to recycle,
7. Causing low emissions to the soil, water and air, as well as low noise emissions,
8. Nevertheless, fulfilling their intended function (fitness for use) to a high level of quality,
9. Unbeatable product diversity.

No label in the non-food sector is as diverse as the Blue Angel. Approx. 12000 products and services across almost all areas of daily life (except foodstuffs) have currently been awarded the Blue Angel ecolabel.

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178 Ib.

179 Ib.

180 https://www.blauer-engel.de/en/your-benefits, 17.08.2020.

The Blue Angel is awarded only to the best products in each category. The scientifically substantiated development of the award criteria is carried out by the Federal Environment Agency. The requirements are then discussed and agreed in a broad-based process including all socially relevant groups such as representatives from industry or consumer and environmental associations. The Blue Angel is a type I environmental label according to ISO 14024. It thus meets the highest requirements with respect to the standards it sets, the relevance of the award criteria and the independence, management and transparency of the development and award processes. Everybody knows the label. Surveys conducted by the Federal Environment Agency confirm 90 percent awareness of the Blue Angel brand. And 23% of consumers state that the environmental label influences their purchase decisions. "The Blue Angel ecolabel has lots of ambassadors: environmental and commercial associations, consumer centers, environmental consultants within local authorities, sustainability portals and many other sustainability-oriented players promote the Blue Angel. In addition to this, there are 1500 companies which use the Blue Angel in their product portfolios. The good international reputation of the German environmental policy and the positioning of the Blue Angel as an "Ecolabel made in Germany" also helps in the marketing of products offering environmental benefits in foreign markets. The Blue Angel is also an important decision-making criterion for public procurements and B2B transactions"[181].

Costs of the Blue Angel, schedule of fees

"If you want to use the Blue Angel for your product or service and comply with all of the requirements in the existing Basic Award Criteria, you can file an application for the use of the Blue Angel environmental label"[182].

The awarding body RAL gGmbH collects a one-off fee of 400 EUR (plus the statutory VAT rate) for processing the application for the use of the Blue Angel ecolabel. If the label holder applies for an extension of the right to use the environmental label for other products or services authorized to carry the label, which are sold on the market under a different brand name and/or distributed by a different sales organization, a processing fee of 200 EUR (plus the statutory VAT rate) is to be paid in each case by the applicant to RAL gGmbH for the conclusion of a contract extension. After the conclusion of a contract on the use of the environmental label, a yearly fee based on a graduated scale is to be paid to RAL. The amount of the fee is determined by the total yearly sales of all of the products or services awarded with the environmental label, in accordance with the corresponding Basic Award Criteria. The following schedule of fees is shown in table 6.

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[181] Ib.

[182] https://www.blauer-engel.de/en/companies/costs-blue-angel-schedule-fees, 17.08.2020.

Table 6. Yearly fee for the use of the environmental label as of 01.07.2017

Annual Sales (in Million €)	Annual Fee [€]	Fee Category
Up to 0,25	320,00	1
More than 0,25 up to 1,0	600,00	2
More than 1,0 up to 2,5	1300,00	3
More than 2,5 up to 5,0	2400,00	4
More than 5,0 up to 10,0	3500,00	5
More than 10,0 up to 15,0	4800,00	6
More than 15,0 up to 20,0	6100,00	7
More than 20,0 up to 25,0	7500,00	8
More than 25,0 up to 40,0	9000,00	9
From 40,0	10500,00	10

Source: own work based on: https://www.blauer-engel.de/en, 17.08.2020.

Use of the logo

"The use of the Blue Angel by the applicant is governed by the contract on the use of the environmental label concluded with RAL gGmbH. This also regulates the type of use and also the period of validity. In terms of the use of the environmental label in advertising or for other measures taken by the applicant, they are required to ensure, for example, that the environmental label is only used in combination with the product which has been certified with the Blue Angel ecolabel"[183].

"The most important advantages of using the Blue Angel logo are as follows:

1. A clear and unambiguous message. The use of the Blue Angel logo on your products acts as a clear and reliable distinguishing feature that provides concrete information and marketing value. By using the Blue Angel logo, you indicate to your customers, employees and other parties that you use natural resources in a responsible way and consider environmental and health protection a particularly important factor,
2. An increase in the level of awareness and brand value. The Blue Angel is Germany's best known and the world's first environmental label. You can thus benefit from the clear competitive advantages and added level of trust that this environmental label enjoys in the economy and amongst consumers. The label's credibility and competence, its objective criteria, its institutionalized award process and governmental links increase your corporate and brand value,
3. Guidance when making purchasing decisions. The market for certified products is growing because consumers place importance on responsibly produced products and services when making their purchasing decisions. The Blue Angel is the dependable guide that provides reliable assistance

[183] https://www.blauer-engel.de/en/companies/how-do-you-use-blue-angel/use-logo, 17.08.2020.

for making ecologically sound purchasing decisions. This is because the Blue Angel guarantees that a product or service meets high standards when it comes to its environmental, health and performance characteristics" [184].

There are 12 product or service groups in the Blue Angel program (table 7).

Table 7. Blue Angel ecolabelled products and services

Paper Products	**Packaging and Disposal**	**(Household) Chemicals, Cleaning**
Paper Filters for Hot Beverages (UZ 65)	Returnable Bottles and Glasses (UZ 2)	Pest Control, Biocide Free (UZ 34)
Sanitary Paper Products (UZ 5)	Returnable Transportation Packaging (UZ 27)	Pest Control, Thermal (Wood) (UZ 57a)
Disposable Diapers (UZ 208)*	Low-Noise Waste-Glass Containers (UZ 21)	Pest Control, Thermal (Indoor) (UZ 57b)
Recycled Paper (Stationery) (UZ 14, UZ 14b)	Products made from Recycled Plastics (UZ 30a)	Sanitary Additives for Camping Toilets (UZ 84a)
Recycled Cardboard (Stationery) (UZ 56)	**Furnishings, Clothing, Everyday Items**	Flushing Water Additives for Camping Toilets (UZ 84b)
Printing and Publication Papers (UZ 72)	Mattresses (UZ 119)	Mechanical Pipe Cleaners (UZ 24)
Printed Matters (UZ 195)	Upholstered Furniture (UZ 117)	**Electric Devices (Household)**
Laundry Detergents and Cleaning Agents	Furniture and Slatted Frames made of Wood (UZ 38)	Baby Phones (UZ 125)
Laundry Detergents (UZ 202)	Toys (UZ 207)	Hair Dryers (UZ 175)
Hand Dishwashing Detergents and Cleaners (UZ 194)	Writing Utensils and Stamps (UZ 200)	Lamps (Illuminants) (UZ 151)
Dishwasher Detergents (UZ 201)	Artists' Colors (UZ 199)	Electric Kettles (UZ 133)
Shampoos, Shower Gels and Soaps (UZ 203)	Textiles (UZ 154)	Toasters (UZ 167)
Vehicles/ Mobility	Shoes and Inlays (UZ 155)	Coffee/Espresso Machines (UZ 136)
Busses (UZ 59/59b)	Shower Heads (UZ 157)	Microwave Ovens (UZ 149)
Municipal Vehicles (UZ 59/59a)	Flushing Boxes (UZ 32)	Television Sets (UZ 145)
Construction Machinery (UZ 53)	Sanitary Tapware (UZ 180)	Digital Projectors (UZ 127)
Car Sharing (UZ 100)	Lead-Free Products (Sinkers) (UZ 67)	Set-Top Boxes (UZ 196)
Car Sharing for Electric Vehicles (UZ 100b)	Plant Containers (UZ 17)	Cooker Hoods (UZ 147)
Ship Design (UZ 141)	Mechanical Watches/Clocks and Lamps (UZ 47)	Vacuum Cleaners (UZ 188)

[184] Ib.

Ship Operation (UZ 110)	**Construction Products**	Solar-Powered Products (UZ 116)
Replacement Catalytic Converters (UZ 184)	Floor Coverings, Panels and Doors Made of Wood and Wood-Based Materials (UZ 176)	Garden Tools (UZ 206)
Mobility Cards (UZ 192)	Elastic Floor Coverings (UZ 120)	**Communications Technology (ICT)**
Electric Cycles (UZ 197)	Textile Floor Coverings (UZ 128)	Computers and Keyboards (UZ 78)
Energy and Heating	Floor-Covering Adhesives (UZ 113)	Monitors (UZ 78c)
Energy Savings Contracts (UZ 170)	Flooring Underlays (UZ 156)	Printers, Copiers and Multifunction Devices (UZ 205)
Energy Meters (UZ 142)	Panel-Shaped Materials (UZ 76)	Toner Modules (UZ 177)
Wood Chips and Wood Pellets (UZ 153)	Sealants (UZ 123)	Telephone Systems (UZ 183)
Gas-Fired Cogeneration Modules (UZ 108)	Internal Plasters (UZ 198)	Cordless Phones (UZ 131)
Solar Collectors (UZ 73)	Wallpapers (UZ 35)	Voice Over IP Phones (UZ 150)
Hot-Water Storage Tanks (UZ 124)	Wall Paints (UZ 102)	Mobile Phones (UZ 106)
Wood Pellet Stoves (UZ 111)	Varnishes, Glazes and Primers (UZ 12a)	Take-back systems for Mobile Phones (UZ 209)
Wood Pellet and Wood Chip Boilers (UZ 112)	Thermal Insulation Materials (Indoor) and Suspended Ceilings (UZ 132)	Routers (UZ 160)
Photovoltaic Inverters (UZ 163)	Thermal Insulation Composite Systems (UZ 140)	Video Conference Systems (UZ 191)
Radiator Thermostats (UZ 168)	Roof Coatings and Bitumen Adhesives (UZ 115)	Interactive Whiteboards (UZ 166)
Air Conditioners (UZ 204)	**Other**	Data Shredders (UZ 174)
Cleaning Services	Lubricants and Hydraulic Fluids (UZ 178)	Power Strips (UZ 134)
Laundrettes (UZ 173)	Spreading Materials (UZ 13)	Uninterruptible Power Supply (UZ 182)
Wet Cleaning Services (UZ 104)	De-Icers for Airfields (UZ 99)	Data Centers (UZ 161)
Carbon Dioxide Cleaning Services (UZ 126)	Climate-Friendly Grocery Stores (UZ 179)	
Fabric Towel Dispensers (UZ 77)	Fabrics from Recycled Plastics (UZ 193)	
Hand Driers (UZ 87)	Leather (UZ 148)	

Source: own work based on: https://www.blauer-engel.de/en, 17.08.2020.

The presented (in table 7) products or services are periodically revised and updated when necessary.

Objective of the environmental label

The overall goal of the "Blue Angel" environmental label is to encourage the demand for and supply of products and services which have a distinctly reduced environmental impact, by providing verifiable, accurate and non-misleading information about environmental factors. The label thus identifies products and services which are determined to be environmentally preferable to other products serving the same purpose (i.e. within a product group or service category)[185].

Blue Angel awarding principles and process

Environmental labelling is based on a holistic examination of products over their entire life cycle. In developing environmental criteria for products, the life cycle stages – from the extraction of raw materials to manufacture, distribution, use and disposal – are each considered in relation to relevant cross-media environmental indicators[186].

Every product group with the Blue Angel ecolabel has its own Basic Award Criteria containing individual requirements that need a corresponding verification. Firstly, it should be checked whether the Basic Award Criteria already exist for the product or service offered on the market. Next, existing Basic Award Criteria need to be considered if a product or service is already allocated to a product group[187].

The Basic Award Criteria are available in German and English, and the application can also be submitted in either German or English. If a product or service is not prepared to meet one of the existing Basic Award Criteria, it should be checked whether a product is included in the list of pending investigative orders or whether it is necessary to prepare a new proposal[188].

Procedure for implementation of new product group

Following the receipt of a new proposal by the Federal Environmental Agency, it is submitted to the Environmental Label Jury, an independent and voluntary body. The Environmental Label Jury normally meets twice a year, usually in May and December. Based on the information submitted, the Environmental Label Jury decides whether a new environmental label should be created for the product group concerned. Therefore, it is in the particular interest of the person submitting the new proposal to word it in such as manner as to make it usable as the basis for a balanced and adequate evaluation. As a rule,

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185 Ib.

186 Ib.

187 https://www.blauer-engel.de/sites/default/files/pages/downloads/filing-new-proposals/information-sheet-new-proposals.pdf, 17.08.2020.

188 Ib.

new proposals should not comprise more than 20 pages, and they must be readily intelligible in themselves[189].

Once the Environmental Label Jury has found that the product group concerned is of particular environmental relevance, the Federal Environmental Agency is commissioned to draw up a list of criteria und to discuss it with those concerned at all levels of society, such as environmental and consumer associations, trade unions, industry and trade, science, testing institutes, etc.

If insufficient data and information are available on a product group, the Federal Environmental Agency, in its function as the Secretariat of the Environmental Label Jury, may commission a feasibility study to compile relevant market data and determine the pollution reduction potential[190].

Costs and persons eligible to submit the proposal:

1. New proposals are processed free of charge,
2. New proposals can be submitted by natural and legal persons under private and public law.

New proposals should contain detailed information on the points specified below. All information should be based on sound data and findings, and source information must be given. All information provided will be treated as confidential.

An introductory outline not more than one page in length should summarize the facts which have given rise to the new proposal, and the environmental objectives.

Information about the proposed product or service include[191]:

1. Name of the product or service,
2. Name of the product group or service category,
3. Target groups in the market (e.g. public purchasers, private final consumers),
4. Extent of marketing (e.g. Germany, EU, worldwide),
5. Market introduction status,
6. Market relevance (e.g. number or tonnage sold, market share),
7. Number of manufacturers in the market who make products that are similarly environmentally friendly,
8. Information (misidentified) about conventional products on the market and the estimated substitution potential,
9. Information about safety and fitness for use in comparison with conventional products, including a reference to the availability of generally accepted testing and verification procedures,
10. Information about costs and prices in comparison with those of conventional products,

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189 Ib.
190 Ib.
191 Ib.

11. Existing contacts to the competent industrial association,
12. Etc.

Environmental relevance includes[192]:

1. Description of the environmental problem the proposed product or service is intended to solve, taking into account its entire life cycle (manufacture, distribution, use/consumption, disposal) and information about the potential and need for environmental improvement,
2. Presentation and description of relevant quantifiable reductions in environmental impact which the proposed product or service entails,
3. Description of the innovative character of the new proposal in comparison with the state of the art and existing legislation, requirements, states, products, processes or procedures.

Case study – RICOH C5300S printer

"Built as a right-sized solution, the RICOH Pro C5300s/C5310s offer a fusion of vibrant color, agile media handling and a wide range of finishing options. With superior reliability, accurate registration and intuitive controls, they are ideal for marketing agencies, in-plants, commercial printers and franchise/pay for print environments looking for a total package – in a compact footprint"[193].

"Support sustainability objectives with a system that takes an intelligent approach to lowering environmental impact and total cost of ownership. The RICOH Pro C5300s/C5310s cutsheet printers are ENERGY STAR® certified and EPEAT Gold rated. Standard single-pass duplex scanning, PXP-EQ toner with a low melting point and the programmable power on/off function all automate the reduction of energy"[194].

"This product is designed to save energy costs. The system automatically reduces energy consumption when not used for a period of time (1 minute). This mode is called the Sleep Mode. From these states, the machine returns to standby printing in a short time (the return time listed above) when it receives a print or copy job. This allows you to save energy without limiting your productivity. With its return time, the system meets the high requirements of the Blue Angel, which attaches particular importance to user-friendliness in this respect. The activation times for the sleep mode can be changed by the user in the range of 1-60 minutes. However, if the activation times are increased, this leads to higher energy consumption and thus to higher electricity costs. It is, therefore, recommended not to change the preset activation times. When the main switch is actuated, there is still a low power consumption of max. 0,3

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192 Ib.

193 https://www.ricoh-usa.com/en/products/commercial-industrial-printing/cutsheet/pro-c5300-c5310s, 17.08.2020.

194 https://produktinfo.blauer-engel.de/uploads/pdf_uploads/Pro_C5300S_Annex12_UZ205_409394_v1.pdf, 17.08.2020.

watts. Complete disconnection from the mains can be achieved by pulling the mains plug. Please observe the instructions in the operating instructions in order to prevent damage to the system and possible loss of data. The device is designed so that it can be switched off at least twice a day. Note on TEC (Typical Electricity Consumption). The aim of the TEC method is to determine the energy efficiency of hardcopy devices (copiers, printers, multifunction systems) and to make them comparable. The method determines the energy consumption of a product over a fixed period of time under normal operating conditions. The following usage cycle is assumed for the present system: Per working day 32 print jobs with 66 pages, simplex at monochrome printing, (2112 pages/day). Hence, the energy consumption for a week in the standard usage cycle according to ENERGY STAR version 2.0 (7-day-week with 5 working days of 8 hours) is 5,7 kWh per week"[195].

3.2. Cradle to Cradle Certified™

(Bożydar Ziółkowski)

History and development of the program

The "cradle to cradle" philosophy was promoted from the 1980s by Walter Stahel and Michael Braungart, although its beginnings can be found in the legacy of industrial ecology and industrial symbiosis at the end of the 1930s. This concept led its promoters to the creation of the ecolabel Cradle to Cradle Certified which is commonly considered to be directly dedicated to the development of the circular economy, unlike other environmental labels which focus on specific aspects of the economy, as e.g. Leadership in Energy and Environmental Design (LEED®) which is tailored to buildings[196]. This ecolabel is granted only to products (including materials) and does not apply to buildings, companies, municipalities, processes, or services[197].

Cradle to Cradle Certified products need to conform to the Cradle to Cradle Certified Product Standard which is oriented towards continuous improvement of industrial products. Continuous improvement means the process of both decreasing the negative impact of a product and increasing positive effects generated by an item. Here, the continuous product improvement is oriented towards two management goals regarding the impact of a product, and should not be limited just to a reduction of the negative environmental and social impact

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[195] Ib.

[196] V. Prieto-Sandoval, A. Mejia-Villa, M. Ormazabal, C. Jaca, *Challenges for ecolabeling growth: lessons from the EU Ecolabel in Spain*, op. cit.

[197] MBDC, *Cradle to Cradle Certified Products Program. Trademark Use Guidelines*, 2014, http://s3.amazonaws.com/c2c-website/resources/media_kit/marketing_guidance/POL_Trademark_Use_Guidelines_20140721.pdf., 18.01.2018.

or to termination of improvement activities when the goal of zero-impact is achieved[198].

The Cradle to Cradle Certified Product Standard stems from the concept of the Cradle to Cradle Design, created by an American architect and designer William McDonough, and German industrial chemist Michael Braungart, who described the idea in their book "Cradle to Cradle: Remaking The Way We Make Things", from the year 2002. According to the core assumption of the book, the Cradle to Cradle Design is a way of designing products through eco-effective methods, which concerns the creation of industrial and consumer goods in both environmentally and socially safe as well as economically efficient manner. The concept of the Cradle to Cradle (C2C) remains in opposition to the Cradle to Grave model, which favors cost-efficiency in industrial development, without taking into account environmental limitations.

The Cradle to Cradle Design was built based on experiences with the "Intelligent Product System" (IPS) and "environmentally intelligent substances" distinguished by the total lack of toxic characteristics and first of all positive impact on the environment. The IPS was created by M. Braungart and his team from the Environmental Protection and Encouragement Agency (EPEA) Internationale Umweltforschung GmbH, founded in the year 1987. "Environmentally intelligent substances" were the subject of interest for W. McDonough when he worked for Rohner Textil, the Swiss manufacturer of textile products. He selected with his team a group of 38 "intelligent substances" (also known as positive products) after analyzing the toxicity of almost 8000 chemicals used in the industry[199]. Altogether with W. McDonough, M. Braungart developed the IPS and identified the principles of the Cradle to Cradle Design in the early 1990s. Since the year 1995, the Cradle to Cradle principles have been applied by McDonough Braungart Design Chemistry, LLC (MBDC) firm for the scientific evaluation and design of products and materials for large and small companies[200].

The general idea of the Cradle to Cradle Design is intelligent designing, thus the new product should generate the maximum value for the economy, ecology, and society (as in fractal ecology) instead of balancing the needs of these three spheres. In this approach, the concept of traditional eco-efficiency (defined as decreasing the negative impact of industry) is rejected and the main attention is attributed to eco-effectiveness. The eco-effectiveness is defined as implementing principles present in natural ecosystems and it embraces a group of three main assumptions: waste equals food, usage of solar energy, respect for

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198 Cradle to Cradle Products Innovation Institute, *C2C Product Certification requirements - Get Certified - Overall Product Scoring*, Cradle to Cradle Products Innovation Institute b.d., https://www.c2ccertified.org/get-certified/levels, 21.08.2020.

199 A. Curry, *Green Machine*, "U.S. News & World Report", pp. 36–38.

200 Cradle to Cradle Products Innovation Institute, *Benefits of the cradle cradle product program*, 2008, http://www.mbdc.com/images/Outline_CertificationV2_1_1.pdf, 02.12.2017.

diversity, or complexity of the system. According to the Cradle to Cradle Design principles, industrial systems should manage material flow within the framework of two closed-loop cycles called biological metabolism and technical metabolism[201].

The Cradle to Cradle Design principles have been described in the Cradle to Cradle Certified Product Standard which is the basis for the Cradle to Cradle Certified Program, created in the year 2005. Every company that can prove compliance of its product with the Standard is entitled to receive the Cradle to Cradle Certified mark and the product certificate assigned since the year 2010 by the Cradle to Cradle Products Innovation Institute (C2CPII), a third-party non-profit organization, and independent body that manages the certification program[202]. For certification purposes, the materials and sub-assemblies are listed as products in the program documents[203]. The certification is focused on testifying the biological or technical recyclability of products, and is based on the quality statement assessed using quantitative indicators.

Since 2019, public consultations regarding the revision of the Cradle to Cradle Certified Product Standard have been initiated. The updated Standard should be released in version 4.0, at the end of 2020, or at the beginning of 2021, after completion of the review[204].

Requirements and methodology of impact assessment

The main goal of the Cradle to Cradle Certified Product Standard is to ensure the continuous improvement of products across five quality categories: material health, material reutilization, renewable energy and carbon management, water stewardship, and social fairness. They are called both "critical sustainability categories" and "critical performance categories". The requirement of the continuous products improvement obliges the certificate holders to outline their declaration for optimization in all of the five mentioned categories and to replace the low scored materials (problematic materials or chemicals, i.e. when X-scored) according to the internal strategic management plan[205].

The Cradle to Cradle Certified Product Standard requires the exclusion of the following items from certification the process[206]:

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[201] MBDC, EPEA, *Introduction to the Cradle to Cradle Design Framework*, 2002, http://www.chinauscenter.org/attachments/0000/0001/CradleDesign.pdf, 17.08.2018.

[202] MBDC, EPEA, *Cradle To Cradle Certified Product Standard*, 2016, http://s3.amazonaws.com/c2c-website/resources/certification/standard/C2CCertified_ProductStandard_V3.1_160107_final.pdf, 17.08.2018.

[203] MBDC, *Cradle to Cradle Certified Products Program. Trademark Use Guidelines...*, op. cit.

[204] Cradle to Cradle Products Innovation Institute, *What is Cradle to Cradle Certified*, https://www.c2ccertified.org/get-certified/product-certification, 23.08.2020.

[205] MBDC, EPEA, *Cradle To Cradle Certified Product Standard...*, op. cit.

[206] Ib.

1. Chemicals for technical and biological nutrients present on the Cradle to Cradle Certified “Banned List”,
2. Services or processes,
3. Food, beverages, pharmaceuticals, fuels, and products intended for combustion during use,
4. Companies, buildings, municipalities, cities, countries,
5. Products manufactured from rare or endangered species (e.g. ivory),
6. Ethically controversial products (e.g. weapons, tobacco),
7. Products responsible for animal abuse (e.g. fur, skins, pelts),
8. Products responsible for safety concerns attributed to physical and chemical characteristics,
9. Products manufactured by companies involved in rain forest damage, child labor, blood metals, blood diamonds, terror support or racism/discrimination,
10. Products used to produce nuclear power,
11. Products that may be contrary to the intent of the Cradle to Cradle principles.

There are five established types of certificates representing certification levels, i.e.: Basic, Bronze, Silver, Gold, and Platinum[207]. They are differentiated according to the level of a product’s advancement in reducing impact, representing the level of environmental and social impact or environmental and social performance and the level of the environmental and social product’s quality, referenced as “achievement levels”. Every certificate is sealed with a single design mark called Cradle to Cradle Certified, equivalent to an environmental label. The use of the logo is permitted only to the extent defined by the license granted to the company and always for the certified product[208]. In case of products certified at the Basic level, the allowance for printing this mark is not valid[209].

The product is assessed in terms of five levels of its environmental and social impact in five critical performance improvement categories. The general score is a cumulative result of a single assessment for five categories and is called an ”overall certification level” or ”product’s overall mark”. The calculated score determines the type of certificate and depends on the lowest score attributed in the assessment process. The qualified company receives both a certificate, that is valid for 2 years, and a product scorecard which can be published and used for educational purposes.

The advancement in impact reduction, illustrated by the Basic, Bronze, Silver, Gold, and Platinum certificate, is an example of continuous improvement, resulting from the intrinsic assumption of the Cradle to Cradle Certified Product Standard that companies will strive to optimize their efforts in

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[207] Ib.

[208] MBDC, *Cradle to Cradle Certified Products Program. Trademark Use Guidelines...*, op. cit.

[209] MBDC, EPEA, *Cradle To Cradle Certified Product Standard...*, op. cit.

all categories. Requirements applied for the five assessment categories and every certification level are presented in table 8.

Table 8. Criteria for assessment according to the Cradle to Cradle Certified Product Standard

1. Material health	Basic	Bronze	Silver	Gold	Platinum
No chemical substances on the list of banned substances that exceed the threshold values	✓	✓	✓	✓	✓
Materials defined as biological or technical nutrients	✓	✓	✓	✓	✓
100% ”characterized” (i.e., all generic materials listed)	✓	✓	✓	✓	✓
Strategy developed to optimize all remaining x-assessed chemicals		✓	✓	✓	✓
At least 75% assessed by weight (complete information on the formula collected for 100% of BN materials that are released directly into the biosphere as part of their intended use)		✓	✓	✓	✓
At least 95% assessed by weight (complete information on the formula collected for 100% of BN materials that are released directly into the biosphere as part of their intended use)			✓	✓	✓
Assessed materials do not contain carcinogenic, mutagenic, or reproductively toxic (CMR) chemicals in any form that may cause plausible exposure			✓	✓	✓
100% assessed by weight				✓	✓
Formula optimized (i.e., all x-assessed chemicals replaced or phased out)				✓	✓
Meets Cradle to Cradle VOC emission standards where relevant				✓	✓
All process chemicals assessed and no x-assessed chemicals present					✓
2. Material reutilization	Basic	Bronze	Silver	Gold	Platinum
Defined the appropriate cycle (i.e., technical or biological) for the product	✓	✓	✓	✓	✓
Designed or manufactured for the technical or biological cycle and has a material (re)utilization score ≥ 35		✓	✓	✓	✓
Designed or manufactured for the technical or biological cycle and has a material (re)utilization score ≥ 50			✓	✓	✓
Designed or manufactured for the technical or biological cycle and has a material (re)utilization score ≥ 65				✓	✓

Well-defined nutrient management strategy (including scope, timeline, and budget) for developing the logistics and recovery systems for this class of a product or material				✓	✓
Designed or manufactured for the technical or biological cycle and has a material (re)utilization score of 100					✓
The product is actively being recovered and cycled in a technical or biological metabolism					✓
3. Renewable energy and carbon management	Basic	Bronze	Silver	Gold	Platinum
Purchased electricity and direct on-site emissions associated with the final manufacturing stage of the product are quantified	✓	✓	✓	✓	✓
A renewable energy use and carbon management strategy is developed		✓	✓	✓	✓
For the final manufacturing stage of the product, 5% of purchased electricity is renewably sourced or offset with renewable energy projects, and 5% of direct on-site emissions are offset			✓	✓	✓
For the final manufacturing stage of the product, 50% of purchased electricity is renewably sourced or offset with renewable energy projects, and 50% of direct on-site emissions are offset				✓	✓
For the final manufacturing stage of the product, >100% of purchased electricity is renewably sourced or offset with renewable energy projects, and >100% of direct on-site emissions are offset					✓
The embodied energy associated with the product from Cradle to Gate is characterized and quantified, and a strategy to optimize is developed					✓
≥ 5% of the embodied energy associated with the product from Cradle to Gate is covered by offsets or otherwise addressed (e.g., through projects with suppliers, product redesign, savings during the use phase, etc.)					✓
4. Water stewardship	Basic	Bronze	Silver	Gold	Platinum
The manufacturer has not committed a material breach of their discharge permit related to their product during the last two years	✓	✓	✓	✓	✓
Local- and business-specific water-related issues are characterized (e.g., the manufacturer will determine if water	✓	✓	✓	✓	✓

scarcity is an issue and/or if sensitive ecosystems are at risk because of direct operations)					
A statement of water stewardship intentions describing what action is being taken for mitigating identified problems and concerns is provided	✓	✓	✓	✓	✓
A facility-wide water audit is completed		✓	✓	✓	✓
Product-related process chemicals in effluent are characterized and assessed (required for facilities with product-relevant effluent) OR Supply chain-relevant water issues for at least 20% of Tier 1 suppliers are characterized and a positive impact strategy is developed (required for facilities with no product-relevant effluent)			✓	✓	✓
Product-related process chemicals in effluent are optimized (effluents identified as problematic are kept flowing in systems of nutrient recovery; effluents leaving a facility do not contain chemicals assessed as problematic) (required for facilities with product-relevant effluent) OR Demonstrated progress against the strategy developed for the Silver-level requirements (required for facilities with no product-relevant effluent)				✓	✓
All water leaving the manufacturing facility meets drinking water quality standards					✓
5. Social fairness	Basic	Bronze	Silver	Gold	Platinum
A streamlined self-audit is conducted to assess the protection of fundamental human rights	✓	✓	✓	✓	✓
Management procedures aiming to address any identified issues have been provided	✓	✓	✓	✓	✓
A full social responsibility self-audit is complete and a positive impact strategy is developed (based on UN Global Compact Tool or B-Corp)		✓	✓	✓	✓
Material-specific and/or issue-related audit or certification relevant to a minimum of 25% of the product material by weight is complete (FSC Certified, Fair Trade, etc.) OR			✓	✓	✓

Supply chain-relevant social issues are fully investigated and a positive impact strategy is developed OR The company actively conducts an innovative social project that positively affects employees' lives, the local community, global community, or social aspects of the product's supply chain or recycling/reuse					
Two of the Silver-level requirements are complete				✓	✓
All three Silver-level requirements are complete					✓
A facility-level audit is completed by a third party against an internationally recognized social responsibility program (e.g., SA8000 standard or B-Corp)					✓

Acronyms: BN – biological nutrient, VOC – Volatile Organic Compound.

Source: own work based on: MBDC, EPEA, *Cradle To Cradle Certified Product Standard*, 2016, http://s3.amazonaws.com/c2c-website/resources/certification/standard/C2CCertified_ProductStandard_V3.1_160107_final.pdf, 17.08.2018.

The internal component of the Cradle to Cradle Certified Product Standard is a very detailed assessment procedure that includes requirements for every criterion presented in the above table in five categories.

Benefits and costs of participation in the program

Among the benefits resulting from the implementation of the Cradle to Cradle Certified Product Standard are[210]:

1. Transparent validation of a company's commitment to guarantee a product's quality and safety which can be helpful to consumers, industry, and regulators,
2. Identification of strategic optimization plans,
3. Possibility to contribute more credits in the LEED building certification, Dutch Green Building Council Program „BREEAM", or in healthy building product databases (e.g. Portico).

The cost of certification for one product or group of products is composed of two components: fees charged by the certifying body i.e., the Cradle to Cradle Products Innovation Institute and fees charged by an Accredited Assessment Body which is responsible for product assessment, testing, and advising in creating optimization strategies. The summary of certification costs charged by C2CPII is presented in table 9.

[210] EPEA – Internationale Umweltforschung, *Accreditation*, http://www.epea.com/accreditation/, 13.01.2018.

Table 9. Costs of certification by the Cradle to Cradle Products Innovation Institute

Cost category and definition	Price [$]	Price [€]
The certification Application (new product application) fee applies to the product never certified before or withdrawn from the certification program. The fee covers the registration procedure costs and the initial review of one assessment report.	3600	3150
The re-certification (every two years) fee applies to the biennial review of the assessment report and covers also the two-year license to use the certification mark by every product.	2000	1750
The certification extension fee is charged when a company applies for an extension of the certification period. This is valid when the updated assessment report required for re-certification is submitted after the first 90-day extension period.	500	450
The interim assessment audit fee is charged in the case of submission of an additional assessment report to C2CPII by a company during the two-year certification period to achieve a new review after the occurrence of some changes related to the product e.g., product line extension, change of the certification level, change in the material composition or production process influencing the certified product, Material Health certification.	650	575
The Revised Certificate (certificate correction) fee is imposed when any correction of information on the certificate is requested by the applying company.	100	90

Source: own work based on the changed and supplemented literature: C2CPII, *Fees Schedule Cradle to Cradle Certified Products Program*, 2016, http://s3.amazonaws.com/c2c-website/resources/certification/policy/POL_C2C_Certified_fees_FINAL_effectiveDec2016_082316.pdf, 23.08.2020; C2CPII, *Fees Schedule Cradle to Cradle Certified Products Program*, 2019, https://s3.amazonaws.com/c2c-website/resources/certification/policy/POL_C2C_Certified_fees_FINAL_011419_effective_1_May_2019.pdf, 23.08.2020.

Additional costs of certification are generated during the preparation phase when an Accredited Assessment Body should be involved as an independent assessor. In the year 2020, the total number of qualified assessment bodies included 13 organizations, but each of them calculated the costs of its service independently.

Case study – CALOSTAT

CALOSTAT, produced by Evenki Resource Efficiency GmbH is a synthetic amorphous silica panel developed for the construction sector. It is a permeable, non-flammable, and heat-insulating product certified at the GOLD level according to the Cradle to Cradle Certified Product Standard in the category Building Supply & Materials, Insulation[211]. In every single criterion

[211] Cradle to Cradle Products Innovation Institute, *CALOSTAT. Cradle to Cradle Certified Products Registry*, 24.01.2018, http://www.c2ccertified.org/products/scorecard/calostatr, 24.01.2018.

i.e.: material health, material reutilization, renewable energy and carbon management, water stewardship, and social fairness the product achieved the golden level. The Material Health Assessment Methodology certifies that CALOSTAT does not contain any problematic or unknown chemicals[212]. In particular, CALOSTAT is characterized by low thermal conductivity λ = 0,019 W/(m^2 K) which is the highest when compared with the air, polyurethanes, glass, and mineral wool, extruded polystyrene foam (XPS) and Perlite[213]. The conductivity of the 6 cm and 14 cm CALOSTAT panel is respectively 0,33 W/(m^2 K) and 0.15 W/(m^2 K)[214]. It is classified as a non-flammable building material (Class A, according to DIN 4102)[215] which can be very useful in the structures exposed to fire risk, has the lowest smoke-emission category and does not produce burning droplets. This mineral insulating material is also water-resistant, fog-resistant[216], and vapor-permeable which makes it stable in contact with water because it is free from internal vapor condensation and destruction caused by ice in winter[217]. CALOSTAT inhibits also mold development[218] which suggests that its surface is resistant to biological destruction and can keep a high level of purity.

In contrary to the majority of insulating materials on the market, CALOSTAT is recyclable[219].

Since its introduction into the market, CALOSTAT was applied successfully in many projects such as: the first-class hotel and multifunctional building CLOUD N°7 in Stuttgart, Germany (for facade insulation), the Manhattan Loft Gardens 42-storey building in London, United Kingdom (for facade insulation and fire protection), the Herzo Base II housing estate – designed as part of the Energie Campus Nürnberg – in Herzogenaurach, Germany (for thermal optimization of brickwork and construction elements).

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212 Cradle to Cradle Products Innovation Institute, *Calostat material health certificate insulation*, 2017, http://www.calostat.com/product/aerosil/downloads/calostat-material-health-certificate-insulation.pdf.

213 G. Gärtner, *Benefit of Silica technology in building application on the example of CALOSTAT*, 04.12.2016, http://web.ornl.gov/sci/buildings/2016/docs/presentations/workshops/workshop-4/Workshop4_Gartner.pdf.

214 Evonik Industries, *Calostat. Getting warmer with an innovative idea*, Evonik Industries 2016, http://www.calostat.com/product/aerosil/downloads/calostat-a-warming-idea-an-awesome-innovation-en.pdf, 18.01.2018.

215 Ib.

216 Ib.

217 Evonik Industries, *CALOSTAT. Technical Information 1404*, 2014, http://www.calostat.com/product/aerosil/Downloads/TI-1404-CALOSTAT-EN.pdf, 24.01.2018.

218 Evonik Industries, *Calostat. Getting warmer with an innovative idea*, op. cit.

219 Ib.

3.3. ENERGY STAR®

(Monika Karková)

History and development of the program

Project ENERGY STAR is a joint program of the US Environmental Protection Agency (EPA) and the US Department of Energy. This project was established in 1992 by EPA and a company of the same name was set up for its operation and implementation, which reports to the EPA, and is directly accountable to the US Government[220].

The ENERGY STAR program has its legislative form, operates under the Clean Air Act and the Energy Policy Act of 2005. Since its inception, the program has been tasked with promoting energy efficiency and providing information on the energy consumption of products and equipment; the program has its own label, which is a guarantee of energy sustainability and is awarded to products on the basis of various standardized methods. These products undergo certification tests at non-profit inspection centers and are awarded the ENERGY STAR certified mark based on strict criteria.

The ENERGY STAR certification mark is a blue square with a white outline of the star and the inscription "ENERGY STAR", and is owned by the company and certified (figure 7).

Figure 7. ENERGY STAR logo

Source: https://www.energystar.gov/, 17.08.2020.

Since its inception, this program has been run as a voluntary program to identify and promote low energy products. Initially it was intended only for computers and printers. In 1995, the program was expanded to include buildings and their heating and cooling systems, as well as new constructions. In 2000, in addition to the USA, the program was already running on the European market, Canada, Japan and Taiwan. For this reason, EPA, as the administrator of ENERGY STAR certified products, instructed members under this brand to

[220] ENERGY STAR, *Homepage ENERGY STAR Overview*, https://www.energystar.gov, 15.05.2020.

launch an annual survey of the impact of the Energy Reduction Program and the Energy Reduction Impact of ENERGY STAR[221].

As already indicated, the ENERGY STAR program was launched in 1992 as a voluntary program by the EPA in the United States and gradually entered Europe. The first products to be certified by this brand were computers and printers, which in independent tests showed reduced energy consumption by up to 20%. In 1995, the portfolio expanded considerably and gradually introduced devices such as servers, white goods, home electronics, heating and cooling systems, display devices, lighting and finally houses. In order to receive the ENERGY STAR certification, a house had to meet the basic EPA criteria and undergo an independent evaluation by certification agencies. The criteria include equipping with Energy Star-certified products and an overall energy saving of at least 15% less than the ICR 2004 standards. In the United States, by the year 2006, approximately 12% of new houses were approved by independent certification bodies and awarded the ENERGY STAR certification mark. At present, in addition to power plants and commercial buildings, residential houses, schools, offices, boarding houses, department stores and warehouses, banks, hotels and industrial facilities can also receive the ENERGY STAR certification[222].

The development of the brand, as mentioned above, has passed 4 basic milestones. The program has its development adapted to specific types of devices. Its development has gone through several versions. In general, it is possible to define several stages of development referred to as Version XY. There are 5 known versions, with each device or service having its own development history. For example, in the area of certification of modern houses that are ENERGY STAR certified, there are versions (figure 8): 1 (1995); 2TBCPhase-in (2006); 2 (2006/2007); 2.5 (2011/2012); 3 (2012). Each version includes new and improved evaluation criteria. These improved rating criteria are being modified by EPA due to ever-evolving electronics and ever-increasing environmental awareness, ensuring that Energy Star-labeled homes will continue to be more energy efficient than unlabeled buildings[223].

As in the case of households, the conditions of certification were also adjusted for computers, appliances, lighting and imaging equipment. In the case of computers, the specifics of the 2018 rating under the name EnergyStar 7.1 were last modified and refined. White goods go through the Energy Guide evaluation, which is a comparison of the annual costs of the evaluated product versus other models, and based on the result, the product can be awarded the

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[221] Ib.

[222] ENERGY STAR USA, 2020, http://www.ecolabelindex.com/ecolabel/energy-star-usa, 15.05.2020.

[223] History of the ENERGY STAR Guidelines for New Homes. https://www.energystar.gov/newhomes/how_homes_earn_label/history, 15.05.2020.

ENERGY STAR label. This Energy Guide label is created by the Federal Trade Commission and indicates that the product is ENERGY STAR certified[224].

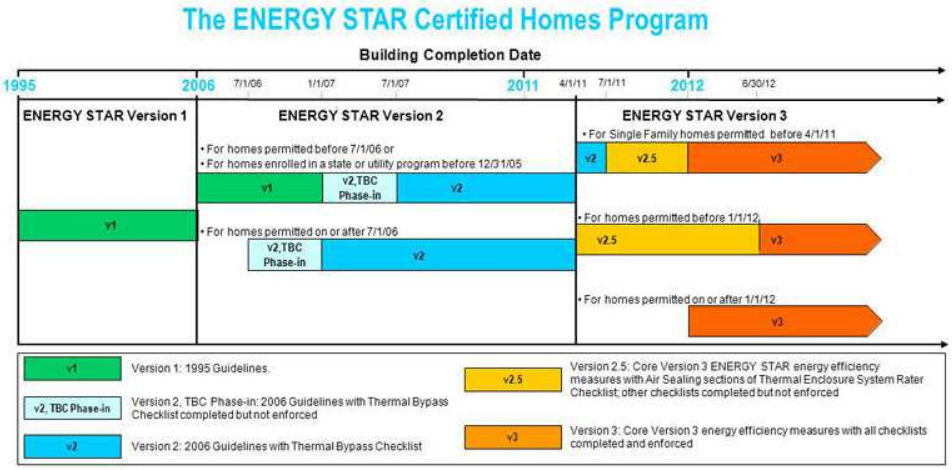

Figure 8. History of ENERGY STAR guidelines for new homes

Source: History of the ENERGY STAR Guidelines for New Homes. https://www.energy-star.gov/newhomes/how_homes_earn_label/history, 15.05.2020.

You can use the savings calculator on the ENERGY STAR website. In the case of home electronics and display devices, the certification requirements in 2011 were tightened by the EPA by adding the conditions for testing in accredited and listed certification bodies. In the field of lighting, ENERGY STAR is awarded to light bulbs that meet strict criteria of quality, efficiency and durability. In 2020, Energystar.gov published an updated guide to ENERGY STAR certificate verification[225].

The U.S. Government Responsibility Office (GAO) inspected the certification process for Energy Star-labeled products in 2010 and found discrepancies in the certification process, and the ENERGY STAR program

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[224] ENERGY STAR Program Requirements for Computers Partner Commitments. ENERGY STAR Computers Final Version 7.1 Specification. https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Computers%20Final%20Version%207.1%20Specification_0.pdf, *ENERGY STAR Program Requirements for Computers – Final Test Method (Rev. Nov-2018)*, 21.01.2020; *Learn More About EnergyGuide*, https://www.energystar.gov/index.cfm?c=appliances.pr_energy_guide, 09.11.2019.

[225] EPA Saves Money with Style, ENERGY STAR Qualified Lighting, 2018, https://www.energystar.gov/ia/new_homes/features/Lighting_062906.pdf; *Light Bulb Key Product Criteria*, https://www.energystar.gov/products/lighting_fans/light_bulbs/key_product_criteria, 12.03.2020; *The U.S. Licensed Professional'sGuide: Understanding the Roles and Requirements for Verifying Commercial Building Applications for ENERGY STAR Certification*, March 2020, ENERGY STAR, 13.06.2020; https://www.energystar.gov/sites/default/files/tools/LicensedProfGuide_March%202020.pdf, 12.04.2020.

faced allegations of fraud and abuse. For this reason, the Environmental Protection Agency has ordered third-party certification since 2011. Since then, all tests have been performed in the EPA-recognized laboratories and must all meet established criteria and be supervised by the Accreditation Authority[226].

In 2016, 1881 tests were performed on products applying for the ENERGY STAR label with a 95% overall compliance rate. Since 2017, 23 independent certification facilities and 255 laboratories have been recognized under the ENERGY STAR certification program.

The use of the ENERGY STAR label in the EU is the essence of The EU-US ENERGY STAR Agreement signed in 2001. This agreement lasted until 20.08.2018[227]. The program is implemented by Council Decision 2006/1005/EC7 and Regulation (EC) no. 106/2008 on a Community energy – efficiency labeling program for office equipment appliances labels.

Requirements and methodology of impact assessment

The ENERGY STAR program is constantly evolving and innovating in response to the ever-increasing demands for environmental protection and the efforts of product manufacturers to implement environmental policies. The EPA Agency constantly reviews and innovates the requirements and methodology for assessing the impact of individual products under the ENERGY STAR program. For this reason, it is not possible to define general criteria for all products. Specific criteria as well as a savings calculator can be found on the energystar.gov website.

Eligibility criteria for imaging equipment are governed by the International Organization for Standardization, specifically ISO standard 21632 "Graphic technology – Determination of the energy consumption of digital printing devices including transitional and related modes", Section 4, "General Conditions". The power supply method can also be used for testing and the nominal value of the power supply is recommended. All of the above conditions and procedures are set out in the document "Test Method for Determining Professional Imaging Product Energy Use Final, Rev. February-2020". However, this document is valid outside the EU. Within the EU, recognition of the ENERGY STAR brand is enshrined in the 2001-2018 agreement[228].

The new specifications introduced in 2009 are about 40% stricter than the previous ones. In addition to requirements directly related to energy efficiency,

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[226] ENERGY STAR, *Third-Party Certification*, https://www.energystar.gov/partner_resources/products_partner_resources/third_party_cert, 01.05.2020.

[227] European Commission, *ENERGY STAR*, https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-products/energy-star_en, 12.04.2020.

[228] Test Method for Determining Professional Imaging Product Energy Use Final, Rev. February-2020. ENERGY STAR Program Requirements Product Specification for Imaging Equipment, https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Version%203.0%20Final%20Professional%20Imaging%20Equipment%20Test%20Method.pdf, 13.06.2020.

these criteria also include provisions for duplexes (i.e. duplexers), which is important, given the significant environmental impact of paper use. The new criteria will speed up the transition to more energy-efficient technologies, e.g. LED backlight. The number of manufacturers interested in the ENERGY STAR brand increased significantly from 16 companies in 2006 to 74 in 2010. This sharp increase can be attributed to the 2008 procurement provisions. 60% of program participants actually cited participation in the program as the main motivation higher success in public procurement There is no data on the percentage of consumers who know the ENERGY STAR logo. There are no data in the EU on the percentage of consumers who know the importance of the ENERGY STAR brand. This is not so surprising, as the program focuses on office equipment, and therefore, on the tertiary sector, not on private consumers[229].

Green Public Procurement (GPP) criteria for imaging equipment

When defining the criteria for imaging equipment within the EU, the methodology clearly defines what display devices are and the definition of the scope.

For each examined product group, two types of criteria are given according to the methodology, namely the main and complex criteria. The main criteria are intended for contracting authorities within the EU focused on environmental impacts. Comprehensive criteria are for the public, interested in the best products available. In most cases, the individual criteria are identical and, therefore, they are listed together in table 10[230].

Table 10. GPP criterion for display devices in the EU

The main and complex criteria are the same	
Subject	Technical specifications
Purchase of energy efficient display equipment with reduced environmental impact	Duplex Multiple images on one sheet of paper Energy efficiency in use Instructions for use for ecological performance management Product life and warranty Resource efficiency for cartridges: A design solution for reusing toner and/or ink cartridges

[229] SDĚLENÍ KOMISE o provádění programu ENERGY STAR v Evropské unii v letech 2006 až 2010, KOM (2011) 337 v konečném zněníth ed. EVROPSKÁ KOMISE: Brusell, 9.6.2011, pp. 1–14, https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0337:FIN:CS:PDF, 13.06.2020.

[230] European Union, *Kritériá GPP EÚ pre zobrazovacie zariadenia*, https://ec.europa.eu/environment/gpp/pdf/criteria/imaging/SK.pdf, 12.03.2020.

Environmental marking criteria	
Main criteria	Complex criteria
Higher energy efficiency in the use mode Points will be awarded for each 5% reduction in energy consumption compared to the energy consumption set out in the technical specifications for the mode of use, measured according to the Imaging Power Test Method, Version 2.0 – May 2012 final, or equivalent methods.	Higher energy efficiency in use mode Points will be awarded for each 5% reduction in energy consumption compared to the energy consumption set out in the technical specifications for the mode of use, measured according to the Imaging Power Test Method, Version 2.0 – May 2012 final, or equivalent methods.
	Duplex Points are awarded to display devices equipped with an automatic duplex/duplex unit (duplex unit). The duplex and/or copy function is set as the default function in the original manufacturer's software.
Standby energy efficiency Points are awarded according to the power consumption of the equipment in the standby mode when connected to the network to which the equipment is connected by means of the power management or similar function. The lower the power consumption, the more points will be awarded. Power consumption must be measured according to the test method for determining power consumption for display devices, version 2.0 – May 2012 final, or equivalent method.	Standby energy efficiency Points are awarded according to the power consumption of the equipment in the standby mode when connected to the network to which the equipment is connected by means of the power management or similar function. The lower the power consumption, the more points will be awarded. Power consumption must be measured according to the test method for determining power consumption for display devices, version 2.0 – May 2012 final, or equivalent method.

Source: own work based on: https://ec.europa.eu/environment/gpp/pdf/criteria/imaging/SK.pdf, 12.03.2020.

As for display devices, requirements are set for Single Voltage External Ac-Dc and Ac-Ac Power Supplies Eligibility Criteria (Version 2.0)[231].

In addition to the Active Mode efficiency requirements found above, power supplies with greater than or equal to 100 watts input power must have a true power factor of 0,9 or greater at 100% of rated load when tested at 60Hz. Testing specifications can be found on the ENERGY STAR website under a separate document: "Test Method for Calculating the Energy Efficiency of Single-Voltage External Ac-Dc and Ac-Ac Power Supplies (August 11, 2004)"[232] (table 11 and 12).

[231] ENERGY STAR, *Program Requirements for Single Voltage External Ac-Dc and Ac-Ac Power Supplies Eligibility Criteria (Version 2.0)*, https://www.energystar.gov/ia/partners/ prod_ development/revisions/downloads/eps_spec_v2.pdf, 15.06.2020.

[232] Ib.

Table 11. Energy-Efficiency Criteria for Ac-Ac and Ac-Dc External Power Supplies in the Active Mode - standard models

Nameplate Output Power (P_{no})	Minimum Average Efficiency in Active Mode (expressed as a decimal)
0 to ≤ 1 watt	≥ 0,480 * P_{no} + 0,140
> 1 to ≤ 49 watts	≥ [0,0626 * Ln (P_{no})] + 0,622
> 49 watts	≥ 0,870

* Filament-style lamps only.

Source: own work based on: ENERGY STAR, *Program Requirements for Single Voltage External Ac-Dc and Ac-Ac Power Supplies Eligibility Criteria (Version 2.0)*, https://www.energystar.gov/ia/partners/prod_development/revisions/downloads/eps_spe c_v2.pdf, 15.06.2020.

Table 12. Energy-Efficiency Criteria for Ac-Ac and Ac-Dc External Power Supplies

Nameplate Output Power (P_{no})	Minimum Average Efficiency in Active Mode (expressed as a decimal)
0 to ≤ 1 watt	≥ 0,497 * P_{no} + 0.067
> 1 to ≤ 49 watts	≥ [0,0750 * Ln (P_{no})] + 0,561
> 49 watts	≥ 0,860

* Filament-style lamps only.

Source: own work based on: ENERGY STAR, *Program Requirements for Single Voltage External Ac-Dc and Ac-Ac Power Supplies Eligibility Criteria (Version 2.0)*, https://www.energystar.gov/ia/partners/prod_development/revisions/downloads/ eps_spec_v2.pdf, 15.06.2020.

For lighting, it is important to specify the criteria for key bulb products, which can also be found in full on the ENERGY STAR website. In the abbreviated form, they are listed in table 13[233].

Table 13. Light bulb key product criteria

Performance characteristics	Current criteria		
Efficiency		Color rendering index	Minimum lamp efficacy (initial lm/W)
	Omnidirectional	<90	80
		≥ 90	70
	Directional	<90	70
		≥ 90	61
	Decorative	65	

[233] ENERGY STAR, *Light Bulb Key Product Criteria*, https://www.energystar.gov/products/lighting_fans/light_bulbs/key_product_criteria, 15.06.2020.

Light output	Light output requirements differ for different categories, based on the incumbent incandescent bulbs. Most requirements are measured in lumens, but PAR, MR and MRX bulbs have requirements in center beam candlepower based on equivalency claim and beam angle
Correlated color temperature	Nominal CCT: 2200K*, 2500K*, 2700K, 3000K, 3500K, 4000/4100K, 5000K, 6500K
Color quality	CRI ≥ 80 and R9 > 0 for LED bulbs
Lumen maintenance	LED: Bulb must maintain minimum percentage of 0-hour light output after completion of the 6000-hr test duration, ranging from 86,7%-95,8% depending on the claimed lifetime of the bulb
Bulb life	Minimum life rating of 10000 hours for CFLs, 15000 for omnidirectional and decorative LED, and 25000 for directional LED bulbs
Dimming	Maximum and minimum light output on the dimmer, as well as flicker and noise and must dim to 20% or less
Warranty	Minimum warranty period of 2 years for bulbs with a life rating of < 15000 hours, and minimum 3-year warranty for bulbs with a life rating ≥ 15000
Allowable base types	The range is limited to bulbs with the following standard ANSI basic types: E26, E26d, E17, E11, E12, G4, G9, GU10, GU24, GU5.3 and GX5.3
Start time	The bulb must light up and remain lit continuously for 750 milliseconds after the application of electricity
Run-up time	Bulb must reach 80% of the stabilized light output in ≤ 45 seconds
Power factor	≥ 0.5 for CFL ≥ 0.6 for Omnidirectional LED bulbs with input power ≤ 10 watts ≥ 0.7 for all other LED bulbs
Rapid cycle stress test	15000 on/off power cycles
Dimensional requirements	The bulb must conform to the shape standards of the American National Standards Institute
Elevated temperature testing	Endurance test at elevated temperature inside a recessed can or test rig maintained at 45°C or 55°C

* Filament-style lamps only.

Source: own work based on: ENERGY STAR, *Light Bulb Key Product Criteria*, https://www.energystar.gov/products/lighting_fans/light_bulbs/ key_product_criteria, 15.06.2020.

Benefits and costs of participation in the program

EPA-certified products that were awarded the ENERGY STAR label in the United States in 2018 helped save 430 billion kWh of electricity, reducing greenhouse gas emissions by 330 billion tons. More than 80% of American households are equipped with ENERGY STAR certified products. The results were based on the CEE domestic survey in 2016. This brand is a guarantee of the quality of environmental protection for consumers and is, therefore, an important factor in purchasing decisions[234].

According to a 2019 report published on the EnergyStar website on energy efficiency, companies found that $8 billion had been invested in energy efficiency programs in 2018. Households that opt for ENERGY STAR

[234] ENERGY STAR, EPA Office of Air and Radiation, Climate Protection Partnerships Division (2017), National Awareness of ENERGY STAR for 2016: Analysis of 2016 CEE Household Survey, http://energystar.gov/awareness, 13.06.2020.

certification will save more than $500 on energy. In 2019, more and more than 3000 products were recognized from more than 180 manufacturers, and more than 2 million jobs in the United States are occupied by companies dedicated to the production or installation of ENERGY STAR certified products[235].

The ENERGY STAR in 2019 was awarded by EPA through 20 independent certification bodies and more than 500 laboratories that, at the EPA's request, tested 2000 products directly at retail outlets, of which 126 products failed to meet the relevant requirements[236].

Case study

Before a product is ready for the ENERGY STAR label, the product must be inspected and tested by the Department of Energy to obtain the Energy Guide label. This label represents the fact that the product meets all the standard conditions set the Ministry of Energy and provides information on the energy consumption of the appliance in comparison with other products in its category, and also shows the approximate operating costs for 1 year.

To obtain the ENERGY STAR label and successfully certify products, the product must go through a procedure. The basis is that each product must meet specified criteria that are specific to each product group and are listed on the ENERGY STAR website.

First, a product manufacturer who wants to be certified must sign up for the voluntary ENERGY STAR program on their site. Then the manufacturer applies for certification of his products. These products will be sent for testing to specialized laboratories listed by EPA as acceptable laboratories.

These laboratories, as an independent third party, will receive a basic product data file called the "Professional Imaging Equipment test Reporting Template – Instruction" which contains all the basic product data, the test laboratory and also the pre- and post-measurement information. These results are then compared with requirements of the ENERGY STAR program and then a decision is taken whether or not to award a blue label.

Decision-making processes can be illustrated through the "Verification Test Model Procedure Decision Tree", which can be found on the ENERGY STAR page in the document "Standard operating procedure for the certification and verification of products to ENERGY STAR specifications, version 3.0"[237].

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235 Lawrence Berkeley National Laboratory (2016), *Typical House Estimates. Prepared for EPA Office of Air and Radiation, Climate Protection Partnerships Division*, 13.06.2020.

236 ENERGY STAR, *Integrity Efforts for Energy Star Products*, https://www.energystar.gov/partner_resources/products_partner_resources/products_integrity, 13.06.2020; Energy Star, *About ENERGY STAR for Products*, https://www.energystar.gov/about/origins_mission/energy_star_overview/about_energy_star_products, 13.06.2020.

237 ENERGY STAR, *Standard operating procedure for certification and verification of products to ENERGY STAR Specifications Version 3.0*, 2019, https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Standard%20Operating%20Procedure%20for%20Product%20Evaluation.pdf, 09.08.2020.

In a simplified form, the certification procedure obtained from a given tree is shown in figure 9.

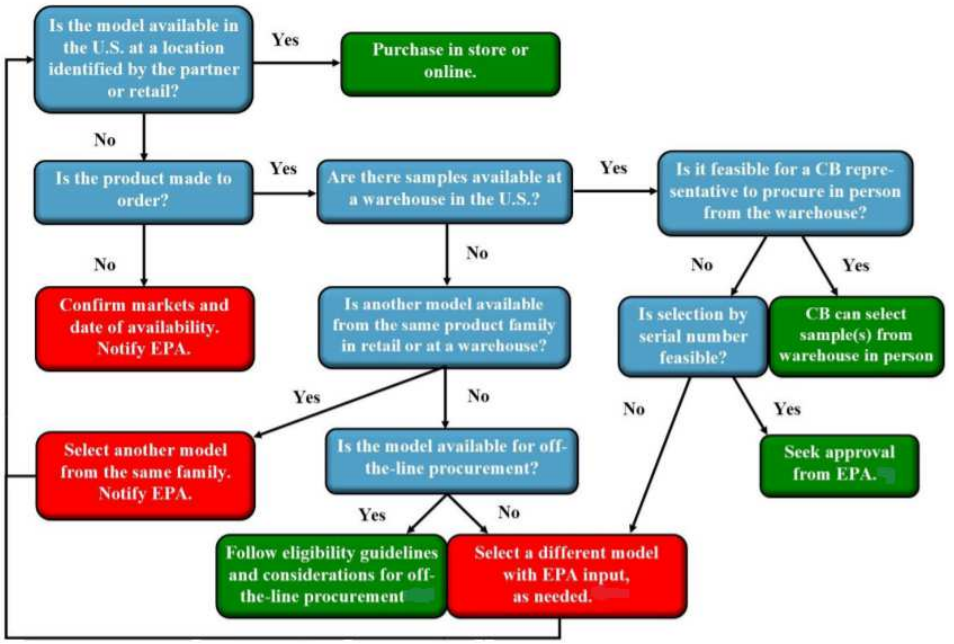

Figure 9. Verification procurement decision tree model

Source: https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Standard%20O perating%20Procedure%20for%20Product%20Evaluation.pdf, 09.08.2020.

As part of obtaining product information and measurement results, the certification process is supervised by the EPA, which is responsible for brand transparency as well as continuous updating of requirements to address the progress.

When a brand is accepted in the EU, a product with an ENERGY STAR label is inspected using the Green Public Procurement (GPP) tool. Due to the expiry of the ENERGY STAR Recognition Agreement 2006/1005/EC7 and Regulation (EC) no. 106/2008 in 2018, the European Union Regulation lays down general criteria for the recognition and approval of the use of the Ecolabel by Regulation of the European Parliament and of the Council. (EC) no. 66/2010 on the Eco Label logo.

This procedure must be followed by all companies interested in the ENERGY STAR brand. So did Alexander Lighting, a company which acquired the brand and used its prestige to increase the sales. By expanding its range of ENERGY STAR certified products, it enables you to save energy. Its marketing focuses on supporting the ENERGY STAR qualification and the use of products

at home helps the owner to save energy as well as money. Quality accessories and education in the field of saving and protection increase the benefit for the community as well as the brand and quality of work. A. Lighting believes in ENERGY STAR and promotes the idea that ENERGY STAR certified products to help builders feel more comfortable. The use of ENERGY STAR certified products helps builders compete and protect the environment. Collaborating at the local level and understanding local needs serves the building community to provide environmental benefits through reduced energy consumption and energy savings. A. Lighting is fully aware that, with support from Puget Sound Utilities, it is able to provide training to all of its builders, including information on the ENERGY STAR certified accessories, performance and features, sales and marketing tools, and local codes for housing lighting. This training prepares employees to increase sales and better help builders. The U.S. Environmental Protection Agency (EPA) statement requires that at least 60% of ENERGY STAR certified luminaires be rebuilt and contain information about the properties and benefits of the ENERGY STAR qualified products and that they comply with the EPA requirements related to the builder's name and logo, home address, savings energy, warranty information and environmental messaging. The statement may be presented on a sample basis and may be presented to homeowners when purchasing a model house or any house representing the ENERGY STAR Advanced Light Package. The keys to a successful ENERGY STAR home sales program include[238]:

1. Employee education,
2. Working with local resources – community support,
3. Wide selection of products and understanding of customer needs,
4. Promotion of the extended lighting statement as a marketing tool for the builder.

3.4. Environmental Choice

(*Marzena Jankowska-Mihułowicz*)

History and development of the program

There are three popular certification symbols in the world that contain the phrase: "Environmental Choice" and they are:

1. Environmental Choice Canada,
2. Good Environmental Choice Australia (GECA),
3. Environmental Choice New Zealand (ECNZ).

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[238] ENERGY STAR, *Alexander Lighting: Increasing Builder Sales with ENERGY STAR Residential Light Fixtures and The Advanced Lighting Package, 2009*, https://www.energystar.gov/ia/products/lighting/fixtures/Alexander_Lighting_CaseStudy.pdf?eebb-e10d, 16.08.2020.

The Environmental Choice Canada is the certification symbol in Canada that depicts three stylized pigeons that make up a maple leaf. They are intertwined and symbolize how consumers, industry, and government work together to improve the Canada's environment[239]. From 2013, the logo with pigeons was replaced by a rectangular logo with rounded corners, containing the image of the UL and EcoLogo brands and the standard certifying a specific product[240]. The EcoLogo Program is available worldwide[241].

Expanding into 2000, the Good Environmental Choice Australia (GECA) program was Australia's first product certification program, and has more Australian certified products than any other program[242].

Environmental Choice New Zealand (ECNZ) is a program that has been applied in this country since 1990[243]. ECNZ labels are presented in figures 10 and 11.

Figure 10. Environmental Choice New Zealand (ECNZ) label

Source: https://www.environmentalchoice.org.nz, 17.08.2020.

Environmental Choice New Zealand™ is the official environmental label in New Zealand and type I ecolabel[244] and guaranties the highest independent accreditation across other environmental labels in New Zealand [245].

The Vision Statement of ECNZ was planned as: "Support the New Zealand Government, businesses and consumers to transition to a sustainable and low-emissions economy by recognizing sustainably preferable products and services"[246].

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239 https://web.archive.org/web/20071125105653/; http://www.ns.ec.gc.ca/g7/eco-can.html, 12.08.2020.

240 https://blog.lalema.com/ecologo-change-logo/, 17.08.2020.

241 https://www.ul.com/about/locations, 17.08.2020.

242 https://geca.eco/about-us/, 17.08.2020.

243 https://www.environmentalchoice.org.nz/about-us/history/, 17.08.2020.

244 https://www.environmentalchoice.org.nz/about-us/about-environmental-choice-new-zealand/, 17.08.2020.

245 https://earthwise.co.nz/sustainability/#environmental-choice, 17.08.2020.

246 https://www.environmentalchoice.org.nz/about-us/about-environmental-choice-new-zealand/, 17.08.2020.

Paint
Licence No. 123456

Detergents and Cleaning Products
Licence No. 1234567

Figure 11. Examples of the correct use of the product category wording and licence number (ECNZ)

* Examples of applying the Labels ECNZ with using the CMYK formula: Green C100 Y100 Black Primary.

Source:https://www.environmentalchoice.org.nz/assets/Documents/ecnz-guide-to-using-the-label.pdf, 17.08.2020.

The mission statement of ECNZ is "To be the most trusted, recognized and sought-after ecolabel in New Zealand"[247].

"Environmental Choice New Zealand" is a brand concentrated on the following values: "trusted, independent, robust, transparent and verifiable"[248].

Important characteristics of the "Environmental Choice New Zealand" label are: local and multi-criteria assessment of products and services, independent verification, solving local environmental problems, ongoing compliance, updating of assessment criteria, and also continuous improvement[249].

Requirements and methodology of impact assessment

Anyone who manufactures a product or provides a service in a category covered by the ECNZ specification may apply for a licence to use the label. This requires meeting the conditions set out in the document entitled "Application and Licence Conditions". The first step is to apply for the Environmental Choice New Zealand licence on the application form. The application is assessed to verify whether the applicant's actions meet the relevant specification (table 14). If so, the applicant is licensed to use the label on the products or services that have been assessed.

[247] Ib.
[248] Ib.
[249] Ib.

Table 14. Specifications of the Environmental Choice New Zealand

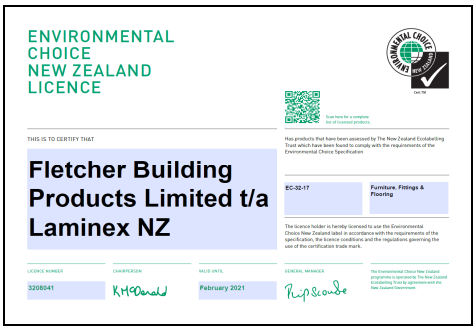
Reference	Description
EC-04-11	Wool and wool-rich pile carpets
EC-06-19	Reusable Plastic Products
EC-07-18	Paints
EC-10-14	Packaging and Paperboard Products
EC-12-14	Newsprint and Derived products
EC-13-15	Sanitary Paper Products
EC-18-17	Recycled rubber products
EC-19-15	Gypsum plasterboard products
EC-24-17	Printers, copiers, faxes and consumables
EC-25-17	Building Insulants
EC-26-15	Office Paper and Stationery
EC-29-20	Toiletry Products
EC-31-12	Textiles, skins and leather
EC-32-17	Furniture, Fittings & Flooring Furniture, Fittings & Flooring supplementary
EC-33-14	Synthetic carpets
EC-34-14	Environmental Leadership Products and Services
EC-41-15	Flat & Long Steel Products
EC-42-19	Portland Cement and Portland Cement Blend
EC-43-18	Concrete: Ready Mixed Concrete, Pre-Cast Concrete, Concrete Products and Dry Bagged Mortars
EC-45-18	Cleaning Services
EC-47-11	Wool Scouring Services
EC-52-12	Fitness Centre Services
EC-53-12	Chemicals
EC-54-13	Office activities
EC-55-12	Recycling for imaging consumables
EC-56-14	End of Life Services for ITT Equipment
EC-57-16	Pre-painted and Resin Coated Steel Products
EC-58-19	Detergents and cleaning products Detergents and cleaning products supplementary
EC-59-19	Construction & Demolition Waste Services

Source: own work based on: https://www.environmentalchoice.org.nz/specifications/published-specifications/, 17.08.2020.

The next step in the licensing process is to establish the schedule for servicing the licence certificate. The schedule will include: contact details, licence number, licence issue date, information on product or service specifications and a list of them. Then the licence supervision plan is defined. The licensee is informed before any checks are carried out. He also agrees to conduct an inspection and must keep documentation confirming compliance with the relevant specification and licence conditions. Verifiers may take or request product, material and waste samples to confirm that the applicable

specification is met. Thereafter, the label can be used on the packaging of the licensed product or a service[250].

An example of the ECNZ licence (obtained by enterprise Laminex New Zealand®) was presented in figure 12. All companies with ECNZ licensed products can be checked on the ECNZ website[251].



page 1

page 2

Figure 12. Example of the certificate of the Environmental Choice New Zealand

Source: https://store.laminex.co.nz/medias/Laminex-New-Zealand-Environmental-Choice-NZ.pdf, 17.08.2020.

The content of the presented licence is as follows (figure 12): "This is to certify that Fletcher Building Products Limited t/a Laminex NZ has products that have been assessed by The New Zealand Ecolabelling Trust which have been found to comply with the Environmental Choice Specification EC-32-17 Furniture, Fittings & Flooring. The licence holder is licensed to use the Environmental Choice New Zealand label under the requirements of the specification, the licence conditions and the regulations governing the use of the certification trademark. Laminex New Zealand® has a range of environmentally preferred products that have been awarded the Environmental Choice New Zealand certification. These products are:

1. Raw board products:

Lakepine® EO medium density fibreboard (MDF)
- Standard
- Moisture Resistant (MR)
- Light / Ultralight

Superfine® Particleboard
- Standard
- Moisture Resistant (MR)

250 Ib.

251 https://www.environmentalchoice.org.nz/our-licensees/, 17.08.2020.

2. Low pressure laminate:
Melteca® Standard
- on Superfine Particleboard
- on ECNZ-licensed MDF
Trade Essentials® Whiteboard
- on Superfine Particleboard
- on ECNZ-licensed MDF"[252].

The enterprise participation in the ECNZ program has both benefits and costs, which are discussed in the next section of this chapter.

Benefits and costs of participation in the program

Environmental Choice New Zealand program of products or service accreditation brings a range of benefits to stakeholders, such as: licensee organizations, their customers, consumers and entire community[253].

The licensee organization as the product or service provider stands out from the competition thanks to the ECNZ label. This labelling raises the company's credibility, prestige, gives it a good environmental reputation, and guarantees that its products are Government-backed[254] environmental, and throughout their entire life cycle, have a less negative impact on the environment than non-labeled products. After implementation of ecolabels the company is perceived as socially responsible in the environment. For these reasons, it gains recognition of the ecologically conscious end-consumers, who are more likely to buy products or use the services of such an enterprise. Ecolabelling is the reason for the loyalty of such buyers. Implementation of sustainable development policy, i.e. taking responsibility for the natural environment, makes employees willingly engage in their duties and it is relatively easier to achieve and retain new employees. Employees can be proud that their company cares about natural resources. The constant and rigorous compliance with environmental regulations by producers also earns the recognition of the community[255].

Maintaining the ECNZ licence requires a lot of effort from the enterprise – keeping up with changes in environmental regulations, eliminating waste, thoughtful initiatives for sustainable development, constant readiness to undergo the evaluation and improving processes. The above activities translate into stable functioning and development of the enterprise in the long term, and thus also – into an increase in sales and economic benefits[256]. Enterprises with products

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252 https://store.laminex.co.nz/medias/Laminex-New-Zealand-Environmental-Choice-NZ.pdf, 17.08.2020.
253 https://www.environmentalchoice.org.nz/get-licensed/licence-benefits/, 17.08.2020.
254 https://www.mfe.govt.nz/more/community-and-public/about-environmental-choice-new-zealand-eco-label, 17.08.2020.
255 https://www.environmentalchoice.org.nz/get-licensed/licence-benefits/, 17.08.2020.
256 Ib.

covered by the ECNZ licence are promoted on the ECNZ website[257], which is of marketing and strategic importance.

Thanks to the ECNZ program "the label tells the story", which means that choosing a product or service ecologically requires relatively little effort and cost from the customer to get sustainability information. Customers who buy an ECNZ labelled product benefit from the reflected glory of the environmental strengths of the manufacturer or service provider[258].

The entire New Zealand community benefits from the Environmental Choice program of products or service accreditation – from reduced waste, increased recycling and awareness of eco-responsible[259].

Obtaining and maintaining the ECNZ licence requires incurring costs specified in the program.

From 1 July 2019, the following prices were applicable to all new licensees using the ECNZ label, as follow[260]:

1. Application fee: $750 + Goods and Services Tax[261] (GST) – with the exception of EC-34-14,
2. Application fee for products under EC-34-14: $1500 + GST,
3. Initial verification fees,
4. Supervision fee (once per year): cost of the control and administration charge – extra 5%,
5. Annual licence fee, to use ECNZ label (table 15),
6. Annual licence fee schedule office size (table 16).

Table 15 presents the annual licence fee, based on the declared annual net sales value of all products which are licensed to use ECNZ label.

The annual licence fee schedule regarding office size was presented in table 16.

In the conditions of increasing exploitation of the Earth's natural resources and the constant warming of the climate, caring for the natural environment is a current and important problem for humanity. Implementing environmental accreditation programs for products and services is important in educating customers and increasing their awareness and responsibility in everyday consumption. Regardless of the effort and costs that must be incurred to implement these programs, it is important to emphasize their importance and profitability for the entire human population.

Every company that strives to label its own products or services with ecological labels, uses ecological programs and following a circular economy approach – is in line with the current, important and very fashionable trend in the market.

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257 https://www.environmentalchoice.org.nz/our-licensees/, 17.08.2020.
258 Ib.
259 Ib.
260 https://www.environmentalchoice.org.nz/get-licensed/our-fees/, 17.08.2020.
261 In New Zealand it's 15% and it applies to all products and services.

Table 15. Annual licence fee, to use the Environmental Choice New Zealand label

Cost category	Declared total annual net sales for all licensed products [$]	Annual licence fee (plus GST) [$]	Annual licence fee (plus GST) [€]
1.	0-100000	1000	840
2.	100001-1000000	2500	2099
3.	1000001-2000000	4000	3359
4.	2000001-3000000	6000	5038
5.	3000001-4000000	8000	6718
6.	4000001-5000000	10000	8397
7.	5000001-10000000	13000	10916
8.	10000001-15000000	16000	13435
9.	15000001-25000000	19000	15954
10.	25000001-40000000	22000	18473
11.	40000001-70000000	25000	20993
12.	70000001-100000000	28000	23512
13.	100000001-300000000	32000	26870
14.	300000001 and more	36000	22111

Source: own work based on: https://www.environmentalchoice.org.nz/get-licensed/our-fees/, 17.08.2020.

Table 16. Annual licence fee schedule office size

Cost category	Office activities (EC-54) Fee schedule office size [head count]	Annual licence fee (plus GST) [$]	Annual licence fee (plus GST) [€]
1.	5-9	1000	840
2.	10-19	2500	2099
3.	20-49	6000	5038
4.	50-99	10000	8397
5.	100-249	16000	13435
6.	250-499	25000	20993
7.	500 and more	36000	22111

Source: own work based on: https://www.environmentalchoice.org.nz/get-licensed/our-fees/, 17.08.2020.

Case study – Laminex New Zealand®

Laminex New Zealand®[262] is one of many companies, which have implemented the ECNZ program.

Laminex New Zealand® offers decorative surfaces and panel products such as: bench-tops, cabinetry, structural flooring, wall lining and commercial joinery. It has over ten years of experience in the field of certification, sustainable development and environmental protection, and also supporting

[262] https://www.laminex.co.nz/, 17.08.2020.

Green Building projects. Since mid-2013, there has been a full-time Sustainability Advisor in the company. This led to the company's understanding of sustainability, the improvement of many processes, and the gaining of importance and market leadership. The ECNZ licence obtained by Laminex New Zealand® in the ranges – Initiative: Furniture & Fittings; Licensee: (EC-32-17) Furniture, Fittings & Flooring –was presented in figure 12 and also on the ECNZ website [263]. Market research compiled by EBOSS has shown that ECNZ is valued by over a third of architects as "very important"[264].

Laminex New Zealand® has developed the GREENfirst™ program, which includes the company's many environmental management programs, in line with the philosophy: "a company needs to be responsible for its actions – socially, ethically, and environmentally"[265].

The challenges posed by the managers of the described enterprise were to produce great products using low-emission methods and environmentally friendly raw materials and to communicate this to the market and prove it. The company's strategies, based on strong environmental ethics, ensure the use of raw materials and fuels from recycled materials, the use of biomass and the introduction of new technologies aimed at energy efficiency. In the management of waste from production processes, industrial worm farming for organic waste is used. Organic waste and wood waste are sources of bioenergy; they reduce vehicle traffic and the company's need for fossil fuels. Thanks to this solution, wood dust as waste from the production process, which used to be the source of the problem and costs, is now a high-energy source of fuel. During the production of Superfine® chipboards and Melteca® laminated panels, the manufacturer not only meets but probably exceeds, low-emission standards and has waste minimization and energy management processes in place[266].

About the low emissions and safety challenges of manufacturing reconstituted wood products and low-pressure laminates, former General Manager Jerome Deperrois said: "It is one of the real benefits of the Environmental Choice New Zealand (ECNZ) certification process; there is no stone unturned and Laminex NZ is required to provide evidence to support any claims. Whether it's through material safety data sheets (MSDS), energy and waste data, ACC Partnership details, emissions tests, or inspections, there is no hiding with ECNZ certification. The manufacturing sites at Taupo and Hamilton are audited annually and while this has been ongoing for many years, passing these supervision audits are never taken for granted. Every aspect of the business is reviewed and the auditors are adept at identifying opportunities for

263 https://www.environmentalchoice.org.nz/our-licensees/3208041-laminex-new-zealand/, 17.08.2020.
264 https://environmentalchoice.org.nz/our-news/case-studies/laminex/, 17.08.2020.
265 Ib.
266 Ib.

improvement. We welcome this – we are in the business of constant improvement"[267].

Commitment to environmental protection is one of Laminex New Zealand's primary goals. These goals are achieved by managing the production, warehouse and corporate offices processes in such areas as[268]:

1. Resource management – e.g. Chain of Custody certification of Forest Stewardship Council (FSC®), for all local manufacturing plans, with the entire supply chain, guarantees that all certified wood products are produced using responsibly sourced wood fibers,
2. Waste management – e.g. thanks to the program "Packaging take-back scheme" over 180 tons of waste are removed from landfills every year. The program also helps customers to reduce the amount of waste sent to landfills. Such significant results are a result of implementation of the media return program for cover sheets and pallets used for packing and transporting orders,
3. Energy consumption – e.g. the "Turning wood waste into energy" program allows for the removal of approximately 72 containers of wood waste from a landfill per day (approximately 1000 tons per year). This is because of the construction of an innovative "briquette machine", which compresses the grinding dust from the production of chipboards and transforms it into energy bricks. Thanks to this activity, the amount of waste in landfills is reduced and the emission of greenhouse gases to the environment is eliminated.

Laminex New Zealand® facilities have a detailed annual sustainability plan designed to reduce the company's environmental impact and involve employees in it. Laminex New Zealand® is an active member of the Sustainable Business Network and the NZ Green Building Council[269]. Because of implementing the ECNZ program, Laminex New Zealand® gets the highest ratings for its products according to the criteria used by The New Zealand Green Building Council and alternative to ECNZ programs: the Green Star and Homestar[270]. This shows the objectivity of the ECNZ certification.

There are occasions where ECNZ certification of Laminex New Zealand® has enabled its customers to follow a more streamlined process to their certification. Good Laminex New Zealand® practices disseminate themselves in the business environment, recipients learn from the supplier, raise their standard of excellence, which is an added value from the use of the ECNZ program[271].

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267 Ib.
268 https://www.laminex.co.nz/about-laminex/sustainability, 17.08.2020.
269 Ib.
270 https://environmentalchoice.org.nz/our-news/case-studies/laminex/, 17.08.2020.
271 Ib.

3.5. EU Ecolabel

(Juraj Šebo)

History and development of the program

Established in 1992 and recognized across Europe and worldwide, the EU Ecolabel is a label of environmental excellence that is awarded to products and services meeting high environmental standards throughout their life cycle: from raw material extraction, to production, distribution and disposal. It also encourages producers to generate less waste and CO2 during the manufacturing process, and to develop products that are durable, easy to repair and recycle[272]. The EU Ecolabel is not an award given to a single product, but a benchmark for 10-20% of environmentally preferred products within a certain product group[273]. From a consumer's perspective this life cycle approach guarantees that the products' main environmental impacts are reduced in comparison with similar products on the market, and fitness-for-use criteria also guarantee good product performance[274]. No technical understanding is required for customers to read and understand the EU Ecolabel, so it is easy for them to make an environmentally friendly choice[275]. For example, in the case of washing-up liquids, the EU Ecolabel minimizes the use of hazardous substances and substances harmful to the aquatic environment, and supports highly biodegradable substances and reduced packaging[276]. Another advantage of the EU Ecolabel is that it goes beyond the pre-existing national ecolabels that are often known only within national borders[277]. Alongside the progression towards a single market, the EU Ecolabel and national ecolabels, such as the Blue Angel or the Nordic Swan, coexist well and are developing a policy of cooperation and coordination. Some interconnections can be seen when new criteria are developed for the EU Ecolabel. In this situation other officially recognized ecolabelling schemes in the Member States should take into account the existing criteria. If we compare the EU Ecolabel with the EU Eco-Management and Audit Scheme (EMAS), it is focused on specific products/services of a company, not on the general environmental performance of the company. In relation to other EU policies, EC recognizes great synergies between the EU Ecolabel and Green Public

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[272] European Commission, *Environment: Ecolabel*, 2020, https://ec.europa.eu/environment/ecolabel/, 10.08.2020.

[273] European Commission, *Environment: Ecolabel: Criteria Development and Revision*, 2019, https://ec.europa.eu/environment/ecolabel/criteria-development-and-revision.html, 10.08.2020.

[274] European Commission, *Environment: Ecolabel: EU Ecolabel for Consumers*, 2019, https://ec.europa.eu/environment/ecolabel/eu-ecolabel-for-consumers.html, 12.08.2020.

[275] European Commission, *Environment: Ecolabel: Frequently Asked Questions*, 2020, https://ec.europa.eu/environment/ecolabel/faq.html#ecolabel-products, 12.08.2020.

[276] European Commission, Environment: Ecolabel: EU Ecolabel for Consumers, op. cit.

[277] European Commission, Environment: Ecolabel: Frequently Asked Questions, op. cit.

Procurement (GPP) and the Environmental Compliance Assistance Programme for SMEs (ECAP)[278].

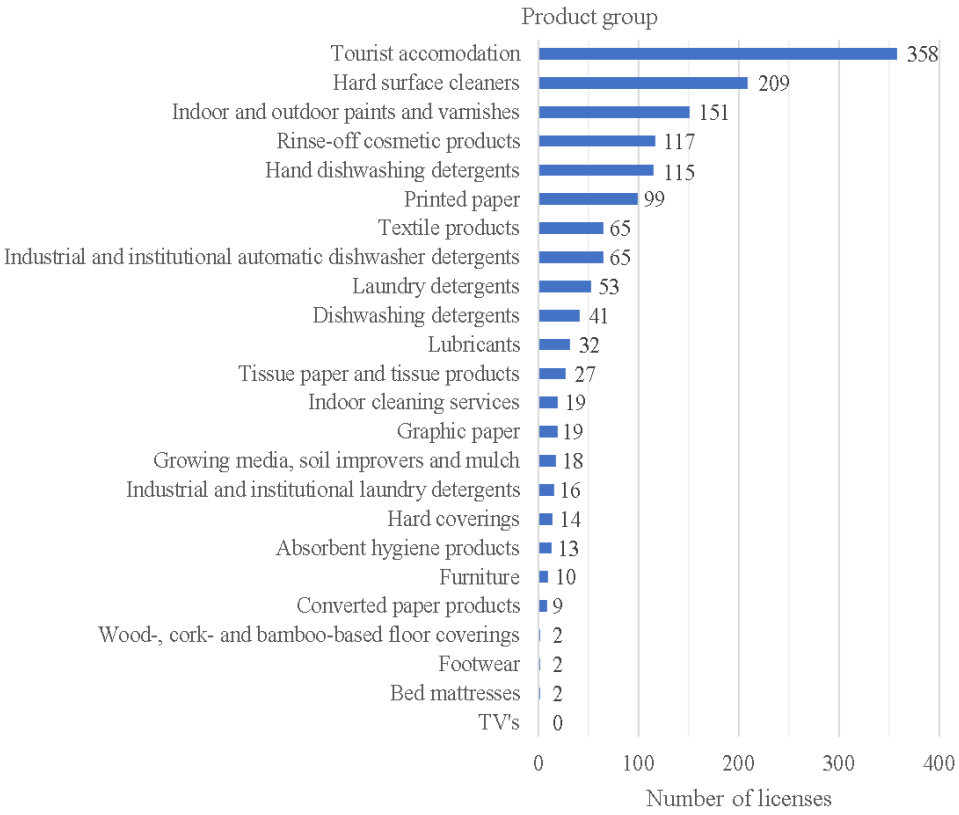

Figure 13. EU Ecolabel licenses per product group

Source: own work compiled on the basis of: European Commission, *Environment: Ecolabel: Facts and Figures,* 2020, https://ec.europa.eu/environment/ecolabel/facts-and-figures.html, 10.08.2020.

By March 2020, 1456 licenses were granted to 70692 products (goods and services) in 24 different EU Ecolabel product categories (figure 9). The highest number of awarded products is in the do-it-yourself category (42335), followed by paper products (7623), clothing and textiles (7101), cleaning up (5875), coverings (4131), personal care products (2597), furniture and bed mattresses (500), holiday accommodation (385), gardening (145) and electronic displays (1). Despite an overall 10% decrease in the total number of products, mainly due to the expiration of old licenses, some EU Ecolabel product groups have witnessed an increase in the number of products in comparison to September 2019. The fastest growing product categories over the past six months are

[278] Ib.

furniture (+645%), floor coverings (+116%), indoor cleaning services (+111%) and hard surface cleaning products (+77%). On the other hand, the evolution of Television products between 2014 and 2020 shows a steep decrease from above 2500 (2014) to 0 (2018-2020). If we look at the regional distribution, Spain with its 27018 award-winning products ranks high above other European countries. Other countries, but with a substantially lower number of awarded products include France (7226), Germany (6053), Italy (5751) and Sweden (4597). At the end of the list there are countries with less than 10 awarded products. Bulgaria has 9 awarded products, then there is Malta (6), the Slovak Republic (5), Latvia (4), Luxembourg (1) and Iceland (0)[279].

Requirements and methodology for impact assessment

EU Ecolabel criteria for products focus on the life cycle stages where the product has the highest environmental impact. This differs from one product to another. For example, textiles have a strong environmental impact when they are dyed, printed and bleached; the impact of detergents depends on the substances used and the impact of electronic equipment during their use phase depends on their energy consumption. In addition to this, product-specific criteria ensure that each product bearing the EU Ecolabel is of good quality and high performance[280].

The EU Ecolabel criteria address 5 main environmental hotspots[281]:

1. The environmental impact of toxic substances (e.g. no chlorine gas is used as a bleaching agent for graphic and copying paper),
2. Deforestation and degradation (e.g. wood, etc. used in furniture must be non-GMO and have a sustainable forest management label),
3. Poorly managed waste disposal and lack of recycling (e.g. tourist accommodations must establish a food waste management plan, etc.),
4. Inefficient use of resources (water, energy, raw materials etc.) and products (food waste, overuse of detergents, etc.) (e.g. the maximum threshold for electricity and fuel consumption during the product manufacturing of floor coverings),
5. Unnecessary carbon emissions (e.g. propellants in sprays are prohibited for industrial and institutional dishwashers).

The development of the EU Ecolabel criteria is executed in a transparent multi-stakeholder process. Scientists and industry experts across a wide range of sectors and impartial non-governmental organizations participate in the development of rigorous environmental and fitness-for-use criteria. Every set of

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279 European Commission, *Environment: Ecolabel: Facts and Figures*, 2020, https://ec.europa.eu/environment/ecolabel/facts-and-figures.html, 10.08.2020.

280 Ib.

281 European Commission, *Environment: Ecolabel: What hides behind the EU Ecolabel?* 2019, https://ec.europa.eu/environment/ecolabel/did-you-know.html, 12.08.2020.

criteria undergoes several rounds of discussions between these stakeholders. Criteria are finally adopted through a Decision of the European Commission[282].

The development and revision of EU Ecolabel criteria could be initiated by the European Commission (EC), Member States, Competent Bodies and other stakeholders, following consultation with the European Union Ecolabelling Board (EUEB). Criteria development is a multi-step process. These stakeholders could propose new product/service group. Before submitting a proposal, they must check if the proposed group is not already included within the scope of an existing group and if products are not medicinal devices/products or food items which are excluded from the EU Ecolabel. If the new product/service group is suitable for EUEB, the EC may open a call for proposals to carry out its criteria development process. The criteria development process could be run by a stakeholder or other party with the following required qualifications: expertise, neutrality, capability of building up a consortium, scientific skills to draw up reports, manuals and criteria. This process (from start to finish) takes 2 years on average [283].

Currently, three more product groups are under development. The first group is titled "Financial products" and the EC has started the development of its criteria in October 2018. The second group is titled "Food and feed products?". For this group EC has undertaken a feasibility study regarding the criteria development. Based on the study and the opinion of the EUEB the EC does not intend to develop the criteria for this product group. The third group is titled "Office Buildings". According to the official EU Ecolabel website information the work on the criteria has temporarily been put on hold while the EC develops a framework with core indicators for the assessment of the environmental performance of buildings[284]. In addition to this "Detergents for professional use" and "Taps and shower heads" are other new product groups mentioned in official EU Ecolabel websites[285].

The development of the criteria for each product group to reduce the main environmental impacts throughout the entire life cycle of the product is carried out by key experts in consultation with the main stakeholders. The criteria are revised on average every four years, in other words they are usually valid for a period of 3 to 5 years, depending on the EC decision for each product group. It is important to reflect on the evolution of materials, innovation in production processes, emission limits and changes in the market[286]. Ecological criteria are reviewed prior to their expiration and may be modified. If the criteria are

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[282] European Commission, *Environment: Ecolabel: Frequently Asked Questions*, 2020, https://ec.europa.eu/environment/ecolabel/faq.html#ecolabel-products, 12.08.2020.

[283] European Commission, *Environment: Ecolabel: Criteria Development and Revision*, op. cit.

[284] European Commission, *Environment: Ecolabel: Product Groups and Criteria*, 2020, https://ec.europa.eu/environment/ecolabel/products-groups-and-criteria.html, 12.08.2020.

[285] European Commission, *Environment: Ecolabel: Frequently Asked Questions*, op. cit.

[286] European Commission, *Environment: Ecolabel: Product Groups and Criteria*, op. cit.

revised, license holders need to renew their contracts; if they are extended, the contracts are automatically renewed. A 12-month transition period is usually given to the existing license holders to comply with the new criteria. The holders may use the EU Ecolabel starting from the date it is awarded until the end of the period of the validity of the criteria[287].

As has been mentioned above different products require different criteria. In view of the large number of EU Ecolabel product groups which meet different criteria, , only the criteria for the product group "Footwear" will be discussed in this part as an example. In general, once the EU Ecolabel is placed on the Footwear product it guarantees the natural origin of sustainably managed raw materials, reduction of pollution in production processes, minimization of the use of hazardous substances and the confirmation that their durability has been tested. From the point of view of life cycle stages, the applicant can quickly check if its product fulfils the requirements related to the product manufacturing and use. During the manufacturing stage, the types of materials, water consumption, emissions, hazardous substances and corporate social responsibility are important criteria. In the case of the criterion such as types of materials , the requirements for cotton that are not recyclable fibers must specify the minimum content of either organic cotton or integrated pest management cotton; the whole wood and cork must be covered by the chain of custody certificates, minimum of 25,0% of the non-recycled pulp fibers must be manufactured from wood that is grown according to the principles of sustainable forest management, etc. With regards to the criteria for water consumption and emissions, the requirements for reducing water consumption in the tanning process must apply. Furthermore, the chemical oxygen demand (COD) value in post-treatment wastewater from leather tanning sites shall not exceed 200,0 mg/l and the total chromium concentration in tannery wastewater after treatment must not exceed 1,0 mg/l. In the case of hazardous substances, for example, the final products, homogeneous materials or articles that form a part of the final product, or the production recipes used, as applicable, must not contain substances specified under the Restricted Substances List and the total use of volatile organic compounds (VOCs) in the final footwear production shall not exceed, on average, 18,0 g VOC/pair. In the use stage, packaging, user information and durability are important criteria. With regards to the packaging, e.g. cardboard and paper used for the final packaging of footwear should be made of 100% recyclable materials. In the case of user information, the following information must be supplied with the product: cleaning and care instructions specified for each product, that is, 'Repair your footwear rather than throw it away. This is less damaging to the environment'. In the case of the durability criterion, e.g. occupational and safety footwear should carry the CE mark and meet the

[287] European Commission, *Environment: Ecolabel: Frequently Asked Questions*, op. cit.

durability requirements specified in accordance with Directive 89/686/EEC[288]. The full list of criteria for the footwear products is included in table 17.

Table 17. Criteria for assessment according to the EU Ecolabel, example of the footwear product group

List of criteria
Criterion 1 – Origin of hides and skins, cotton, wood and cork, and man-made cellulose fibers
1.1 – Requirements on hides and skins
1.2 – Cotton and other natural cellulosic seed fibers
1.2(a) – Organic production standard
1.2(b) – Cotton production according to IPM principles and restriction on pesticides
1.3 – Origin of wood and cork
1.4 – Man-made cellulose fibers (including viscose, modal and lyocell)
1.5 – Plastics
Criterion 2 – Reduction of water consumption and restrictions in tanning of hides and skins
2.1 – Water consumption
2.2 – Restrictions in tanning of hides and skins
Criterion 3 – Emissions to water from the production of leather, textile, and rubber
3.1 – Chemical Oxygen Demand (COD) in wastewater from leather tanning sites
3.2 – Chemical Oxygen Demand (COD) in wastewater from textile
3.3 – Chemical Oxygen Demand (COD) in wastewater from processing of natural and synthetic rubber
3.4 – Chromium in tannery waste water after treatment
Criterion 4 – Volatile Organic Compounds (VOCs)
Criterion 5 – Hazardous substances in the product and shoe components
5.1 – Restriction of Substances of Very High Concern (SVHC's)
5.2 – Restriction based on CLP hazard classifications
Criterion 6 – Restricted Substances List
Criterion 7 – Parameters contributing to durability
Criterion 8 – Corporate Social Responsibility with regard to labor aspects
Criterion 9 – Packaging
Criterion 10 – Information on the packaging
10.1 – User Instructions
10.2 – Information appearing on the eco-label

Source: own work based on: European Commission, *EU Ecolabel Footwear: User manual*, 2016.

The Regulation on the EU Ecolabel allows manufacturers, producers and retailers coming from European or non-European countries to apply for the EU Ecolabel for their products. Owners/operators of tourist accommodation or campsite services from non-European countries can apply for the EU Ecolabel, but their services must be provided on the European market[289].

[288] European Commission, *The EU Ecolabel for Footwear products*, 2017.
[289] European Commission, *Environment: Ecolabel: Frequently Asked Questions*, op. cit.

The application process consists of the following steps[290]:

1. Pre-application: understanding the EU Ecolabel. Every product/service supplied for distribution, consumption or use in the European Economic Area (excluding food and medical device/product groups), is eligible for the EU Ecolabel. In general producers, manufacturers, importers, service providers, wholesalers and retailers (for products placed on the market under their own brand name) are eligible to apply,
2. Contact with a national Competent Body. Once the applicant found the criteria relevant to its products/services, it should contact a Competent Body, which is an independent organization that manages the EU Ecolabel on the national level. It provides guidance regarding the documents needed,
3. Product and service registration in the online EU Ecolabel Catalogue. The catalogue is a database that is designed to provide stakeholders with the lists of valid products/services per producer and retailer, along with the corresponding product/service information,
4. Product and service testing to build an application dossier. The list of relevant declarations, data sheets and test results is laid out in each product/service group User Manual. The Competent Body verifies all the submitted information and carries out further tests if necessary. All costs related to the tests and independent verification with regards to the compliance with the criteria are covered by the applicant. Product tests should be preferably performed by laboratories that meet the general requirements of EN ISO 17025 or equivalent, for that specific test,
5. Application submission and fees. The costs of running the scheme vary between Competent Bodies and from one product to another, so the fees may vary accordingly. Table 2 presents the requirements related to maximum fees established in the EU Ecolabel Regulation,
6. Assessment. The Competent Body examines the whole submitted documentation and may request additional documentation. Upon receiving the application, the Competent Body should assess the applicant´s product against the criteria set for it within two months, but any missing documentation can delay the assessment process[291]. The Competent Body may reject an application, if sufficient documentation is not sent within 6 months. After the entire documentation has been approved, the Competent Body may carry out an on-site visit to the applicant or applicant suppliers' sites and charge a fee for it,
7. Application approval and license award. The Competent Body issues the contract and license upon approving the application. This contract specifies the services or range of products covered by the license and the

[290] European Commission, *Environment: Ecolabel: How to apply for EU Ecolabel*, 2020, https://ec.europa.eu/environment/ecolabel/how-to-apply-for-eu-ecolabel.html, 12.08.2020.

[291] European Commission, *Environment: Ecolabel: Frequently Asked Questions*, op. cit.

terms of use of the EU Ecolabel. Once the contract is signed, a certificate will be sent. The EU Ecolabel certificate contains the following important details[292]: the license number that can be used with the EU Ecolabel logo, the legal name of the applicant, the services or range of products for which the EU Ecolabel was awarded and all relevant trade names under which the product is sold or the service is marketed. Within the framework of compliance monitoring, it is the responsibility of the license holder to ensure criteria compliance throughout the entire validity of the license(s). Product tests or factory inspections could be needed or carried out. The competent body could request an immediate Corrective Action Plan or prohibit the use of the EU Ecolabel, if there is violation of the criteria,

8. Communication about EU Ecolabel products and services. The license holder can take full advantage of the EU Ecolabel through advertising and communication by ensuring that the EU Ecolabel logo and license number are visible on a product/service and in related promotional materials, websites or in social media. The EU Ecolabel Catalogue, official EU Ecolabel publications and websites are also a viable marketing tools to promote products/services to consumers. The EU Ecolabel Logo is protected by EU law. When using the logo several rules and restrictions apply: the logo cannot be modified, mixed with other pictures/logos/texts, both the logo and the license number box should appear on the product/service packaging or in marketing materials, and it should also be visible and legible and not smaller than 10,6 x 10,6 mm.

If some of the characteristics of a EU Ecolabel product change, the license holder does not need to submit a new application, if the new characteristics do not affect the compliance with the criteria[293].

Benefits and costs of participation in the program

The benefits resulting from implementation of the EU Ecolabel include[294]:

1. The purpose is to facilitate the customer's (business or individual) choice in favor of an eco-product,
2. Recognition across Europe; it enhances the reputation of the license holder, indicates the corporate social responsibility,
3. The E-Catalogue, where the license holder should register the product/s, gives the opportunity to get through to the customers,
4. The monthly EU Ecolabel News Alert and biannual Flower Newsletter often feature outstanding companies, providing a great marketing opportunity,

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292 European Commission, *Environment: Ecolabel: How to apply for EU Ecolabel*, op. cit.
293 European Commission, *Environment: Ecolabel: Frequently Asked Questions*, op. cit.
294 Ib.

5. The simple (possibly online) application process,
6. Special discounts for SMEs, micro-enterprises, applicants from developing economies and companies registered under EMAS or certified under ISO 14001.

As mentioned above, the costs of running the scheme vary between Competent Bodies and from one product to another, so the fees may vary accordingly. Table 18 presents maximum fees established in the EU Ecolabel Regulation.

Table 18. Maximum fees established in the EU Ecolabel Regulation

Type of applicants	One-off application fee [€]*	Annual fee [€]**
Micro-enterprises	200-350	Max 18750
SMEs and firms from developing countries	200-600	Max 18750
All other companies	200-2000	Max 25000
* 30% reduction for companies registered under EMAS or 15% reduction for companies certified under ISO 14001 can be applied. Reductions are not cumulative and only the higher reduction applies where both systems are met. ** Annual fees can be a flat fee or a fee based on the annual value of sales within the EU for the product awarded the EU Ecolabel. Where the annual fee is calculated as a percentage of the annual sales value, it will not be more than 0.15% of that value. In the case of SMEs, micro-enterprises or applicants from developing countries, the annual fee is reduced by at least 25%.		

Source: own work based on: European Commission, *Environment: Ecolabel: How to apply for EU Ecolabel*, 2020, https://ec.europa.eu/environment/ecolabel/how-to-apply-for-eu-ecolabel.html, 11.08.2020.

Case study – Kavat

The Swedish company Kavat is one of the first footwear companies, which acquired the EU Ecolabel, and with its 50 ecolabelled models also one of the most eco-friendly manufacturers in Europe. In industry where supply chain complexity makes it difficult for a company to be transparent, Kavat decided to "tell the truth" to its customers, and this transparency pushed it to improve its controls on every step of the value chain. In today's world, where most leather products are treated with chrome, heavy metals and coloring dyes, which bleed into rivers and ecosystems, degrading them along the way, Kavat innovate and its "Eco Performance leather" is waterproof, chrome-free and with great breathability. The company also follows the EU Ecolabel recommendation of offering a "Repair Service" for worn-out shoes. Finally, Kavat turns to the EU Ecolabel criteria for guidance on eco-friendly best practices when developing any of its product lines, e.g. new models of rainboots and leather boots[295].

[295] European Commission, *Environment: Ecolabel: Success Stories*, 2019, https://ec.europa.eu/environment/ecolabel/documents/Success_story_Kavat.pdf, 12.08.2020.

3.6. FSC

(*Igor Budak, Boris Agarski, Milana Ilić Mićunović*)

The Forest Stewardship Council (FSC) system is a global certification scheme, founded in 1993 to support and verify environmentally, socially, and economically beneficial forest management practices[296]. FSC is established with the mission "to promote environmentally appropriate, socially beneficial, and economically viable management of the world's forests"[297]. The stated vision of the FSC is the recognition of the true value of forests which is fully incorporated into society worldwide, with the FSC as "the leading catalyst and defining force for improved forest management and market transformation, shifting the global forest trend toward sustainable use, conservation, restoration, and respect for all"[298].

The purpose of FSC labels is to give consumers the opportunity of supporting responsible forestry. These labels are used on a wide range of wood-made products and products whose raw materials are extracted from wood – from timber products and furniture, through cardboard packaging products to pencils and books. FSC logo guarantees that the product comes from responsible sources – environmentally appropriate, socially beneficial and economically viable[299]. Through its process of certification FSC is, directly or indirectly, focused on issues that include illegal logging, deforestation and global warming. Although the FSC system has been the subject of criticism related to results of its global impact and its orientation to large corporate systems[300], there are independent reports confirming its positive effect on economic development, improved management planning, environmental impact assessments, environmental conservation, biodiversity, poverty alleviation and social and political empowerment[301].

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296 https://fsc.org, 17.08.2020; K. Sugiura, Y. Oki, *Reasons for Choosing Forest Stewardship Council (FSC) and Sustainable Green Ecosystem Council (SGEC) Schemes and the Effects of Certification Acquisition by Forestry Enterprises in Japan*, "Forests" 2018, Vol. 9(4), No. 173, pp. 1–12.

297 https://fsc.org, 17.08.2020.

298 Ib.

299 https://fsc.org, 17.08.2020; K. Sugiura, Y. Oki, *Reasons for Choosing Forest Stewardship Council (FSC)*..., op. cit.

300 R. Conniff, *Greenwashed Timber: How Sustainable Forest Certification Has Failed*, „Yale Environment 360" 20 February 2018, https://e360.yale.edu/features/greenwashed-timber-how-sustainable-forest-certification-has-failed, 10.01.2020.

301 K. Sugiura, Y. Oki, *Reasons for Choosing Forest Stewardship Council (FSC)*..., op. cit.; M. van Kuijk, F.E. Putz, R.J. Zagt, *Effects of forest certification on biodiversity*, Tropenbos International, Wageningen 2009.

Development of the FSC system

In 1993, in response to an unsuccessful attempt to reach an agreement on stopping the deforestation at the Earth Summit in Rio in 1992, a committed group of businesses, environmentalists and community leaders came together to create a revolutionary, voluntary, market-based approach that would improve forestry practices worldwide. FSC was officially born in 1994, when FSC AC was established as a legal entity in Mexico. The first certified product was the wooden spatula in the UK. From 1996 to 1997 the first general assembly took place, the first FSC National Standard was endorsed in Sweden and principle 10 for plantations was ratified. In the period between 1998 and 1999 approximately 10 million hectares of forest were certified according to FSC standards, and the first FSC-certified and labelled non-timber product was produced in Chicle gum, Mexico. At that time, the first book was printed on the FSC-certified paper ("A Living Wage" by Lawrence B. Glickman). It is worth mentioning that in the years 2000 - 2002 FSC received the International Environmental Prize of the City of Götheberg. Also, during that period policies for the group certification of the chain of custody were developed, while the FSC Board of Directors approved the FSC social strategy. In 2003 the FSC secretariat was moved from Oaxaca, Mexico to Bonn, Germany. During the same year certified forests reached 40 million of hectares, while at the same time there were 20000 FSC-certified products on the market. Standards for small or low-intensity managed forests (SLIMF) came into force in 2004, after two years of development. During the same year FSC received the prestigious ALCAN prize for the contribution it made to the improvement of forest management around the world. Accreditation Services International GmbH was set up in 2005 to manage the FSC accreditation program. By that year more than 10 million hectares of tropical forest was certified according to the FSC standards. In 2006, the FSC Project Certification Standard was approved; the FSC complied with the ISEAL Code of Good Practice, while the FSC Controlled Wood standards came into force[302].

In the period between 2007 and 2008 the Global FSC Strategy was approved by the FSC Board of Directors and FSC Global Development was created to strengthen FSC markets and trademarks. By that time, more than 100 million hectares were certified according to the FSC's Principles and Criteria in 79 countries. The 15000th chain of custody certificate and the 1,000th Forest Management certificate were celebrated in Portugal in the year 2009. In the same year, the first meeting of European small forest holders' network was held in Bonn, Germany. In 2011, regional offices for Latin America and Asia Pacific were opened, and Forest Certification for Ecosystem Services (ForCES) program was launched. By that year, FSC membership rose to 800, while the 20000th chain of custody certificate and the 1000th forest management

[302] https://fsc.org, 17.08.2020.

certificate were issued. By 2012, 30 national offices, 7 national focal points and 5 national representatives were organized and appointed. At that time, the FSC group certificates included almost a quarter of a million small and community producers. Over 180 million hectares of forest worldwide were managed according to the FSC standards, and the 27000th chain of custody certificate was issued by 2013. In this year, the Permanent Indigenous Peoples' Committee was established to give a formal voice to indigenous peoples in accordance with the FSC's principles. In 2015 a new global brand campaign: Forests For All Forever, was launched. The Global Strategic Plan 2015-2020 outlined the future direction of the FSC at an international level and the challenges faced by the world's forest stakeholders. Global campaign to celebrate the work of its Olympic torchbearers, the #ForestChampions was launched in 2016 and reached more than 5 million people in social media. Much of the timber used in the construction of venues for the 2016 Olympic games in Rio and Paraolympic Games was FSC-certified, while millions of FSC-certified products were used during the Games. In 2016 the first Asian woman Rulita Wijayaningdyah, an Indonesian trade unionist, was appointed as the Chairperson of the FSC International Board of Directors. In 2017 the Vancouver Declaration was launched as a commitment made by organizations around the world to work towards meeting the UN's Sustainable Development Goals by sustainably sourcing forest products. The first restaurant in the world achieved the FSC certification – it was ÁmaZ in Peru. In 2017, pilot tests for wood identification technologies were conducted in North America with great success. The FSC Ecosystem Services Procedure FSC-PRO-30-006, an initiative to create incentives for the preservation of valuable ecosystem services in responsibly managed forests, was launched in 2018. This was the world's first procedure in the forest certification. FSC International moved into new offices in Bonn. Finally, in 2019 FSC celebrated 25 years of sustainable forest management. By that year, over 199 million of hectares were certified and over 37000 CoC (chain of custody) certificates were issued[303].

FSC Labels

FSC labels can be found on millions of products around the world – from toilet rolls and papers used for books' printing, through toys and pencils to furniture. The label means, simply said, that by choosing products with the FSC labels, one is helping to take care of the world's forests[304].

There are three FSC labels[305]:

1. FSC 100%,
2. FSC Recycled,
3. FSC Mix.

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303 Ib.
304 Ib.
305 Ib.

The FSC 100% label (figure 14a) means that the wood within the product comes entirely from FSC-certified, well-managed forests. The meaning of the FSC Recycled label (figure 14b) is that all the wood or paper in the product comes from reclaimed or re-used materials. The FSC Mix label (figure 14c) indicates that the wood within the product is from the FSC-certified forests, recycled material, or controlled wood.

a b c

Figure 14. FSC labels

Source: https://fsc.org, 17.08.2020.

The great and interesting thing about the FSC on-product labels is that once one becomes familiar with these labels, it will be possible recognize them everywhere. However, the sourcing of wood is a complex issue, and the FSC needs to carefully follow how products get from forest to store. The three labels and procedures behind each of these three labels, enable the FSC to ensure that the product is made with forest materials from approved sources. There is hope that in the near future every product will be labelled as FSC 100%. The principle for translating the above-mentioned hope into reality is rather simple – the more people choose FSC-certified products, the more companies will be interested in meeting that demand and will strive to obtain the FSC certificate[306].

What is important for customers is that whichever FSC label is on a given product, they can be sure that they are purchasing the product that was not manufactured at the expense of forests, or the animals, plants, and people who rely on it. This is why it is important to educate people to pay attention to FSC

[306] Ib.

labels when shopping in supermarkets, furniture stores, book stores or coffee shops[307].

Standards

The FSC comprises two certification standards[308]:

1. Forest Management Certification,
2. Chain of Custody Certification.

The FSC forest management certification confirms that a forest is managed in a way that preserves biological diversity and benefits the lives of local people and workers, while ensuring it sustains economic viability. There are ten principles that any forest operation must adhere to before it can receive the FSC forest management certification. These principles cover a broad range of issues, from maintaining high conservation values to community relations and workers' rights, as well as monitoring the environmental and social impacts of the forest management. The FSC also provides a number of criteria relating to each principle in order to provide practical ways of working out whether they are complied with. The FSC's principles have been developed in such a way as to enable their application worldwide and as to make them relevant to all kinds of forest ecosystems, and to a wide range of cultural, political and legal settings[309].

FSC's Principles and Criteria set out the global requirements for responsible forest management. Chamber-balanced standard development groups (SDG) adapt the International Generic Indicators at the regional or national level to reflect the diverse legal, social and geographical conditions of forests in different parts of the world. The resulting adjustment is incorporated into a National Forest Stewardship Standard[310]. If a country lacks the National Forest Stewardship Standard; a technical working group can form and develop an interim national forest standard[311].

The group certification scheme is an option for FSC certificate holders through which they can join together and share their efforts for forest management planning, harvesting, monitoring and marketing their products. The group certification scheme can be an easier way to get FSC-certified, especially for smallholders, as it enables the group members to share the costs and work related to applying and maintaining the FSC certificate[312].

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307 Ib.
308 Ib.
309 Ib.
310 FSC-STD-60-002 V1-0 Structure and Content of National Forest Stewardship Standards.
311 FSC-PRO-60-007 V1-1 Structure, Content and Development of Interim National Standards.
312 https://fsc.org, 17.08.2020; FSC-STD-30-005 FSC Standard for Group Entities in Forest Management Groups.

Small or low-intensity managed forests (SLIMF) are eligible for streamlined requirements and auditing procedures that reduce the costs and efforts of the certification. In many countries specific forest management requirements for SLIMF were developed and incorporated into the national standards, in order to facilitate the certification process for smallholders. The auditing process can be also relaxed for SLIMF operations[313].

Another term that should be clarified is the controlled wood. This term refers to materials from acceptable sources that can be mixed with FSC-certified materials in products that carry the FSC Mix label. The controlled wood requirements identify five categories of unacceptable sources for wood, which is not allowed to be mixed with the FSC-certified materials[314]:

1. Illegally harvested wood,
2. Wood harvested in violation of traditional and human rights,
3. Wood harvested in forests in which high conservation values (HCVs) are threatened by management activities;
4. Wood harvested in forests being converted to plantations or non-forest use,
5. Wood from forests in which genetically-modified trees are planted.

The two main FSC controlled wood standards are[315]:

1. FSC-STD-40-005 V3-1 FSC Requirements for Sourcing FSC Controlled Wood, which directs businesses to avoid sourcing material from unacceptable sources,
2. FSC-STD-30-010 V2-0 FSC Controlled Wood Standard for Forest Management Enterprises, which specifies requirements for forest management enterprises to show that their management practices result in material from acceptable sources.

FSC chain of custody certification (CoC) provides credible assurance for products with environmentally and socially responsible sources to access the market. The FSC CoC certification verifies that FSC-certified material has been identified and separated from non-certified and non-controlled material as it makes its way along the supply chain, from the forest to the market. To achieve the CoC certification, company's business must meet the FSC-STD-40-004 Chain of Custody Certification standard[316]. All sizes and organizational structures (single-site, multi-site, as well as groups of organizations[317]) are acceptable for the CoC certification, enabling the certification cost optimization[318].

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313 https://fsc.org, 17.08.2020; FSC-STD-01-003 V1-0 SLIMF Eligibility Criteria.
314 https://fsc.org, 17.08.2020.
315 https://fsc.org, 17.08.2020.
316 FSC-STD-40-004 Chain of Custody Certification.
317 FSC-STD-40-003 Chain of Custody Certification of Multiple Sites.
318 https://fsc.org, 17.08.2020.

FSC-certified products may have a different composition, including FSC-certified forest material (FSC 100%), controlled wood and/or reclaimed material (introduced in recognition of the important role that the reclaimed material plays in protecting the world's forests[319])[320].

FSC project certification provides third-party assurance for projects made of or containing forest-based materials from responsible sources. There is a range of options for certifying organizations of all sizes that manage projects, from small to large entities, as well as a variety of project types (e.g. a single wooden boat, office building, a subdivision of houses, a civil engineering project, event infrastructure such as concert stages, seating etc.)[321].

Controlled wood risk assessments are described below. FSC risk assessments are used to determine the risk of an organization obtaining material from unacceptable wood sources when sourcing controlled wood. Companies that already have or wish to apply for the CoC certification, and that need to source controlled wood from non-FSC certified suppliers, are obliged to carry out risk assessments. The FSC risk assessments can either constitute the Centralized National Risk Assessment (CNRA), developed by the Performance and Standards Unit, or the National Risk Assessment (NRA), developed by a partner in the country. All approved FSC risk assessments can be found in the FSC document center, including the current timetable for the CNRA and NRA development, and an overview of published and unpublished CNRA and NRA risk designations[322].

FSC Certification

Companies willing to use the FSC label on any of their products, must first receive the chain of custody certification. This certification proves that the sourcing materials come from FSC-certified forests, recycling and/or controlled sources, as well as that FSC-defined best practice throughout the production process and supply chain is followed. However, it does not mean that all products produced by that company are made of these materials. Only products that use the FSC-certified materials can carry the FSC on-product label. In other words, just because one product carries it, does not mean that all products from the same company are made from responsibly sourced materials. This means that it is necessary to look for the FSC label on individual products to find out which of them are FSC-certified and which are not[323].

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319 FSC-STD-40-007 Sourcing reclaimed material for use in FSC Product Groups or FSC Certified Projects.

320 https://fsc.org, 17.08.2020.

321 https://fsc.org, 17.08.2020; FSC-STD-40-006 FSC Chain of Custody Standard for Project Certification.

322 https://fsc.org, 17.08.2020.

323 Ib.

The forest management and chain of custody assessments that lead to the FSC certification are performed by independent **certification bodies**. FSC sets the standards for forest management[324] and chain of custody certification[325], and defines the procedures that the certification bodies should follow in their certification assessments[326].

FSC certification bodies evaluate forests based on 10 FSC principles organized as criteria[327]:

1. Compliance with laws,
2. Workers' rights and employment conditions,
3. Indigenous peoples' rights,
4. Community relations,
5. Benefits from the forest,
6. Environmental values and impacts,
7. Management planning,
8. Monitoring and assessment,
9. High conservation values,
10. Implementation of management activities.

FSC is the only global forest certification system to have an integrated accreditation program that systematically checks its certification bodies. Accredited certification bodies are regularly audited by the Assurance Services International (ASI), which is responsible for verifying the certification body compliance with the FSC rules and procedures through a combination of field and office audits. All FSC-accredited certification bodies must meet FSC accreditation requirements. As the certification bodies conduct annual checks on holders of the FSC forest management and CoC certificates, ASI carries out the annual office and field audits of the certification bodies[328].

Examples of ecolabelled products

Example 1. Fuji Xerox Professional Copy Paper

Fuji Xerox Professional is a smooth multi-purpose white paper for everyday high-quality printing, intended for all copying and laser printing applications. Fuji Xerox Professional is FSC™ certified, with the FSC Mix label, and is made from Elemental Chlorine Free pulp (ECF) coming from farmed plantations that are ISO14001 environmentally accredited. This type of Fuji Xerox paper is also qualified for ISO9706 (Permanent Paper) and is acid free, which makes it suitable for use in archival storages of documents, where it should stay for

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[324] FSC-STD-20-007 Forest management evaluations.
[325] FSC-STD-20-011 Chain of Custody Evaluations.
[326] FSC-STD-20-001 General requirements for FSC accredited certification bodies.
[327] K. Sugiura, Y. Oki, *Reasons for Choosing Forest Stewardship Council (FSC)*..., op. cit.
[328] https://fsc.org, 17.08.2020.

several hundred years. Professional paper is produced in A4 and A3 formats with weights of 70 and 80 gsm[329].

Example 2. Staedtler's Noris® 2B Triangular GRED PEPERIKSAAN pencil

Noris® 2B Triangular GRED PEPERIKSAAN is a Staedtler's pencil, FSC™ certified with the FSC 100% wood label. It is designed for shading, writing, drawing, sketching and computer scanning. This pencil features strong and dark leads with smooth and faster shading. The triangular shape of the pencil enables a better grip. It is also approved for OMR (Optical Mark Recognition) tests[330].

Example 3. Bizzotto's KIBALI table

KIBALI is an outdoor round eating table for 6 persons – 160 cm in diameter, 76 cm high, with a central solid leg Ø25 cm – produced by Bizzotto company from Italy. It is made of recycled teak wood with water-based paint finishing, FSC certified with the FSC Recycled label[331].

3.7. Green Seal

(*Igor Budak, Boris Agarski, Milana Ilić Mićunović*)

History and development of the program

Green Seal is a non-profit ecolabelling organization, founded in 1989, with the mission to transform the economy for a healthier and greener world, through the use of science-based programs whose purpose is to enable consumers, purchasers, and companies to contribute to the creation of a more sustainable world. This is achieved through development of standards, certification procedures, and continuing educational activities[332].

The Green Seal is an environmental label used by product producers and providers of services[333]. The Green Seal Certification Mark (figure 15) is registered with the United States Patent and Trademark Office[334].

With thousands of certified products, services and spaces from the world's leading companies, the Green Seal certification mark is a universal symbol that a product or service meets the highest benchmark of health and environmental leadership[335].

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329 https://www.fujixerox.com.sg/en/Products/SG-Office-Supplies/Fuji-Xerox-Professional-Paper, 17.08.2020.

330 https://www.staedtler.com.my/en/products/pencils-accessories/pencils/noris-2b-triangular-gred-peperiksaa-triangular-pencil/, 17.08.2020.

331 https://www.bizzotto.com/en/kibali-table-d160-fsc.html, 17.08.2020.

332 https://www.standardsportal.org/usa_en/sdo/greenseal.aspx, 17.08.2020.

333 Ecolabel Index, http://www.ecolabelindex.com/ecolabel/green-seal, 17.08.2020.

334 https://www.uspto.gov/trademark, 17.08.2020.

335 Green Seal, https://www.greenseal.org, 17.08.2020.

In 1990's Grenn Seal started providing technical assistance to Federal, State, and local governments as well as to managements of other environmental purchasing, operations, and facilities institutions[336]. Today, many other US organizations and programs reference Green Seal standards – these are, among others: the US Green Building Council LEED rating system[337], Practice Green Health[338], the AASHE STARS program[339] and the Green Ribbon Schools Program of the U.S. Department of Education[340]. Green Seal's credibility and recognizability was confirmed by the study of the Responsible Purchasing Network from 2010, in which the Green Seal was recognized by 95% of purchasers and used by 76%[341]. Choose Green Reports, a series of buying guides for purchasers published by the Green Seal during the 1990's, contributed to this for sure.

Figure 15. Green Seal Certification Mark

Source: Green Seal, https://www.greenseal.org, 17.08.2020.

Green Seal is accredited by the American National Standards Institute (ANSI) as a developer of American National Standards[342]. Also, Green Seal fulfils the criteria for third-party certifiers of the USA Environmental Protection Agency (EPA)[343]:

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336 EPA Sustainable Marketplace: Greener Products and Services, https://www.epa.gov/greenerproducts#greenseal/, 17.08.2020.

337 The U.S. Green Building Council, https://www.usgbc.org/organizations, 17.08.2020.

338 Sustainable Procurement, https://practicegreenhealth.org, 17.08.2020.

339 Sustainability Tracking, Assessment & Rating System (STARS), https://stars.aashe.org, 17.08.2020.

340 U.S. Department of Education Green Ribbon Schools, https://www2.ed.gov/programs/green-ribbon-schools/resources.html, 17.08.2020.

341 Responsible Purchasing Trends, Responsible Purchasing Network, 2010, http://www.responsiblepurchasing.org/publications/trends_2010.pdf, 17.08.2020.

342 American National Standards Institute, *Standards Developing Organizations*, https://www.standardsportal.org/usa_en/sdo/greenseal.aspx, 17.08.2020.

343 Green Seal, https://www.greenseal.org, 17.08.2020; EPA Sustainable Marketplace: Greener Products..., op. cit.

1. Open, transparent standard development process and award criteria,
2. Criteria based on Life Cycle Analysis,
3. Clear consumer communication on nature of certification,
4. Regular updating of standards and criteria,
5. Facility inspection or audit,
6. Protocols for testing institutions or laboratories,
7. Access to certification for companies of all sizes.

International credibility of the Green Seal is based on its functioning according to the principles for environmental labels (type I) of the International Organization for Standardization defined under the standards ISO 14020 and 14024[344]. Also, Green Seal is a co-founder of Global Ecolabelling Network (GEN), which consists of 27 international ecolabelling programs, where it represents United States of America (USA)[345]. Besides the above-mentioned ISO standards, Green Seal procedures correspond to guidelines of the Global Ecolabelling Network's Internationally Coordinated Ecolabelling System (GENICES)[346].

Standards and product categories

In order to achieve the Green Seal certification, products and services have to meet the requirements defined by Green Seal standards. The standards are based on a life cycle approach, considering the impacts from all life cycle stages – raw materials extraction, manufacturing, use, and end-of-life. Product and service categories are evaluated during the development of a standard to ensure that all significant functional, environmental, and health impacts are taken into account in all life-cycle stages[347].

For more than three decades, the Green Seal's strict standards for health, sustainability and product performance have led the permanent improvement on the market, contributing to better purchasing decisions but also to rewarding of innovators from industry[348]. The Green Seal's standards comprise requirements for reducing health, environmental, and social impacts, associated with the life cycle of organizations, services, and products. These reduction requirements have been continually adjusted to the level which is technologically and economically feasible; the Green Seal standards are defined on a category-by-category basis, which gives a significant opportunity to reduce a product, service, or organization's life cycle impact[349].

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344 Ecolabel Index, http://www.ecolabelindex.com/ecolabel/green-seal, 17.08.2020; Green Seal, https://www.greenseal.org, 17.08.2020; ISO 14020:2000, https://www.iso.org/standard/34425.html, 17.08.2020.

345 Global Ecolabelling Network: Full Members List, https://www.globalecolabelling.net/gen-members/gen-full-members-list/, 17.08.2020.

346 Green Seal, https://www.greenseal.org, 17.08.2020; Global Ecolabelling Network..., op. cit.

347 Green Seal, https://www.greenseal.org, 17.08.2020.

348 Ib.

349 https://www.standardsportal.org/usa_en/sdo/greenseal.aspx, 17.08.2020.

Today, the Green Seal program comprises 24 standards with requirements for more than 500 product categories. The Green Seal standards can be classified into two categories – standards for products and those for services[350]:

1. Product Standards:
   - GS-1 Sanitary Paper Products,
   - GS-7 Printing and Writing Paper,
   - GS-8 Cleaning Products for Household Use,
   - GS-10 Coated Printing Paper,
   - GS-11 Paints, Coatings, Stains, and Finishes,
   - GS-18 Paper Products used in Food Preparation,
   - GS-20 Environmental Innovation,
   - GS-34 Cleaning and Degreasing Agents,
   - GS-35 Food Service Packaging,
   - GS-36 Adhesives for Commercial Use,
   - GS-37 Cleaning Products for Industrial/Institutional Use,
   - GS-40 Floor Care Products for Industrial/Institutional Use,
   - GS-41 Hand Cleaners for Industrial/Institutional Use,
   - GS-43 Recycled Content Latex Paint,
   - GS-44 Soaps, Cleansers, and Shower Products,
   - GS-48 Laundry Products for Household Use,
   - GS-50 Personal Care and Cosmetic Products,
   - GS-51 Laundry Products for Industrial/Institutional Use,
   - GS-52 Specialty Cleaning Products for Household Use,
   - GS-53 Specialty Cleaning Products for Industrial/Institutional Use,
2. Service Standards:
   - GS-33 Hotel and Lodgings Properties,
   - GS-42 Commercial and Institutional Cleaning Services,
   - GS-49 Residential Cleaning Services,
   - GS-55 Restaurants and Food Services.

Standards have been developed following a science-based life cycle approach and an open, transparent stakeholder consensus-based process. The development process comprises the following steps[351]:

1. Selection of the Product Category,
2. Conducting the Feasibility Assessment (Checking if there is a need in the market for differentiation),
3. Development of Criteria (Product function, performance assessments, environmental and health impacts),
4. Conducting outreach to Stakeholders,
5. Publication of the Draft Standard and technical documents for comment,

[350] Green Seal, https://www.greenseal.org, 17.08.2020
[351] Ib.

6. Public Comment Period,
7. Revision of the Standard,
8. Issuance of the Standard and Public Supporting Technical Documents.

During the public comment periods, all interested parties (individuals, companies, non-profit organizations etc.) are given an opportunity to register in order to review and comment on draft standards and technical documents. These feedbacks on standards are welcomed by Green Seal and always considered during the review. Standards have usually been reviewed every three to five years. Updates of standards are usually required in order to take into account changes on the market and the progress connected with new technologies. In some cases, Green Seal conducts focused revisions to resolve minor issues in the standards, such as: expanding the scope, updating lists of prohibited substances, resolving difficulties, or clarifying requirements. All revisions are followed by a public comment period, during which Green Seal seeks comments related only to the proposed changes. Standards can also be retired, and this is done in following cases[352]:

The environmentally-preferable options on the market have become mainstream,

1. Other ecolabelling programs, of the confirmed quality and integrity, have covered the product categories covered by the standard,
2. New technologies have improved the entire product category,
3. The product category is no longer produced and sold on market.

However, all Green Seal's withdrawn standards are available on demand, as well as the explanation why a standard has been retired. The list of currently retired standards is given below[353]:

1. GC-12 Occupancy Sensors,
2. GS-2 Alternative Fueled Vehicles,
3. GS-3 Re-Refined Engine Oil,
4. GS-5 Compact Fluorescent Lamps,
5. GS-9 Paper Towels and Napkins (incorporated into GS-1),
6. GS-15 Newsprint,
7. GS-16 Reusable Bags,
8. GS-21 Powdered Laundry Bleach (incorporated into GS-48 [Household Use] and GS-51 (Institutional Use]),
9. GS-47 Stains and Finishes (incorporated into GS-11),
10. GS-13 Windows,
11. GS-31 Electric Chillers,
12. GS-54 Architectural Thermal Insulation Materials.

Standard development procedures of the Green Seal have been externally reviewed by third parties. The result of these reviews is that the Green Seal's

[352] Ib.
[353] Ib.

standard development procedures meet the guidelines of two ISO standards, which define the goals, considerations, and procedures for voluntary environmental labelling programs[354]:

1. ISO 14020:2000, Environmental labels and declarations – General principles,
2. ISO 14024:2002, Environmental labels and declarations – Type I environmental labelling – Principles and procedures.

In addition, approximately every five years, the GEN conducts an onsite audit of Green Seal programs in order to ensure compliance with ISO 14020 and ISO 14024 standards. The previous audit of Green Seal was conducted by GEN in September 2015[355].

Application, certification and evaluation procedures

The application procedure for the Green Seal certification starts with finding the standard that best suits the product or service that is planned for certification. In order to find the appropriate standard, one can consult a list of representative products to see if the product or service fits the selected standard. When the right standard is found, it should be explored in detail in order to become familiar with its criteria and scope. In the next stage, the online Certification Interest Form (CIF) should be filled in and submitted. In the CIF, an applicant is requested to provide some data regarding the company and product or service. After submitting the CIF, the Green Seal's Customer Success team contacts the applicant within 1-2 business days, sending them the application and instructions for payment. Then, if the application is accepted and payment is received, Green Seal signs the contract with the applicant's company[356].

The evaluation process starts with the collection of raw material data required for analysis of the product. Once the data has been evaluate, any identified issues have to be resolved in cooperation with the appointed Green Seal project manager. All information is kept strictly confidential. The evaluation is continued through the analysis of packaging information, performance testing results, labels, training and marketing materials. This is followed by an audit of the production or service location, conducted by another Green Seal representative. The senior project manager performs a double-check evaluation and if any issues are found, the appointed project manager works with the applicant company to resolve them as quickly as possible. The certificate is issued once all the requirements are fulfilled[357].

Afterward successful certification, the applicant will receive complimentary promotional and marketing support related to the obtained Green Seal

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354 Ib.; ISO 14020:2000, https://www.iso.org/standard/34425.html, 17.08.2020.
355 Green Seal, https://www.greenseal.org, 17.08.2020.
356 Ib.
357 Ib.

Certificate, which can include social media campaigns, press releases, and guest blog posts on the Green Seal's webpage. The certified product or service is subject to periodic compliance monitoring, which is required to maintain certification[358].

Benefits and costs of participation in the program

Among the benefits resulting from certification according to the Green Seal program are[359]:

1. Improving the company's sustainability,
2. Indicating exceed in leadership-level, by incorporation of the life-cycle-based criteria for sustainability,
3. Satisfying the requirements from purchasers, facility managers, meeting planners, and consumers,
4. Increased customer loyalty,
5. Valuable brand enhancement by showing environmental and health excellence.

Fees for Green Seal certification are paid for evaluation and monitoring activities. They change regarding "the type of product under review (original product, private label, similar or nearly identical product), number of products

Table 19. Evaluation fees for original products in Green Seal program

Tier V Annual sales/revenue less than $5 million	Single Product	Multiple Products (fee per product)	
	$5150	2-4 products	5 or more products
		$3875	$3350
Tier IV Annual sales/revenue $5 million to $20 million	Single Product	Multiple Products (fee per product)	
	$6450	2-4 products	5 or more products
		$4850	$4200
Tier III Annual sales/revenue $20 million to $100 million	Single Product	Multiple Products (fee per product)	
	$8075	2-4 products	5 or more products
		$6050	$5250
Tier II Annual sales/revenue $100 million to $500 million	Single Product	Multiple Products (fee per product)	
	$9800	2-4 products	5 or more products
		$7550	$6550
Tier I Annual sales/revenue $500 million or over	Single Product	Multiple Products (fee per product)	
	$10950	2-4 products	5 or more products
		$9450	$8200

Source: own work based on: Green Seal, *Fees for Green Seal Certification under GS-1 Standard for Sanitary Paper Products*, https://www.greenseal.org/wp-content/uploads/2018/10/GS1-6.2-Fee-Schedule.pdf, 10.02.2021.

[358] Ib.

[359] Green Seal, Certification, 2021, https://www.greenseal.org/certification, 10.02.2021.

submitted for certification and the company's total annual revenue"[360]. The information on evaluation fees for original products is presented in table 19.

The certified products must be reviewed every 12 months to retain license to use the Green Seal Mark. The costs of annual compliance monitoring presents table 20.

Table 20. Monitoring fees for original products in Green Seal program

Tier V Annual sales/revenue less than $5 million	Single Product	Multiple Products (fee per product)	
	$3625	2-4 products	5 or more products
		$2700	$2350
Tier IV Annual sales/revenue $5 million to $20 million	Single Product	Multiple Products (fee per product)	
	$4525	2-4 products	5 or more products
		$3375	$2950
Tier III Annual sales/revenue $20 million to $100 million	Single Product	Multiple Products (fee per product)	
	$5650	2-4 products	5 or more products
		$4250	$3675
Tier II Annual sales/revenue $100 million to $500 million	Single Product	Multiple Products (fee per product)	
	$7050	2-4 products	5 or more products
		$5300	$4575
Tier I Annual sales/revenue $500 million or over	Single Product	Multiple Products (fee per product)	
	$8825	2-4 products	5 or more products
		$6625	$5725

Source: own work based on: Green Seal, *Fees for Green Seal Certification under GS-1 Standard for Sanitary Paper Products*, https://www.greenseal.org/wp-content/uploads/2018/10/GS1-6.2-Fee-Schedule.pdf, 10.02.2021.

The fees for private label products, similar products or nearly identical products are accordingly reduced.

Examples of ecolabelled products

Example 1. 3M's Floor Pad

3M has been awarded the Green Seal's Certification for Floor Pads under the Environmental Innovation program (GS-20 standard), which recognizes products that significantly reduce environmental impact through product innovation – significantly improved performance, and/or durability, extended useful life, reduced solid waste generation[361]. More information on the Scotch Brite Clean Shine Pad is provided in table 21.

[360] Green Seal, *Fees for Green Seal Certification under GS-1 Standard for Sanitary Paper Products*, https://www.greenseal.org/wp-content/uploads/2018/10/GS1-6.2-Fee-Schedule.pdf, 10.02.2021.

[361] Green Seal, https://www.greenseal.org, 17.08.2020.

Table 21. Main information about Scotch Brite Clean Shine Pad

Product/Service	Scotch Brite Clean Shine Pad
Manufacturer	3M
Licence number	806101
Standard	GS-20 Environmental Innovation

Source: own work based on: Green Seal, https://www.greenseal.org, 17.08.2020.

Scotch-Brite™ Clean & Shine Pad (figure 16) is a 2-in-1 cleaning pad designed for use in low-speed scrubbers that gradually increases shine with repeated use. It cleans and shines in the same step, using only a low-speed scrubber. It saves costs and labor by reducing or eliminating the need to burnish and removes black marks three times faster than traditional cleaning pads. The two-sided pad lasts longer than traditional cleaning pads. The product is effective on most coated and uncoated hard floors including VCT, LVT, vinyl, rubber, marble, stone, terrazzo, granite, and concrete using only water or neutral cleaner[362].

Figure 16. 3M's Scotch-Brite™ Clean & Shine Pad

Source: https://www.3m.com/3M/en_US/company-us/all-3m-products/~/Scotch-Brite-Clean-Shine-Pad, 17.08.2020.

Example 2. von Drehle's Preserve White Household Roll Towels

Preserve White Household Roll Towels (figure 17), produced by von Drehle are soft, strong, and absorbent 2-ply towels that are individually wrapped and are made from 100% recycled fibers. This product is certified under Green Seal Standard GS-1 based on chlorine-free processing, energy and water efficiency, 100% recycled material with a minimum of 50% post-consumer material[363]. The main data, related to certification of this product are given in (table 22).

[362] https://www.3m.com/3M/en_US/company-us/all-3m-products/~/Scotch-Brite-Clean-Shine-Pad, 17.08.2020.

[363] Green Seal, https://www.greenseal.org, 17.08.2020; http://www.vondrehle.com/towels/household-roll-towels, 17.08.2020.

Table 22. Main information about Preserve White Household Roll Towels

Product/Service	Preserve White Household Roll Towels
Manufacturer	von Drehle
Licence number	805061
Standard	GS-1 Sanitary Paper Products

Source: Green Seal, https://www.greenseal.org, 17.08.2020.

Figure 17. Von Drehle's Preserve White Household Roll Towels

Source: Green Seal, https://www.greenseal.org, 17.08.2020; http://www.vondrehle.com/towels /household-roll-towels, 17.08.2020.

Example 3. Lake Yellowstone Hotel Xanterra Parks Resorts

Lake Yellowstone Hotel Xanterra Parks Resorts received the Green Seal Gold level certification in November 2017, for environmental sustainability (table 23). The Green Seal Gold is the highest-level certification, which ensures that lodging properties meet rigorous sustainability criteria[364].

Table 23. Main information about Lake Yellowstone Hotel Xanterra Parks Resorts

Product/Service	Lake Yellowstone Hotel Xanterra Parks Resorts
Manufacturer	/
Licence number	805920
Standard	GS-33 Hotel and Lodgings Properties

Source: Green Seal, https://www.greenseal.org, 17.08.2020.

The fact that the Lake Yellowstone Hotel is over 125 years old and that it was possible to fulfil high environmental requirements and accomplish Green Seal certification at a historic landmark, shows that there is no need for a fancy new building to reduce the environmental footprint. Evidence of sustainability can be found at Lake Hotel almost anywhere, from compostable bioplastic containers for take-away food, sustainable food and retail options through to

[364] Green Seal, https://www.greenseal.org, 17.08.2020; https://www.yellowstonenationalpark-lodges.com/sustainability/, 17.08.2020.

Rainforest Alliance coffee in hotel rooms and water bottle refill stations, as well as the Softer Footprint Green Housekeeping program which offers a $5/night discount to guests staying multiple nights by foregoing housekeeping which helps to conserve energy and water[365].

The sustainable approach, which was evaluated in the Green Seal certification process, goes far deeper than what is visible to guests. During the process of evaluation, everything from the office materials and cleaning supplies used by staff, to the furniture in the hotel rooms and the paint on the walls, was evaluated by a third-party inspector. The goal of this process was to ensure that the hotel meets the highest standards for waste minimization, energy conservation, management of fresh water resources, waste water management, pollution prevention, and environmentally sensitive purchasing[366].

3.8. LEED

(*Dariusz Wyrwa, Janusz Strojny*)

History and development of the program

The environmental safety movement started in 1960s. An embargo introduced by OPEC (Organization of the Petroleum Exporting Countries) caused a significant increase in oil and natural gas prices which led to an energy crisis. This, on the other hand, increased an overall interest in so called green civil engineering, one of the objectives of which was to limit energy consumption[367].

Nowadays buildings are a necessity to humanity, however they also have an impact on the natural environment. It is believed that buildings are responsible for 23% of all air pollution, 50% of greenhouse gases production, 40% of water pollution and 40% of solid waste production in the cities. Urbanization also causes the use of non-renewable resources, a decrease in the biodiversity, forest degradation, and decay of rural areas. It may lead to the air, water and soil pollution and cause global warming. However, it is worth pointing out that the development of civil engineering is also a significant factor for economic growth and creation of workplaces[368].

The construction and operation of buildings are estimated to have the biggest impact on the global energy consumption and CO_2 emissions. According to the data from the year 2018 values for these categories are estimated at 36% and 39% respectively. The last few years have seen a rapid increase in the buildings' usable area which leads to an increase in the energy consumption as

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365 https://www.yellowstonenationalparklodges.com/sustainability/, 17.08.2020.

366 Ib.

367 White Paper on Sustainability, A Report on the Green Building Movement, "Building Design and Construction (BDC)", November 2003, p. 4.

368 V.Y. Tam, K.N. Le, *Sustainable Construction Technologies, Life-Cycle Assessment*, Butterworth-Heineman, Oxford 2019, p. 30.

well as increased emissions . The latter, in particular, has recently started to increase following a period of downward trend between 2013 and 2016,[369].

There are many definitions of a green building in the literature, which is very often identified with an ecological building. According to the EPA (Environmental Protection Agency) a green building is defined as designed, constructed and operated in such a fashion that it saves energy, water and other resources as well as reduces waste and emissions, which limits the impact of the building on the human health and natural environment[370].

The green building may be also described as the building which, thanks to its structure, during its construction or operation, reduces or completely eliminates the negative effects and generates the positive effects on the climate and the natural environment. Green buildings help to preserve the precious natural resources as well as improve the quality of life. In particular, they allow for the effective use of energy (this includes the renewable energy sources such as solar power), water and other resources, the reduction in pollution levels and production of waste as well as the use of nontoxic and reusable materials. They also ensure a good indoor air quality. In addition to this, the aspects of quality of life along with natural environment as well as the adjustment of the building itself to environmental changes are taken into consideration as early as at the design phase[371].

The construction has a very high potential for reducing the impact on the natural environment. One of the ways to create positive trends in its development is the creation and implementation of multi-criteria certificates, which, despite some drawbacks, pay close attention to sustainable development and encourage reflection and discussion on issues affecting the broadly understood quality of the building, emphasizing at the same time the use of materials and energy, comfort of use or the materials it is made of[372].

The first building assessment and certification system for compliance with sustainable development conditions, established in Great Britain in 1990, was the BREEAM (Building Research Establishment Environmental Assessment Method) system developed by the Building Research Establishment. The LEED system (Leadership in Energy and Environmental Design) developed by the U.S. Green Building Council (USGBC) is currently considered the most popular building certification system in the world. The origins of the LEED date back to 1993 when the U.S. Green Building Council was established. The support in the

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369 Global Alliance for Buildings and Construction, International Energy Agency and the United Nations Environment Programme, *2019 Global Status Report for Buildings and Construction. Towards a zero-emissions, efficient and resilient buildings and construction sector*, 2019, pp. 9–12.

370 https://www.epa.gov/greeningepa/green-buildings-epa, 17.08.2020.

371 https://www.worldgbc.org/what-green-building, 17.08.2020.

372 M. Mokrzecka, *Międzynarodowe systemy certyfikacji LEED, BREEAM i DGNB. Wstępna analiza porównawcza poparta studium przypadku*, "Journal of Civil Engineering, Environment and Architecture JCEEA" 2015, Vol. XXXII, Z. 62, p. 314.

amount of $300000 received from the Department of Energy by the GBC was critical in facilitating the preparatory work for the development of the assumptions for the building certification system[373].

David Gottfried an environmental attorney developer, Mike Italiano and Rich Fedrizzi, a HVAC specialist from Carrier Corporation initiated the establishment of U.S. Green Building Council in 1993. Its mission was to promote sustainable development of building practices. The founding meeting organized in April in the American Institute of Architects conference room was attended by representatives of almost 60 different companies and several non-profit organizations[374].

An early document from 1994, related to the work on the LEED system contained information that the USGBC is a non-profit organization of the construction industry representatives which promotes the understanding, development and implementation of principles, programs, technologies, standards and practices in the field of ecological buildings on a national scale[375]. Initially, in 1996 the name of the created system was supposed to be DOMEC. It was a proposal of a volunteer marketing committee. Robert Watson, general director and chief scientist in the ECON group, who was also chairman of the LEED steering committee between 1995 and 1996 states that the letters DOM were taken from the Latin words referring to home, but also to market dominance, while letters EC were to symbolize ecology and economics. However, Watson proposed a name that referred to the leadership, energy, environment and design, which was found to be more acceptable by the steering committee[376].

In July 1994, a draft of the green building rating system was created. In 1998, work began to develop and launch the LEED New Construction (NC) v1.0 pilot program which was implemented until December 1999 (table 24).

This program was mainly based on strategies related to the improvement in the energy efficiency of new buildings and led to the LEED certification of the first 12 buildings in 2000. LEED v2.0 was introduced in 2000, and after 2002, LEED v2.1. By the time LEED v2.2 was implemented in 2005, the assessment criteria had become much more universal, and assessment system options had evolved to include not only LEED NC, but also Existing Buildings (EB), Commercial Facilities (CI), and Core & Shell projects (CS)[377].

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373 J. Kriss, *From a simple idea to a several-hundred-billion-dollar industry*, https://www.usgbc.org/articles/simple-idea-several-hundred-billion-dollar-industry, 17.08.2020.

374 N. Stecky, *Sustainability and High Performance Green Buildings. LEED for New Construction and Existing Buildings* [in] S. Doty, W.C. Turner (eds), Energy Management Handbook, The Fairmont Press, Lilburn 2009, p. 580.

375 R. Ade, M. Rehm, *The unwritten history of green building rating tools: a personal view from some of the "founding fathers"*, "Building Research & Information" 2019, Vol. 48, p. 1–17.

376 Ib.

377 T.K. Das, *Industrial Environmental Management, Engineering, Science, and Policy*, John Wiley and Sons, Inc., Hoboken 2020, pp. 467–468.

Table 24. Historical applicability of LEED versions

Version	Years Applicable	Additional information
1.0	1998-2000	First launched in August 1998, officially released in 1999. Beta version tested on selected 19 projects
2.0	2000-2002	First published in 1999, officially released in March 2000, 624 projects registered and 238 certified
2.1	2002-2005	Officially released in November 2002, 2134 projects registered and 352 certified
2.2	2005-2009	First published in 2003, officially released in 2005, 19524 projects registered and 2476 certified from August 2009
3.0 (LEED® 2009)	2009-2016	Launched in April, 2009, deadline for the registration of the project: October 31, 2016
4.0	2013	Released in November, 2013
4.1	2019	Announced in November, 2017, released in December 2018 as a beta version - LEED v4.1 is not a change to the full version. Instead, it is another evolution for the rating system, using the existing credit requirements as a foundation. LEED v4.1 is an update focused on implementation, applicability, and agility of the LEED

Source: own work based on: G. Chen, Leed V4 BD&C Exam Guide, ArchiteG Inc., Irvine, 2015, pp. 37–38; G.M. White, J. Nichols, J. York, *Green Buildings Rating Systems and Green Leases* [in] J.C. Howe, M. Gerrard (eds), *The Law of Green Buildings: Regulatory and Legal Issues in Design, Construction, Operations, and Financing*, American Bar Association and Eli Press, Chicago 2010, p. 17; Ch.J. Kibert, *Sustainable Construction: Green Building Design and Delivery*, John Wiley and Sons, Inc., Hoboken 2016, p. 156; G.P. Nassos, N. Avlonas, *Practical Sustainability Strategies: How to Gain a Competitive Advantage*, Wiley, Hoboken 2020, p. 193.

Initially, the LEED system was gaining popularity very slowly, which resulted in a small number of certified projects. After 2008, there was a significant increase in the number of issued certificates and since 2010 these numbers have remained constant at around 5000 – 7000 issued certificates level. The number of the certificated projects is presented in table 25.

Table 25. Number of certificated projects

Year	Total	Certification level							
		Certified		Silver		Gold		Platinum	
2000	3	1	33,3%	1	33,3%	0	0,0%	1	33,3%
2001	6	3	50,0%	1	16,7%	2	33,3%	0	0,0%
2002	21	9	42,9%	4	19,0%	7	33,3%	1	4,8%
2003	45	18	40,0%	12	26,7%	11	24,4%	4	8,9%
2004	116	48	41,4%	34	29,3%	30	25,9%	4	3,4%
2005	199	74	37,2%	67	33,7%	51	25,6%	7	3,5%
2006	318	107	33,6%	101	31,8%	96	30,2%	14	4,4%

2007	483	139	28,8%	166	34,4%	141	29,2%	37	7,7%
2008	1064	303	28,5%	392	36,8%	316	29,7%	53	5,0%
2009	2858	580	20,3%	1061	37,1%	922	32,3%	295	10,3%
2010	3994	688	17,2%	1177	29,5%	1587	39,7%	542	13,6%
2011	5406	845	15,6%	1815	33,6%	1891	35,0%	855	15,8%
2012	6809	1631	24,0%	2090	30,7%	2292	33,7%	796	11,7%
2013	7968	2413	30,3%	2345	29,4%	2179	27,3%	1031	12,9%
2014	5878	1750	29,8%	1667	28,4%	1848	31,4%	613	10,4%
2015	6581	1703	25,9%	2265	34,4%	2031	30,9%	582	8,8%
2016	7152	2215	31,0%	1771	24,8%	2309	32,3%	857	12,0%
2017	7073	1563	22,1%	2536	35,9%	2284	32,3%	690	9,8%
2018	7232	2676	37,0%	1686	23,3%	2107	29,1%	763	10,6%
2019	5795	1634	28,2%	1534	26,5%	1848	31,9%	779	13,4%
	69001	18400	26,7%	20725	30,0%	21952	31,8%	7924	11,5%

Source: own work based on https://www.usgbc.org/projects, 17.08.2020.

Requirements and methodology of impact assessment

The United States Green Building Council in cooperation with Green Business Certification Inc. (GBCI) is the system operator responsible for the LEED certification. When applying for certification of buildings outside the United States, there is a need to cooperate with an Accredited Professional (LEED AP), i.e. a consultant, without whom certification would be extremely difficult technically. During the entire process the AP assists in the system requirement interpretation, fills in the documentation and uploads it onto the LEED Online Platform, reports to the USGBC and communicates with the operator, as well as accepts or appeals against the decisions of the certification body regarding the granting of specific loans. The most current list of almost 4000 LEED APs operating in 167 different countries can be found on the United States Green Building Council website.

The LEED rating systems establish specific frameworks and performance metrics by building type. They are grouped into five categories, which are presented in table 26.

Table 26. LEED v4 rating systems

Rating system	Type of the projects	Construction types
LEED BD+C Building Design and Construction	For new buildings or major renovations	1. New Construction, 2. Core and Shell, 3. Schools, 4. Retail, 5. Data Centers, 6. Warehouses and Distribution Centers,

		7. Hospitality, 8. Healthcare.
LEED ID+C Interior Design and Construction	For complete interior fit-out projects	1. Commercial Interiors, 2. Retail, 3. Hospitality.
LEED O+M Building Operations and Maintenance	For existing buildings that are undergoing improvement work or little to no construction	1. Existing Buildings, 2. Schools, 3. Retail, 4. Data Centers, 5. Hospitality, 6. Warehouses and Distribution Centers, 7. Multifamily.
LEED ND Neighborhood, Development	For new land development projects or redevelopment projects containing residential uses, non-residential uses, or a mix	1. Plan, 2. Built Project.
LEED Homes Design and Construction	For single family houses, low-rise multi-family or mid-rise multi-family houses	1. Homes, 2. Multifamily Low-rise Houses (one to three stories), 3. Multifamily Mid-rise Houses (four to six stories).

Source: own work based on: https://www.usgbc.org/leed, 17.08.2020.

In most cases the certificates are one-off and have no expiry date. The only exception to this rule is the EB O + M for existing buildings which have been in use for several months only, and should be renewed every five years. Not only newly built facilities are subject to evaluation in the LEED system, but also the existing and modernized ones. The LEED certification is currently carried out in 167 countries and territories around the world[378].

For all LEED BD + C and LEED O + M projects, for an additional fee it is possible to carry out an initial certification which allows for the determination of the number of points a given project can obtain during the full certification process. This allows for the use of the effect of designing a building in accordance with the LEED standards to attract potential tenants and entities interested in investing in the building before obtaining the final certificate. In order to start the preparation work on the LEED documentation the project needs to be registered with the USGBC. During this time the project team gains access to www.leedonline.com website and, as the work progresses, they can upload the required documents on the USGBC servers. The project can be reviewed by experts in three stages:

[378] https://www.usgbc.org/articles/leed-v41-pacific-region-roadshow-seattle-usgbc-washington, 17.08.2020.

1. Pre-certification – during the project phase,
2. Design Review – after the gathering of project documentations is completed,
3. Construction Review – after the construction work is finished.

The LEED certification system is divided into categories of requirements for which a specific number of points (credits) is obtained. These categories have changed with the introduction of subsequent versions of the system, and so did the scoring criteria. The details can be found in table 27. The changes were introduced not only to make it easier to obtain a certificate, but especially to make the system more flexible and to allow a greater number of different buildings to participate in the certification process. The categories in different LEED versions are presented in table 27.

Table 27. Difference in categories and points in New Construction Rating Systems in LEED versions

Categories	LEED v2.2		LEED v3 (2009)		LEED v4	
	Points	Percent	Points	Percent	Points	Percent
Location and Transportation (LT)	-	-	-	-	16	14,5%
Sustainable Sites (SS)	14	20,3%	26	23,6%	10	9,1%
Energy and Atmosphere (EA)	17	24,6%	35	31,8%	33	30,0%
Water Efficiency (WE)	5	7,2%	10	9,1%	11	10,0%
Indoor Environment Quality (IEQ)	15	21,7%	15	13,6%	16	14,5%
Material and Resources (MR)	13	18,8%	14	12,7%	13	11,8%
Innovation (ID)	5	7,2%	6	5,5%	6	5,5%
Regional Priority (RP)	-	-	4	3,6%	4	3,6%
Integrative Process (IP)	-	-	-	-	1	0,9%
Total	69	100%	110	100%	110	100%

Source: own work based on: https://www.usgbc.org, 17.08.2020.

In the most complex version of the LEED system so far, different levels of points in each category that can be obtained by individual types of facilities can be identified. For example, in the LEED v4 for Building Design and Construction in the Location and Transportation category, the variation in the maximum number of points which can be obtained ranges between 9 and 20 points[379].

The system also specifies the minimum number of points that each building must receive to obtain a certificate at any given level. It also dependable on the type of a building being assessed. The total number of points currently available is 100 + 10 for the last two categories. Each category has more than a dozen of prerequisites without which it is impossible to obtain the certification (i.e. the measurement of and the reduction in the water consumption or energy in the

[379] https://www.usgbc.org/resources/leed-v4-building-design-and-construction-current-version, 17.08.2020.

building). All the points are awarded in the binary system type : the requirement is either fulfilled or not.

During the development of the system, the number of points required to obtain a certificate has also changed. The number of credits currently required to obtain a specific rating is as follows: 40-49 points for the Certified level, 50-59 for the Silver level, 60-79 for the Gold level and 90-110 for the Platinum level (table 28).

Table 28. Levels of LEED Ratings

Level	LEED v2			LEED v3, L		
	Points	Percentage of all points		Points	Percentage of all points	
Certified	26-32	37,7%	46,4%	40-49	36,4%	44,5%
Silver	33-38	47,8%	55,1%	50-59	45,5%	53,6%
Gold	39-51	56,5%	73,9%	60-79	54,5%	71,8%
Platinum	52-69	75,4%	100,0%	80-110	72,7%	100,0%

Source: own work based on: https://www.usgbc.org, 17.08.2020.

Benefits and costs of participation in the program

According to the information provided by the USGBC, green, LEED certified buildings are more attractive to tenants, as they achieve rental rates up to 20% higher than average (on average, the rent is about 6% higher) and the vacancy rate is 4% lower than for real estate without certification. The research covering the years 2015-2018 indicated that buildings certified by the USGBC allowed for energy savings of $1,2 billion, water savings of $149,5 million, maintenance savings of $715,3 million and waste savings of $54,2 million. LEED certified buildings in relation to non-certified buildings show on average[380]:

1. 34% lower CO_2 emissions,
2. 25% less energy consumed,
3. 11% less water consumed.

Furthermore it is estimated that tenants of the LEED buildings had travelled 4 billion miles less in their cars thanks to the optimal location of their buildings and the availability of alternative means of transportation.

In May 2009, CB Richard Ellis and the University of San Diego examined 154 buildings that were considered green and were ENERGY STAR® or LEED certified (at any level). 534 tenant responses were received which allowed to determine the impact of these buildings on employee productivity. According to 12% of respondents, employees are definitely more productive while 42,5% said that employees are more productive. In addition to this, 45% of respondents reported fewer sick days than before the relocation. The same percentage of

[380] https://www.usgbc.org/leed/why-leed, 17.08.2020.

tenants surveyed said that they did not notice any changes. What is also interesting is that 10% of the surveyed responders noticed that the employees spend more days on a sick leave than before, however this was true only for the ENERGY STAR® certified buildings. Moreover, according to the tenants, their employees spend 2,88 days less on sick leave which is a huge advantage for those entities[381].

A key aspect of the impact of the LEED certification on the environmental benefits is that 87,5% of the personnel which supervises the construction of facilities that participated in the LEED program did not identify any negative, unintended environmental impact. The very logic of the certification system means that it is not only limited to buildings built in a sustainable manner, but it also applies to their surroundings[382].

Also the cost analysis regarding the implementation of solutions that enable the LEED certification and ensure objective benefits in the form of financial savings gained as a result of reduction in energy and water consumption during the operation of the building confirms that the decision to proceed with the certification procedure can be a good investment[383].

The costs of participation in the LEED program are not low. The list of selected costs can be found in table 29.

Table 29. Cost of participation in the LEED program, Building Design and Construction

Fees per Building	Silver, Gold and Platinum Level Members [$]	Organizational or Non-members [$]
Registration	1200	1500
Pre-certification	4000	5000
Combined Certification Review: Design and Construction	$0,050/sf – $0,068/sf sf – square foot	

Source: own work based on: https://www.usgbc.org/tools/leed-certification/fees, 17.08.2020.

The fee for the project registration and pre-certification can be reduced for holders of the Silver, Gold and Platinum level certificates. The cost of certification depends primarily on the calculated building's square footage including the parking lot[384].

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381 N.G. Miller, D. Pogue, Q.D. Gough, S.M. Davis, *Green Buildings and Productivity*, "The Journal of Sustainable Real Estate" 2009, Vol. 1, No 1, pp. 80–87.

382 Z. Ullah, M.J. Thaheem, A. Waheed, A. Maqsoom, *Are LEED-certified healthcare buildings in the USA truly impacting sustainability?*, "Indoor and Built Environment" 2020, Vol. 29, pp. 7–23.

383 Ó. Ribero, D. Garzón, Y. Alvarado, I. Gasch, *Economic benefits of LEED certification: a case study of the Centro Ático building*, "Revista Ingeniería de Construcción" 2016, Vol. 31, No 2, pp. 139–146.

384 More information about certification fees is available at https://www.usgbc.org/tools/leed-certification/fees

Case study

The modernization cost analysis of the Center for Advanced Studies and Energy National building at the University of Science and Technology in Islamabad and its impact on the possibility of obtaining the LEED v4 (BD + C) certification indicates that even small but well-thought-out investments increase the chances of obtaining the Silver level LEED certification. It has been calculated that prior to its modernization the building would get only 29 out of 110 possible points. The proposed changes are as follows: installation of bike racks, bathrooms with showers and changing rooms for cyclists, three parking lots with appropriate chargers for electrical vehicles, installation of water savings devices for both bathroom and kitchen areas (this would lead to 54% of water savings), installation of more than a dozen new water meters and hiring of an entity authorized to conduct the changes in accordance with the LEED requirements. The total investment cost would be approximately $110k. The value of the purchased equipment would equal to around 21% of the total value, 72% of the value would be related to hiring the authorized contractor while the remaining 7% would be spent on the fees related to the certification itself (LEED AP services and USGBC fees)[385].

An interesting example of a LEED O+M certified facility in Europe is the Rondo 1 building in Warsaw. Its first LEED Gold certificate was awarded in 2011 (the building received a total of 61 point during the assessment)[386]. It was the first building in Europe to receive this type of certification in the "Existing Buildings" category. Despite the fact that the building has received many different awards it is the LEED certificate that is promoted on the building's official website[387]. During the construction phase, harmless building materials were used. Suitable infrastructure for cyclists (free–of- charge locker rooms and showers) was also created. Solutions which facilitate the maximum use of natural light for office spaces were implemented and 100% of the energy used inside the building has renewable energy certificates. Rondo 1 also uses approximately 30% less drinking water than standard buildings. An additional attribute is a very advantageous location which allows for the use of public transport[388].

During a re-certification, based on the LEED 2009 O+M system which was conducted in June of 2016, the building received 80 points which gave it the

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385 Z. Ullah, A. Khan, M.J. Thaheem, *Comparison of LEED credit achieved by case study building before and after retrofitting*, 1st International Conference on High Performance Energy Efficient Buildings and Homes (HPEEBH 2018) August 1-2, 2018, Lahore, Pakistan, pp. 248–254, https://www.researchgate.net/publication/326915014_Comparison_of_LEED_credit_achieved_by_case_study_building_before_and_after_retrofitting.

386 https://www.usgbc.org/projects/rondo-1, 17.08.2020.

387 https://rondo1.pl/budynek, 17.08.2020.

388 https://www.propertynews.pl/biura/rondo-1-z-certyfikatem-w-kolorze-platyny,47673.html, 17.08.2020.

Platinum level certificate. In December 2019, thanks to the LEED v4.1 O+M re-certification, the building received 85 points and the Platinum level certificate[389].

3.9. Nordic Swan

(Juraj Šebo)

History and development of the program

The Nordic Swan Ecolabel was established in 1989 by the Nordic Council of Ministers as a voluntary ecolabelling scheme for the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden)[390]. In 1994 the Nordic Swan Ecolabel was also one of the founders of the Global Ecolabelling Network – the international network for ISO type I ecolabels[391].

The Nordic Swan Ecolabel voluntary ecolabelling scheme is also called Nordic Ecolabel[392]. Behind the Nordic Swan Ecolabel is the non-profit organization Nordic Ecolabelling that offers independent third-party certification and support for a wide range of goods and services[393].

The reason for establishment of the scheme was to help companies that want to go ahead with sustainable solutions and thereby enable consumers and professional buyers to choose environmentally best goods and services[394]. It also encourages the development of products and services that have less of an impact on the environment and climate than similar products on the market. The Nordic Ecolabel takes into account the environmental impact of goods and services during their entire life cycle, from raw materials extraction, production, and use to waste/recycling. It places strict requirements on climate and environmental impact, and also function and quality. It is an important instrument for achieving the Nordic countries' goals for sustainable consumption and production[395]. The Nordic Swan Ecolabel addresses 12 of the 17 UN Sustainable Development Goals, its criteria have bearing on the 2030 Agenda, as well as e.g. Sweden's national sustainability goals and the generational goal. The Nordic Swan Ecolabel is only awarded to the best products and services. The target is not to ecolabel all products and services. This would weaken its credibility as a trustworthy ecolabel[396].

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389 https://www.usgbc.org/projects/rondo-1-0, 17.08.2020.

390 Nordic Swan Ecolabel, *The Nordic Swan*, www.nordic-ecolabel.org/the-nordic-swan-ecolabel/, 01.07.2020.

391 Ib.

392 Nordic Ecolabeling, *Regulation for the Nordic Ecolabeling of Products*, 2016.

393 Nordic Ecolabeling, *Sustainable consumerism in the Nordic region: The report*, 2018.

394 Nordic Swan Ecolabel, op. cit.

395 The Nordic Council of Ministers, *Goals and Principles for the Nordic Ecolabel (the Swan)*, 2014; Nordic Ecolabeling, *Sustainable consumerism*…, op. cit.

396 Ecolabeling Sweden, *Strategies for sustainable business development: The report*, 2019.

All fundamental decisions about the Ecolabel – including guidelines, rules for development work and criteria for usage – are made at Nordic level (the Nordic Ecolabelling Board is the decision-making body, the Nordic Ecolabelling Association is responsible for the operational coordination of the national ecolabelling organizations). The national ecolabelling organizations are responsible for the licensing of individual products using set criteria, in accordance with the requirement for certification stipulated by the international standard ISO 17065[397]. In all Nordic countries, these scheme managing organizations are state-owned companies that operate without profit or industry interests[398]. The Nordic Swan Ecolabel has no self-interest in existing, e.g. if there is be sustainable society in future. In fact, it already closed down product groups where the industry is managing on their own or new legislation has been implemented[399].

The Nordic Swan Ecolabel has participated in changes in different industries. It has contributed to the disappearance of dangerous chemicals from the printing industry, enabled consumers to find ecolabelled detergents and toilet paper in stores and helped to achieve a more energy-efficient and chemicals-friendly hotel industry[400]. The current Ecolabeling Sweden (2019)[401] report shows that green buildings and sustainable building techniques are becoming a new norm. Just looking at the last three years shows that the number of Nordic Swan Ecolabelled houses has quadrupled in the Nordic countries. In Sweden, there are now 21740 apartments, houses and pre-schools built according to our strict requirements on energy efficiency and healthy building materials[402]. Currently, more than 25000 products and services (globally) are covered by 2155 licenses in 58 industries[403].

Since the Nordic Swan was a joint initiative of several Nordic countries, its development may, to some extent, be country-specific. In Sweden, the first criteria appeared in 1991. They were established for batteries. In 1992 first licenses were awarded to paper and detergents. In 1996, 96% of all Swedes knew about the Nordic Swan Ecolabel commonly referred to as "Svanen". In 1999 the first criteria for a service were approved. In 2005 the first Nordic Swan ecolabelled house appeared. In 2007 the Nordic Swan Ecolabel's procurement network was established to support companies that want to make sustainable purchases (currently 240 members). In 2010, license number 2000 was distributed in the Nordic region and the largest advertising initiative "Save the

397 The Nordic Council of Ministers, *Goals and Principles…*, op. cit.; Nordic Ecolabeling, *Sustainable consumerism…*, op. cit.

398 Nordic Swan Ecolabel, *The history of the Nordic Swan Ecolabel*, https://www.svanen.se/en/tasks-of-nordic-swan-ecolabel/history-of-nordic-swan-ecolabel/, 01.07.2020.

399 Ecolabeling Sweden, *Strategies for sustainable…*, op. cit.

400 Nordic Swan Ecolabel, *The history…*, op. cit.

401 Ecolabeling Sweden, *Strategies for sustainable…*, op. cit.

402 Ib.

403 Nordic Ecolabeling, *Sustainable consumerism…*, op. cit.

world little by little every day" was launched in 2015. In 2017, the world's first Nordic Swan Ecolabelled funds were launched (currently 21 funds)[404].

The dissemination of ecolabels in the Nordic countries is considered to be a success. The Nordic Swan label has been reported to be recognized by more than 90% of the consumers in Sweden and slightly less in Norway, Finland and Denmark and much less (about 50%) in Iceland[405]. Currently, the Nordic Ecolabeling (2018) report informs that 89% of all Nordic citizens recognize the Nordic Swan Ecolabel as a brand and that 72% of Nordic consumers think that the Nordic Swan Ecolabel makes it easier for them to make environmentally friendly choices. Reports from Ecolabeling Sweden (2019) show that 97% of all people in Sweden recognize the Nordic Swan Ecolabel as a brand. According to Bjorner (2002) study the Nordic Swan label has had a significant effect on Danish consumers' brand choices for toilet paper and detergents, corresponding to a willingness to pay for the certified environmental label of 10-17% of price of the labelled products[406]. More recent Nordic Ecolabeling (2018) report, based on survey executed in 2018, shows that 1 out of 4 people in the Nordic countries believe that more ecolabelled products would make the greatest contribution to promoting sustainable consumption. The report also shows that 1 out of 3 people claim to have chosen sustainable products and services to support responsible brands. As further stated, 75% of Nordic consumers consider it to be of vital importance that labelling schemes are objective and independent[407].

The Nordic Swan Ecolabel is part of a new initiative (ModUpp 2020) and one of the best known third-party labels in Sweden. This initiative calls on decision-makers and purchasers in the public sector to use third-party certifications for the environment and social sustainability in order to shift to a more modern approach towards public procurement[408].

"According to the Nordic Swan Ecometer (2019) realised in Sweden, 1 of 2 people say that sustainability in their workplace has increased over time. This also shows, that when asked 'Does your employer has a sincere desire to work more sustainably?' 44% of people answered 'yes', 16% 'no' and 40% 'don't know', while young people were the most skeptical (only 24% answered 'yes').

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404 Nordic Swan Ecolabel, *The history…*, op. cit.

405 Nordic Swan Ecolabel, *Why choose ecolabelling?*, 2020, www.nordic-ecolabel.org/why-choose-ecolabelling/, 01.07.2020; Ch. Leire, A. Thidell, *Product-related environmental information to guide consumer purchases e a review and analysis of research on perceptions, understanding and use among Nordic consumers*, "Journal of Cleaner Production" 2005, Vol. 13, pp. 1061–1070.

406 T.B. Bjorner, L.G. Hansen, C.S. Russel, *Environmental labelling and consumers' choice – An empirical analysis of the effect of the Nordic Swan*, Working Paper No. 02-W03, Vanderbilt University, Nashville, USA 2002, pp. 1–53.

407 Nordic Ecolabeling, *Sustainable consumerism…*, op. cit.

408 Ecolabeling Sweden, *Strategies for sustainable…*, op. cit.

Furthermore, this shows that 1 of 3 people say their employer's sustainability work consists of empty words and that they miss action"[409].

Requirements and methodology of impact assessment

In the Nordic Swan Ecolabel scheme the environmental impact through the product´s life cycle is analysed and forms the basis for defining a limited number of requirements for the most important environmental issues ("hotspots"). According to the Nordic Ecolabeling (2019) report, the Nordic Swan Ecolabel sets strict criteria for resource consumption and waste, effect on climate, use of chemicals, and biodiversity. Key factors in this work include the choice of raw materials, use of hazardous chemicals, use of energy and resources, emissions to all kind of recipients, health aspects, noise and waste treatment associated with production, transport and final disposal. The product's lifespan and whether it can be repaired are also important, as is the extent to which it can be reused and recycled. Environmental principles, such as the precautionary and substitution principles are also included in the development of criteria. The environmental priorities are based upon the Nordic Ecolabel's RPS (relevance, potential, steerability) analysis tool. Products featuring the Nordic Ecolabel should also be characterized by good quality and functionality, so usually requirements regarding these factors are included. In addition to environmental criteria, sustainability criteria are gradually being added. The stringency of the environmental requirements is high, adaptable to technical advancements and related to the Nordic countries' official environmental regulations. The purpose of the criteria is to identify the most environmentally sound products on the Nordic market. The target is that a maximum of one third of the products available in the Nordic Region meet the criteria at the point in time when the criteria are adopted. The criteria are valid for a maximum of five years. The requirements are evaluated at least every third year[410]. Licenses are time-limited and companies must apply again to create sustainable development[411].

As mentioned in the Ecolabeling Sweden (2019) report, the Nordic Swan Ecolabel can "nudge" companies to operate more circularly. For example, its requirements for packaging and paper, as well as some construction products, demand that the product has to be made partly from recycled raw material. In the case of renovation (services) the Nordic Swan Ecolabel criteria include recycling and reuse, and there are requirements for an assessment and plan for reuse of materials, as well as for waste management. This is crucial to ensure a resource-efficient renovation, in line with the circular thinking[412].

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409 Ib.
410 The Nordic Council of Ministers, *Goals and Principles…*, op. cit.
411 Nordic Ecolabeling, *Sustainable consumerism in the Nordic region: The report*, 2019.
412 Ecolabeling Sweden, *Strategies for sustainable…*, op. cit.

The Nordic Swan Ecolabel covers several hundred product types, which are grouped in more than 60 different product groups (table 30)[413].

Table 30. Nordic Swan Ecolabel product groups

Alternative dry cleaning	Industrial cleaning and degreasing agents
Baby products with textiles	Investment funds and investment products
Candles	Laundry detergents and stain removers
Car and boat care products	Laundry detergents for professional use
Chemical building products	Liquid and gaseous fuels
Cleaning agents for use in the food industry	Machines for parks and gardens
Cleaning of liquid damaged electronics	Office and hobby supplies
Cleaning products	Outdoor furniture and playground equipment
Cleaning services	Packaging for liquid foods
Closed Toilet Systems	Photographic developments services
Coffee service	Primary batteries
Compost bins	Printing companies, printed matter, envelopes and other converted paper products
Computers	Rechargeable batteries and portable chargers
Construction and facade panels	Remanufactured OEM Toner Cartridges
Copy and printing paper	Renovation
Cosmetic products	Sanitary Products
De-icers	Ski wax
Dishwasher detergents and rinsing agents	Small houses, apartment buildings and buildings for schools and pre-schools
Dishwasher detergents for professional use	Solid Biofuel Boilers
Disposable bags, tubes and accessories for health care	Solid fuels and firelighting products
Disposables for food	Stoves
Durable/resistant wood for outdoor use	Supplies for microfiber based cleaning
Floor coverings	Textile services
Furniture and fitments	Textiles, hides/skins and leather
Grease-proof Paper	Tissue paper
Grocery Stores	Toys
Hand Dishwashing Detergents	Transport wash installations
Heat pumps	TV and Projectors
Hotels, Restaurants and Conference Facilities	White Goods
Imaging equipment	Windows and exterior doors
Indoor paints and varnishes	

Source: own work based on: Nordic Swan Ecolabel, *Product groups,* https://www.nordic-ecolabel.org/product-groups/, 02.07.2020.

The certification process could be divided from the applicant's point of view into three steps[414]:

[413] Nordic Swan Ecolabel, *Product groups*, https://www.nordic-ecolabel.org/product-groups/, 01.07.2020.

[414] Nordic Swan Ecolabel, *Certification*, https://www.nordic-ecolabel.org/certification/apply, 01.07.2020.

1. Fulfillment of application form and delivery of other associated declarations (if required). In this step it is possible to apply for several products at the same time, but if products are produced at different places, they usually require individual certifications,
2. Within 3 weeks the national ecolabelling organization (NEO) will determine the status of the application, inform about the need for additional documentation or for changing something related to the product in order to meet the requirements of the Nordic Swan Ecolabel. Once all the documentation is ready, the NEO will contact the applicant and they make an appointment for an inspection visit. If the production in reality actually complies with the documentation, technical review of the application is initiated,
3. When the application passes the technical review and administrative details are handled, the certification is granted. From that moment on, the applicant may use the Nordic Swan Ecolabel on its products (or in relation to its services). Usually the certification process lasts 2 to 6 months.

The application consists of an application form and documentation showing that the requirements are fulfilled. Each requirement is marked with letter O (obligatory requirement) and a number (table 32). All requirements must be fulfilled in order to receive a license. All information submitted to Nordic Ecolabelling is treated confidentially[415].

The license can cover multiple products within the same product group. As a rule, the license covers one production site. Normally the Nordic Swan Ecolabeling license is valid worldwide. However, for certain product groups there is an option to apply for a license for a single Nordic Country. Typically, in the case of services, the license covers each country where the applicant operates[416].

In order to be licensed under the Nordic Swan Ecolabel, the applicant must comply with the requirements of the relevant criteria[417]. Criteria documents for each product group encompass a wide range of requirements. According to the different criteria applied for each group of products table 31 shows the requirements applied for three selected products (groups of products).

[415] Nordic Ecolabeling, *Criteria document - TV and Projectors - version 5.8*, 2020, 17.08.2020.
[416] Nordic Ecolabeling, *Regulation for the Nordic Ecolabeling of Products*, 2016.
[417] Ib.

Table 31. Nordic Swan criteria for three selected products

Product/ product group	Laundry detergents	Tissue paper	TV sets
Criterion/group of criteria 1	Meet strict requirements concerning environmentally hazardous chemicals, including requirements for eco-toxicity and biodegradability	Made of fibers from sustainable forestry and/or recovered fiber and has been produced with low levels of emissions to air and water.	Low energy consumption
Criterion/group of criteria 2	Meet strict health related requirements concerning chemicals that pose a health hazard, including complete ban on CMR classified substances and various specifically problematic substances such as SVHCs and suspected endocrine disruptors	Energy consumption during production is low and limits are placed on the use of chemicals hazardous to health and the environment, both during production and in the paper product itself.	Do not contain harmful flame retardants.
Criterion/group of criteria 3	Promote increased use of sustainable renewable raw materials	Resources are used efficiently and environmentally suitable production methods are employed.	Are free of mercury and contain a minimal amount of environmentally hazardous and harmful chemicals
Criterion/group of criteria 4	Are concentrated	Only raw materials of the highest quality in environmental terms may be used.	Easy to recycle
Criterion/group of criteria 5	Are efficient at 30ºC (color-safe and delicate) and 40ºC (white wash)		
Criterion/group of criteria 6	Have a packaging that contains recycled materials and is designed for circular economy		

Source: own work based on: Nordic Ecolabeling, *Criteria document – Laundry detergents and stain removers – version 8.0*, 2020; Nordic Ecolabeling, *Criteria document – Tissue paper – version 5.8*, 2018; Nordic Ecolabeling, *Criteria document – TV and Projectors – version 5.8*, 2020, 17.08.2020.

Table 32. Nordic Swan Ecolabel requirements for TV, product category "TV and projectors"

No	Category	Requirements
O1	Specific requirement for television-sets	All products should have a hard or soft on-off switch
O2	Passive standby for televisions	The product must meet the requirements for power consumption in standby and off mode according to current Eco-design regulation (EC) No 642/2009
O3	Energy efficiency for television sets	The product must meet the requirement for Energy Efficiency Class A+ in the current Energy Labelling Regulation (EU) No 1062/2010, with updates, for all screen sizes
O5	Flame retardants in plastic and rubber parts	e.g. flame retardants HBCDD, TCEP and high chlorinated short chain and high chlorinated medium chain chloro-paraffins must not be added
O6	Chlorine-based plastics	Plastic parts >25g must not contain chlorinated polymers
O7	Phthalates in the external power cable	The external power cable delivered with the product must not contain the following substances: DEHP, etc.
O8	Mercury content in background light in LCD displays and projector lamp	The background light in the TV-screen must not have any mercury (Hg) content The lamp for projectors cannot contain mercury (Hg)
O9	Declaration of nitrogen trifluoride (NF3) and sulfur hexafluoride (SF6) emission during LCD production	The LCD panel must be produced in such a way that the greenhouse gases NF3 and SF6, if they are part of the production process, are eliminated by a system that is an integral part of the production process. It is the responsibility of the manufacturing company to ensure that the emission reduction system is installed, operated and maintained in accordance with the manufacturers (of the emission reduction system) specifications The manufacturer of the LCD shall declare the amount of NF3 and SF6 purchased in relation to the amount of LCD (m2) produced over one year
O11	Dismantling	The manufacturer shall demonstrate that the product can be easily dismantled by professionally trained recyclers, using the tools usually available to them, for the purpose of: 1. Undertaking repairs and replacements of worn-out parts, 2. Upgrading older or obsolete parts, 3. Separating parts and materials, ultimately for re-cycling. To facilitate the dismantling: 1. Fixtures within the products should allow for this disassembly, e.g. screws, snap-fixes, especially of parts containing hazardous substances, 2. Plastic parts should be of one polymer or be of compatible polymers for re-cycling and have the relevant ISO11469 marking if >25g in mass. Exception is made for extruded plastic materials and for light emitters in flat screens, 3. Metal inlays that cannot be separated should not be used, 4. Data on the nature and amount of hazardous substances in the television set will be gathered in accordance with the directive on classification, packaging and labelling of

		dangerous substances (67/548/EEC) and directive 2006/121/EEC about changes in directive 67/548/EC.
O12	Re-cycled material in packaging	When cardboard boxes are used, they must be made of at least 50 % of post-consumer re-cycled material. Only primary packaging, as defined in Directive 94/62/EC, is subject to the requirement
O13	Requirements regarding life-time extension	The manufacturer must offer a commercial guarantee to ensure that the product will function for at least two years. This guarantee should be valid from the date of delivery to the customer The availability of compatible electronic replacement parts must be guaranteed for seven years from the time that production ceases. This must be written in the electronic and/or printed product fact sheet
O14	Operating instructions	The product should be delivered with an instruction manual which provides advice on how the product is best used from an environmental perspective. The instructions should include information that the product is Nordic Eco-labelled with a brief explanation of what this means together with a reference that more information about the Nordic Ecolabel can be found on the Nordic Ecolabel website
O15	Code of conduct	The license holder must have a code of conduct that shows how the license holder works to ensure that human rights, labor rights, environmental protection and anti-corruption measures follow international guidelines, such as the principles of the United Nations Global Compact The licensee should make sure that all suppliers / subcontractors are aware of the code of conduct, and insist that they apply it. If the license holder violates the code of conduct the Nordic Ecolabel license can be revoked.
O16	Nordic ecolabel licence contact	The company should appoint a person responsible for ensuring the fulfilment of Nordic Ecolabel requirements, and a contact person for communications with Nordic Ecolabelling. Preferably, this should be the same person
O17	Documentation	The licensee must be able to present a copy of the application and factual and calculation data supporting the documents submitted on application (including test reports, documents from suppliers and suchlike).
O18	Quality of the product	The licensee must guarantee that the quality in the production of the Nordic Ecolabeled TV or projector is maintained throughout the validity period of the licence
O19	Service and support	The licensee should offer the possibility of service and support in the official Nordic language where the Nordic Ecolabeled product is sold
O20	Planned changes	Written notice must be given to Nordic Ecolabelling of planned changes in products and markets that have a bearing on Nordic Ecolabel requirements.
O21	Unplanned nonconformities	Unplanned non-conformities that have a bearing on Nordic Ecolabel requirements must be reported to Nordic Ecolabelling in writing and in a journal

O22	Traceability	The licensee must be able to trace the Nordic Ecolabeled product in the production
O24	Legislation and regulations	The licensee must guarantee adherence to safety and EMC regulations, working environment legislation, environmental legislation and conditions/concessions specific to the operations at all sites where the Nordic Ecolabeled product is manufactured. Additionally the licensee must guarantee adherence to product-specific regulations in all the Nordic countries where the product is sold

Source: own work based on: Nordic Ecolabeling, *Criteria document – TV and Projectors – version 5.8*, 2020, http://www.unglobalcompact.org, 17.08.2020.

Benefits and costs of participation in the program

According to the fee regulation[418] the applicants and holders of the Nordic Swan license, could face by different fees (table 33). Application fees are payable by the applicant in conjunction with the application. The fee for on-site inspection is applied when multiple on-site inspections are necessary (Remark. An on-site inspection at one production site in the Nordic region is covered by the application fee). Following the award of a license, the applicant must pay a license fee. The license fee is payable annually for the right to use the ecolabel in the Nordic market. It is based on the turnover of the Nordic Swan ecolabelled product. Nordic Ecolabelling charges also a fee for sales outside the Nordic countries, if it exceeds a certain level. In the event of termination, a fee shall be paid for realised sales during the license period and for the value of remaining stock of ecolabelled products, even on expiry of the license. A licensee wishing to amend the contents or extend the scope of the license must pay an amendment and/or an extension fee, and any adjusted license fee, for the work thus carried out by the ecolabelling organization. Nordic ecolabelling can charge a fee for the inspection of raw materials for Nordic Swan ecolabelled products and for listing inspected raw materials.

Table 33. Costs of certification by Nordic Swan

Cost category	Denmark	Norway	Sweden
Application fee (first)	3000 EUR + VAT	3000 EUR + VAT	30000 SEK + VAT
Renewal of license	1500 EUR + VAT	1500 EUR + VAT	15000 SEK + VAT
Annual license fee for Nordic countries	0,3% of turnover + VAT per year	0,3% of turnover + VAT per year	0,3% of turnover + VAT per year (0,05% if > 30 mil. EUR)
Min./Max annual fee for the Nordic countries	2000 EUR / different or no max. fee (e.g. 85 000 EUR) + VAT per year	2000 EUR / different or no max. fee (e.g. 85 000 EUR) + VAT per year	2000 EUR / different or no max. fee (e.g. 85 000 EUR) + VAT per year

[418] Nordic Ecolabeling, *Fee Regulation of Nordic Ecolabeling*, 2017.

Annual license fee outside the Nordic countries	2000 EUR + VAT per year	2000 EUR + VAT per year	2000 EUR + VAT per year
Extension of license	e.g. 4-8 hours: 750 EUR + VAT *	e.g. 4-8 hours: 750 EUR + VAT *	e.g. 4-8 hours: 750 EUR + VAT *
Fee for on-site inspection	500 EUR + VAT per visit	500 EUR + VAT per visit	500 EUR + VAT per visit
Remarks: VAT = Value Added Tax These numbers are valid in general (or specifically for TV) but don't include all specific cases. * Charged according to how long it takes to deal with the matter			

Source: own work based on: Ecolabelling Denmark, *Product group: TV and Projectors*, 2017, https://www.ecolabel.dk/en/product-groups/show-product-group?produktgruppeid=071&projektgruppe=Svanen#,tab:fees, 04.07.2020; Ecolabeling Norway, *Fees Nordic Swan Ecolabel*, 2020, https://www.svanemerket.no/PageFiles/17162/20170927_Fees_Nordic_Swan_Ecolabel.pdf, 04.07.2020; Miljømerking, *TVer og projektorer*, 2017, https://www.svanemerket.no/svanens-krav/elektrisk-og-elektronisk/TV-projektor/, 04.07.2020; Ecolabeling Sweden, *TV and Projectors 071*, 2020, https://www.svanen.se/en/how-to-apply/criteria-application/tv-and-projectors-071/, 04.07.2020.

Case study – Ballograf (Sweden)

Ballograf is a Swedish producer of pens established in 1945. Since the change of owners in 2005 Ballograf decided to place an increased emphasis on the environmental impact and awareness of the company. The company sensed an increased interest in environmentally friendly products within their business and decided to design and produce a Swan labeled pen, which was not available on the market at the time. The development of the pen was a challenge as the "body" of the pen had to be produced mostly of cardboard, each end of the pen had to be made of recyclable plastic and the ink container also needed to be made of recyclable plastic and contain environmentally friendly ink. This had implications for the company's subcontractors as they had to develop a new type of ink, and also for Ballograf itself as the company, among other things had to buy a new mold for casting the pens. In total, the development took 1,5 years. The largest impact of the Swan Label on Ballograf has been manifested in the strengthened environmental profile of the company and the signal which it can send to its customers. The company believes that the Swan Label has improved the brand of the company and that it is easier to build a brand among customers. Furthermore, the fact that the pen is the first of its kind to be Swan labelled has created some degree of attention. The company believes that it is easier to get the new pen advertised in catalogues and product magazines as the product is new and first of its kind. The Swan Label is also part of an increased focus on the chemicals used in the production – especially with regards to ink[419].

[419] U.B. Kjeldsen, M. Wied, P. Lange, M. Tofteng, K. Lindgaard, *The Nordic Swan and companies*, *TemaNord*, 2014, https://www.diva-portal.org/smash/get/diva2:715465/FULLTEXT02.pdf, 17.08.2020.

4. Self-declared environmental claims

(*Igor Budak, Boris Agarski, Milana Ilić Mićunović*)

4.1. Mobius loop

One of the most famous and universally recognized symbol on products and packaging is the so-called Mobius loop (or Möbius loop). The Mobius loop symbol is primarily associated with the fact that a product/packaging can be recycled, more often than not when it contains a recyclable material. Although there is an opinion that this is symbol stands for recycling, this is only a part of its definition. The original meaning of this symbol is more complex.

History and development of the program

The original symbol was designed by Gary Anderson in 1970, a young student from the University of Southern California. The symbol was the result of his participation in the competition to design a paper recycling symbol[420].

The symbol, which contains three half-bent arrows in the shape of a triangle, is based on the Mobius strip, which was discovered by a German mathematician August Ferdinand Möbius in the 19th century. Each arrow is folded back and all three are connected to each other, which conditionally represents the recycling cycle. Each arrow has its own meaning, it is a symbol for the 3R environment[421]:

1. Reduce,
2. Re-Use,
3. Recycle.

Reduce – reuse – recycle are the basic postulates for total waste management, with the idea to primarily make an effort to avoid waste, or reduce its quantities, then to reuse it, and finally recycle and process, giving new usable products. At the end of this cycle, only what is unusable will be disposed of in a way that will not be harmful to the environment and our health.

Also, it should be noted that there is a 6R concept that gives meaning to every folded part of the arrows in the Mobius loop and is in line with the eco-design concept. One interpretation is the addition of such terms as – recover, redesign and remanufacture to the basic 3R terms, achieving a more comprehensive and complete presentation of material flows in the sustainable

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[420] J. Hodolič, I. Budak, M. Hadžistević, Đ. Vukelić, M. Majernik, J. Chovancova, J. Pankova-Jurikova, M. Ćulibrk, *Sistemi za upravljanje zaštitom životne sredine*, op. cit.

[421] Ib.; M. Ilić, I. Budak, B. Crnobrnja, J. Hodolič, *Analysis of self-declared environmental labels*, "RMZ - Materials and Geoenvironment" 2009, Vol. 56, No 1, pp. 74–87.

product life cycle. Another variant is adding – rethink, refuse, repair – a concept that is more related to the ideology of the so-called "green living"[422].

The Mobius loop symbol is used in different ways and in different variations. The color and position of the symbol should correspond to the product which will be applied. Some of the basic guidelines and at the same time, only the graphical symbol defined in ISO 14021 is the symbol of the Mobius loop. According to the standard, there are two basic forms of using this environmental label[423]:

1. The product can be recycled (1a. Recycling codes),
2. The product contains recycled material.

Recyclability

The form of the Mobius loop, which means that the product can be recycled, is the most commonly used form. This symbol should be applied to products made of materials that can be recycled and must be understood as a claim of recyclability (figure 18)[424].

Figure 18. Mobius loop – variations of the graphical solution when using the term recyclable

Source: ISO 14021:2016, Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling).

Recycled content

When recycled material is used in the production of a product, in some percentage, the Mobius loop should be applied with the percentage of recycled material (figure 19). As in the previous case, there are variations of the graphic solution depending on the need and product/packaging[425].

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422 Global Environment Outlook 6, Go cilcular- add oxygen to the economy, UN Environment Report, 2019.

423 Decision 97/129/EC – establishing the identification system for packaging materials pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste, Official Journal of the European Communities, 1997.

424 ISO 14021:2016, Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling).

425 Ib.

Figure 19. Mobius loop – variations of the graphical solution when using the term recycled content

Source: ISO 14021:2016, Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling).

Recycling codes

The generic form of the Mobius loop (without percentage) also refers to the fact that the product/packaging can be recycled. The presence of a number inside the loop, the so-called recycling code, indicates the type of material from which the product/packaging is made.

Program "Plastic" (the Mobius loop with recycling codes) was adopted primarily for plastic products, in order to facilitate the process of their selection. In 1988, the American Plastics Industry Association (SPI) developed a resin identification coding system, based on the Mobius loop. Based on this system, the international standard - ISO 1043-1 Plastics – Symbols and abbreviated terms was developed. Although several coding systems of this type are in use worldwide , it can be said that in the case of plastics all of them are mainly based on the ISO 1043-1 standard, with possible minor modifications[426].

Although the presence of the symbol is associated with the fact that this plastic object can be recycled, the basic role is to identify the plastic raw material from which the product is made. This system enables simpler and more efficient classification of plastic packaging according to the raw material origin. So far, this method of numbering has covered 6 groups of most commonly used plastic materials, while others are marked with number 7 – "Other"[427] (table 34).

Paper is the most common component of municipal waste, especially in developed countries. Today, the following types of paper are recycled: old newsprint, packaging cardboard, quality paper for printers and photocopiers and mixed paper. Cardboard is the most frequently recycled packaging material, and the result of recycling is mainly the production of new packaging, corrugated cardboard[428].

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426 Decision 97/129/EC – establishing the identification system…, op. cit.

427 Ib.

428 J. Hodolič, Đ. Vukelić, M. Hadžistević, I. Budak, M. Badida, L. Šooš, B. Kosec, M. Bosak, M., *Reciklaža i reciklažne tehnologije*, op. cit.

Table 34. Recycling codes for plastic materials

						
Polyethylene Terephthalate	High-Density Polyethylene	Polyvinyl Chloride	Low-Density Polyethylene	Polypropylene	Polystyrene	Other

Source: Decision 97/129/EC – establishing the identification system for packaging materials pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste, Official Journal of the European Communities (1997).

In order to promote the recycling and special separation of waste from paper and cardboard, certain labels are applied in this area as well. The Mobius loop is mainly used in combination with a certain text which more precisely indicates the type of paper (table 35). In addition to the Mobius loop with recycling codes, there are many different variants of the Mobius loop for paper and cardboard made by different countries, companies and paper recycling organizations[429].

Table 35. Recycling codes for paper and cardboard

			
Cardboard	Other Cardboard	Paper	Paperboard

Source: Decision 97/129/EC – establishing the identification system for packaging materials pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste, Official Journal of the European Communities (1997).

Ferrous metals, iron and steel are more suitable for recycling, than all other components of municipal solid waste and can be reprocessed practically countless times. Steel is a very suitable material for making packaging, especially for food products. In addition to steel cans which are recycled most frequently, steel car parts, white goods and other bulky waste are also recycled.

[429] Decision 97/129/EC – establishing the identification system…, op. cit.

A special advantage in iron and steel recycling is the possibility of their magnetic separation[430].

The production of aluminum from its ore (bauxite) is very energy demanding. On the other hand, aluminum is very suitable for recycling, because, unlike other materials (especially paper and plastic), its properties do not change during the recycling process (similar to other metals and glass). The fact that recycling does not change the properties of aluminum suggests that new aluminum packaging can be made from 100% recycled material. This enables the creation of a practically closed loop, in which used packaging is constantly recycled into new packaging, while saving energy.

Aluminum products most often use the label shown in table 36, whereby the code of the material and the abbreviation which denotes the material are used in different applications[431].

Table 36. Recycling codes for metal

	
Steel	Aluminum

Source: Decision 97/129/EC – establishing the identification system for packaging materials pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste, Official Journal of the European Communities (1997).

The production of glass is based on raw materials that are abundant in natural resources. Its production, however, requires significant energy investments, which is the most important feature in assessing the acceptability of the production of glass packaging, from the point of view of environmental protection. Glass, on the other hand, thanks to 100% recyclability and repeatability of the recycling process, is ideal for reuse. This is also the reason why it still remains the dominant packaging material in the beverage industry. If the collection of glass packaging is organized correctly, recycling in a closed loop is possible[432].

Special codes have been developed in the Mobius loop for glass products/packaging (table 37), to draw consumer's attention to the possibility of recycling glass.

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430 J. Hodolič, Đ. Vukelić, M. Hadžistević, I. Budak, M. Badida, L. Šooš, B. Kosec, M. Bosak, M., *Reciklaža i reciklažne tehnologije*, op. cit.

431 Decision 97/129/EC – establishing the identification system…, op. cit.

432 J. Hodolič, Đ. Vukelić, M. Hadžistević, I. Budak, M. Badida, L. Šooš, B. Kosec, M. Bosak, M., *Reciklaža i reciklažne tehnologije*, op. cit.

Table 37. Recycling codes for glass

									
Mixed Glass	Clear Glass	Green Glass	Dark amber Glass	Light amber Glass	Light leaded Glass	Leaded Glass	Copper Mixed	Silver Mixed	Gold Mixed

Source: Decision 97/129/EC – establishing the identification system for packaging materials pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste, Official Journal of the European Communities (1997).

Organic materials such as wood and textiles, are renewable raw materials, and the production of products from these materials requires less energy than other materials. Wooden packaging and textiles can be reused, although their characteristics may deteriorate over time. At the end of their life cycle, they can be recycled in terms of grinding and use in the wood and paper industry, i.e. used as an energy source or destroyed by incineration[433].

The Mobius loop recycling codes for wood products/packaging are given in table 38.

Table 38. Recycling codes for wood and textiles

				
Wood	Cork	Cotton	Jute	Other Textiles

Source: Decision 97/129/EC – establishing the identification system for packaging materials pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste, Official Journal of the European Communities (1997).

Composite packaging and batteries are much more complex to recycle and pose a greater environmental risk. In order to facilitate separation from waste and since it is very often impossible to identify the composition of complex packaging and batteries, the Mobius loop with recycling codes on these materials is very welcome for easier sorting and management of waste which may contain hazardous substances[434] (table 39 and 40).

[433] Ib.

[434] Decision 97/129/EC – establishing the identification system…, op. cit.

Table 39. Recycling codes for composites

							
Paper or cardboard + Miscellaneous metals	Paper or cardboard + Plastic	Paper or fireboard + Aluminum	Paper or fireboard + Tin	Paper and cardboard + Plastic + Aluminum	Paper or fireboard + Plastic + Aluminum + Tin	Biodegradable Plastic	Plastic and Aluminum

Source: Decision 97/129/EC – establishing the identification system for packaging materials pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste, Official Journal of the European Communities (1997).

Table 40. Recycling codes for battery

							
Lead – acid Battery	Alkaline Battery	Alkaline Battery	Nickle–cadmium Battery	Nickle–metal hydride Battery	Lithium Battery	Silver-oxide Battery	Zinc-carbon Battery

Source: Decision 97/129/EC – establishing the identification system for packaging materials pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste, Official Journal of the European Communities (1997).

Requirements and methodology of impact assessment

The requirements of ISO 14021 regarding the application of the Mobius loop are primarily related to the fact that the symbol may only be used in the case of claims of recycled content or recyclability of the product and/or packaging[435].

The graphic representation of the label itself must comply with ISO 7000 and must correspond to the product to which it is applied in terms of position and color, and be recognizable. Also, if the product/packaging is made of a different material, it must be clearly indicated to which part of the product/packaging the Mobius loop refers to, or the symbol must be associated with a brief explanation next to them[436].

[435] ISO 14021:2016, Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling).

[436] Ib.

Most countries have adopted regulations regarding the identification system, that is, the method of numbering, abbreviations, and symbols used in recycling codes[437]. These regulations regulate the application of the Mobius loop as well as the accompanying letters and numerical abbreviations according to the type of material (plastic, paper and cardboard, metal, wood, textiles and glass, etc.) whereby they are recognizable at the international level.

Requirements related to the use of the Mobius loop symbol in the recyclability claims concept

This symbol means that products are recyclable, i.e. those that can be recycled, if the local community has provided appropriate conditions for waste collection and selection.

The term recyclable may only be used[438]:

1. When the system for collection, sorting and transport of materials, from the place of origin to the recycling plant, is easily accessible,
2. When the claimed product is collected and recycled,
3. When the recycling plant is available to receive the collected material.

Requirements related to the use of the Mobius loop symbol in the recycled material claim concept

When there is a claim about recycled materials, the use of symbols is not mandatory. However, if the symbol is used to claim the content of recycled materials, it must be a Mobius loop with the corresponding percentage value in the form of "X%", where X is the recycled content expressed as an integer. The percentage value must be located either inside the Mobius loop or outside and immediately next to the Mobius loop. Examples of acceptable percentage positions are given in figure 19. The Mobius loop with a percentage value, denoted by "X%", must be regarded as a claim for recycled content. If the percentage of recycled content is variable, it can be expressed as "at least X%" or "more than X%". Where a symbol is used, the type of material may be indicated[439].

Benefits and costs of participation in the program

The Mobius loop is a self-declared environmental label and the use of symbol is free of charge, but technically regulated. The symbol must not be used in a modified form, and be appropriated by the company, as its logo or other sign.

The benefits of using this symbol are primarily related to the provision of information that contributes to easier waste management, thanks to the

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437 Decision 97/129/EC – establishing the identification system, op. cit.
438 ISO 14021:2016, Environmental labels and declarations, op. cit.
439 Ib.

possibility of recycling certain materials. The Mobius loop, as mentioned above, can be used on all products that can be recycled or contain recycled material. However, there are certain specifics regarding application on different materials. The codes that are defined and located inside the Mobius loop facilitate the sorting of materials and their subsequent recycling[440]. Furthermore, this type of product/packaging labelling has the advantage of providing consumers, customers and potential buyers with better information about the product.

Usage of Mobius loop on the example from Lenovo

The case study is based on Lenovo packaging specifications for recyclable packaging materials. This example is not standard for ecolabels, as this type of ecolabelling does not require special conditions to obtain a license, and is thus called self-declared. The case study refers to the recommendations and specifications of the labels themselves and context in which they are used on the product/packaging.

Lenovo applies a comprehensive waste management system to reduce the impact of waste materials on solid waste stream. The integrated system emphasizes source reduction and recycling programs before exploring alternatives for disposal. Material recycling strategies is focused on the use of[441]:

1. Materials derived from recycled packaging,
2. Other materials which constitute resources for secondary applications (e.g., recyclable materials).

Their purposes are[442]:

1. To establish parameters for the recycled content to be included in corrugated and plastic packaging,
2. To reduce and/or eliminate the use of non-recyclable materials or compositions of materials that prevent or hinder the recycling of Lenovo packaging after use,
3. To promote recycling by providing information (in the form of markings), which will increase the likelihood that packaging materials will be recycled.

The Lenovo specifications include, but are not limited to, the following packaging materials and packaging components: thermoplastic cushions (RLDPE/RHDPE), molded cushions (of any resin), fabricated cushions (of any resin), corrugated fibreboard, paperboard, rigid and flexible plastics.

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440 M. Ilić Mićunović, R. Ostojić, T. Puškar, M. Radišić, V. Nikić, *Application of LCA results as self-declared environmental claims*, [in] SETAC Europe – LCA Case Study Symposium 20, Novi Sad 2014.

441 O. Peng, *Lenovo Packaging Specification 41A0613: Recyclable Packaging Materials Selection and Identification, Engineering Specification*, 20.01.2013, https://www.lenovo.com/us/en/pdf/social_responsibility/41A0613_Recyclable_Packaging_Materials.pdf, 10.08.2020.

442 Ib.

Example 1. Recycling symbols and general guidelines for the use of paper packaging – paper

The symbols used are typical for paper & paperboard products. These products usually display a recycling symbol with an explanation of the percentage of recycled materials. However, even paper and paperboard products that have already been made from recycled materials can be considered recyclable.

The original Mobius loop design with the three chasing arrows twisting & turning among themselves has transformed over the years. The symbols are often used interchangeably as their use is neither regulated nor required (when first developed, the symbols lost the case for a trademark and fell into the public domain). With this in mind, the new China RoHS requirements have adopted the use of this symbol as a means of identifying the material (Paper based)[443].

If no part-specific artwork is included in the purchase order, the symbol used should be printed near the box maker's certificate in approximately the same size[444].

The Recyclable Content Symbols used in Lenovo packaging are presented below (figure 20).

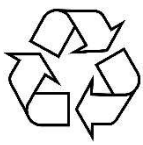

Figure 20. Recyclable content symbols used in Lenovo packaging

Source: O. Peng, *Lenovo Packaging Specification 41A0613: Recyclable Packaging Materials Selection and Identification, Engineering Specification*, 20.01.2013 https://www.lenovo.com/us/en/pdf/social_responsibility/41A0613_Recyclable_Packaging_Materials.pdf, 10.08.2020.

Symbols, which are presented in figure 20, represent two variations of the original recycling symbol. The upper symbol is outlined as a universal recycling symbol, while the lower one as a modification. Paper products usually display the outline form, often with inscriptions such as – Recyclable. When identified with one of the symbols, packaging materials are referred to as recyclable or recoverable. Although these symbols are used on packaging distributed nationwide, the legal regulations governing the collection of these products for the purpose of recycling are determined locally and can vary greatly.

[443] Ib.
[444] Ib.

Figure 21. Symbols of 100% recycled content

Source: O. Peng, *Lenovo Packaging Specification 41A0613: Recyclable Packaging Materials Selection and Identification, Engineering Specification*, 20.01.2013, https://www.lenovo.com/us/en/pdf/social_responsibility/41A0613_Recyclable_Packaging_Materials.pdf, 10.08.2020.

Packaging marked with this symbol has been manufactured in 100% from recycled materials. Typically, additional information is included with the symbol such as – "Printed on recycled paper" or "100% recycled material" or simply "Recycled" (figure 21). The text is usually located to the right or under the symbol. The AFPA (American Forest & Paper Association) promotes the use of the 100% recycled symbol on all paper products that are manufactured from 100% recovered paper fiber. Containers that are free of contaminants (e.g., corrugated coatings) should be marked with the symbol[445].

If a percentage is indicated within this symbol, it means that this is the percentage in which the product has been made from recycled post-consumer materials (figure 22).

Figure 22. Symbols of partial recycled content

Source: O. Peng, *Lenovo Packaging Specification 41A0613: Recyclable Packaging Materials Selection and Identification, Engineering Specification*, 20.01.2013, https://www.lenovo.com/us/en/pdf/social_responsibility/41A0613_Recyclable_Packaging_Materials.pdf, 10.08.2020.

This symbol differs from the others by having solid black arrows within an outer black circle. The circle denotes that at least some content came from recycled material. As with the 100% Recycled Content symbol, additional information is usually included, such as – 50% Total Recovered Fiber/25% Post Consumer Content or 50% Recycled Content. The text is usually located to the right of or below the symbol. The AFPA recycled content symbol may be used to identify any paper based packaging that is manufactured from less than 100% recycled paper fibers. The term "total recycled fiber" or "total recycled paper"

445 Ib.

may be used instead of "total recovered fiber". This symbol must state the recycled content within 5% (by weight)[446].

Example 2. Recycling symbols and general guidelines for the use of paper packaging – polymeric material

In addition to specifying the use of easily recyclable materials, Lenovo Corporation promotes recycling by purchasing products that contain recycled materials. In order to help in achieving this objective, Lenovo requires that plastic packaging be manufactured using the maximum possible amount of post-consumer recycled resin[447].

Below was presented Plastic Coding System. The Society of Plastics Industry (SPI) has developed a coding system that identifies the commonly used plastic resins for recycling purposes. Although this system was originally designed to assist plastic bottle manufacturers, some industrial plastic manufacturers and users of plastic packaging have adopted the system to assist them in sorting resin for recycling. In figure 23, "A" and "B" indicate the percentage of recycled content of the material in the following form: post-consumer/total recycled material. This is a simple way to identify the recycled content of the material, while eliminating the potential for misleading marketing claims. The recycled composition of a packaging part may be described as follows[448]:

1. A = 25% of post-consumer waste recycled content, 15% of industrial waste recycled content,
2. B = 40% of total recycled content, 60% of material, 100% in total,
3. C = the outline of the figure; an isosceles triangle comprised of chasing arrows,
4. D = numerical identification for the material taken from the SPI standard,
5. E = acronym identifying the material. ISO 1043 acronyms are identified in Table 41. It is essential that the SPI resin number "07" be accompanied by the ISO 1043 acronym, if appropriate.

"A" & "B" are not required, but this guideline eliminates the potential for misleading marketing claims. The use of the resin identifier requires that resins be 99% pure to avoid contamination during subsequent recycling. If the plastic part is not manufactured from 100% post-consumer recycled materials, a qualification must be made which clearly identifies the minimum percentage of recycled plastic in the package. This qualifier must specify the recycled content within 5% (by weight). Suppliers of plastic packaging who have knowledge that their materials contain or have been in contact with contaminants, including

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446 Ib.
447 O. Peng, Lenovo Packaging Specification 41A0613…, op. cit.
448 Ib.

hazardous materials, must consider the effects of these elements and may best serve the recycling effort by intentionally omitting the resin identifier[449].

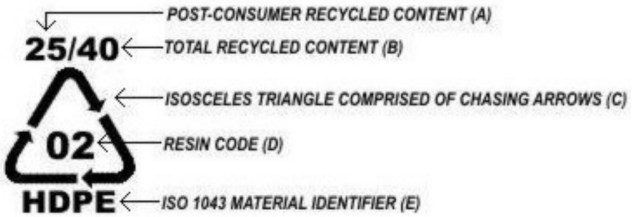

Figure 23. The resin identifier symbols

Source: O. Peng, *Lenovo Packaging Specification 41A0613: Recyclable Packaging Materials Selection and Identification, Engineering Specification*, 20.01.2013 https://www.lenovo.com/us/en/pdf/social_responsibility/41A0613_Recyclable_Packaging_Materials.pdf, 10.08.2020.

The Resin Identifier is presented below (figure 24).

Figure 24. The resin identifier

Source: O. Peng, *Lenovo Packaging Specification 41A0613: Recyclable Packaging Materials Selection and Identification, Engineering Specification*, 20.01.2013, https://www.lenovo.com/us/en/pdf/social_responsibility/41A0613_Recyclable_Packaging_Materials.pdf, 10.08.2020.

A generic form of the plastic resin identification code is also used to designate the recyclability of other packaging materials. Usually there is a descriptive text to designate the particular content[450].

Responsibilities of Lenovo's Suppliers are[451]:

1. These requirements apply to all packaging materials used to make shipments to Lenovo or to customers on Lenovo's behalf. They also apply to all packaging materials purchased by Lenovo and subsequently used by Lenovo for its products, parts and supplies shipments,
2. Suppliers of packaging material products have the sole responsibility to accurately identify and mark the post-consumer recycled content in their products so as to comply with any international, federal, state and local laws. These laws may require specific levels of recycled content and/or

[449] Ib.
[450] Ib.
[451] Ib.

labelling in accordance with environmental labelling and truth in advertising regulations,
3. Suppliers who design packages for the shipment of parts, options, supplies or products must ensure that they use materials and methods which are conducive to recycling,
4. Suppliers who use packaging materials for shipments to Lenovo or sell packaging materials to Lenovo, but do not manufacture and monitor all phases of the material production, must verify that their supplier of cellulosic material conforms to the requirements identified above,
5. Suppliers should contact Lenovo Purchasing at a manufacturing or distribution location, if they are in need of assistance in understanding these responsibilities.

4.2. Green Dot

"The Green Dot" is an internationally protected symbol for product packaging. The Green Dot belongs to the so-called recycling ecolabels. It is similar to type II ecolabels in that there is no special procedure for obtaining this label, it requires to documents to prove the claim that the label carries, while the license for use is payable per kilogram of packaging waste and a contract is concluded with the national licensee. After the product is used and the packaging is discarded, the system will make sure that it is recycled, and not sent to a landfill. Products marked with the Green Dot are gladly seen in markets across Europe because they convey a message to consumers and business partners about the socially responsible business of manufacturers.

The packaging waste disposal system, which is now recognizable as the "Green Dot", has been developed and applied in the 1980s in Germany. The system soon became popular throughout Europe and beyond. This symbol was developed by the German packaging waste recycling organization Duales System Deutschland AG[452].

History and development of the program

The Green Dot label was first used in Germany as "Der Grüne Punkt" program, which is consider to be a precursor to the European program. The system was designed by Klaus Töpfer, German Minister for the Environment. The original of this symbol was introduced in 1991 by Duales System Deutschland (DSD), a non-profit organization, and has been accepted by EU member states and some other European countries since 1994[453].

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[452] J. Hodolič, I. Budak, M. Hadžistević, Đ. Vukelić, M. Majernik, J. Chovancova, J. Pankova-Jurikova, M. Ćulibrk, *Sistemi za upravljanje zaštitom životne sredine*, op. cit.

[453] Ib.

In 1995, the Green Dot license was transferred to PRO Europe (Packaging Recovery Organization) based in Brussels, today the general representative of the Green Dot.

The design of the Green Dot symbol is associated with the Chinese "yin and yang" symbol and the Mobius loop. The original appearance of this environmental label is in light and dark green. For esthetical or material reasons, or not to be confused with other symbols, many manufacturers print it in black and white, or in combination with other colors[454].

At the same time, "Pro Europe" is also the so-called "Umbrella", which brings together national industrial organizations that successfully deal with the treatment of packaging waste in more than 25 countries of the European Union. All EU countries, through their national industrial organizations for the treatment of packaging waste, act in accordance with European legislation in this area, which lays down the basic rules that must be respected by all members. The rules obligate that all types of packaging waste must be treated within the system, i.e. paper, glass, metal, plastic, wood, textiles, and minimum and maximum percentages are determined for each type of material[455].

The Green Dot is one of the most widely used environmental labels in the world. Currently this return system is present in 31 European countries and has the bilateral partnership of Green Dot North America, Toronto and Canada. These partners are responsible for ensuring that the Green Dot program does not interfere with other similar labels in the USA, Canada and Mexico[456].

It is important to note that only companies operating in Europe can obtain a Green Dot license. Non-European companies, therefore, often depend on their distributors to obtain the license. This can result in a loss of control over finances or administration, a conflict of interest while working with multiple distributors in a particular country, the appearance of multiple reports from different distributors, or confusion and additional work when changing the distributor[457].

Currently, more than 150000 companies have Green Dot licenses and more than 400 billion packaging items have been labelled with the symbol[458].

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454 General programme instructions for The Green Dot trademark, https://www.pro-e.org/the-green-dot-trademark, 10.08.2020.

455 Ib.

456 Ib.; I. Budak, B. Kosec, J. Hodolic, M. Ilic, B. Crnobrnja, M. Sokovic, *Contribution to the Analysis of Self-Declared Environmental Labels*, [in] Proceedings of the 9th International Foundrymen Conference, Opatija, Croatia, 18th-19th of June 2009.

457 I. Budak, B. Kosec, J. Hodolic, M. Ilic, B. Crnobrnja, M. Sokovic, *Contribution to the Analysis of Self-Declared Environmental Labels...*, op. cit.

458 General programme instructions for The Green Dot trademark, op. cit.

Requirements and methodology of impact assessment

The Green Dot is not mandatory for packaging waste, but a choice for a company. The Green Dot system requires the company to be part of the packaging waste management system and to pay a fee for the achievement of national goals[459].

In December 1994, the European Union adopted Directive 94/62 /EC on packaging and packaging waste. This law imposes direct responsibility on all producers, importers and distributors on the European market, and sets specific goals for reducing packaging waste. Also, the revision of the Packaging Directive in 2004 (Directive 2004/12/EC) was adopted[460]. In order to meet the requirements of this Directive, manufacturers, importers and distributors must[461]:

1. develop their own return schemes for the packaging of their products,
2. or join non-profit industrial organizations, such as the Green Dot program, which are established to organize the collection, sorting and recycling of used packaging.

This directive is the European Union's response to the problem of packaging waste in terms of land acquisition and resource consumption. By 2001, most EU member states had to introduce a system for collecting and returning 50-65% of packaging. Even more significant recycling targets have been set for 2020 in the Commission's Circular Economy Package[462].

According to the directive, the companies that have not taken part in the Green Dot program, have to collect recyclable packaging themselves, although this is generally only possible for small and not large producers[463].

By joining the Green Dot program, producers are deprived of the obligation to take back their packaging waste. The green dot is assigned to the packaging, not to the product itself. The mark can be placed on the packaging only when a license is obtained. The price of the license varies from country to country and manufacturers must register for the program in each country to which they wish to export their products.

There are also requirements regarding the position and appearance of the symbols on the packaging. The symbol must be clearly visible and must match the product in appearance and color. Its minimum size is 6 mm, it cannot be altered and must correspond to the proportions. The packaging for hazardous

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459 Ib.

460 DIRECTIVE 2004/12/EC of the European Parliament and of the Council, amending Directive 94/62/EC on packaging and packaging waste, Official Journal of the European Union 2004.

461 Ib.; DIRECTIVE 94/62/EC – European Parliament and Council Directive on packaging and packaging waste, Official Journal of the European Union 1994.

462 General programme instructions for The Green Dot trademark, op. cit.

463 DIRECTIVE 94/62/EC – European Parliament and Council..., op. cit.

materials should be addressed to the national Green Dot license representatives[464].

Benefits and costs of participation in the program

The method of payment is based on the "producer pays" principle and takes into account the costs of collecting, sorting and recycling different packaging materials. The price of payment depends on the country and the material from which the packaging is made (it varies when paper, plastic, wood, metal, etc. are used). The system contributes to waste reduction, because it motivates manufacturers to reduce the production of packaging. They automatically pay less for this licence, which is one of the biggest benefits of this program[465].

Prices range between €0,01 and €1,50 per kilogram of packaging waste. Once registered, on a monthly, quarterly or annual basis, companies must report to the national Green Dot program on the generation of their waste. An example of the cost per tonne of packaging waste in Germany is given in table 42.

Table 42. Fees for the use of isolated "Der Grüne Punkt" trademark ("The Green Dot") for packaging distributed in Germany in 2020

Material	€/ton
Glass	1,00
Paper/cardboard	3,00
Tinplate	5,00
Aluminum	13,00
Plastics	17,00
Composite carton	13,00
Miscellaneous Composites	13,00
Organic Materials	2,00

Source: own work based on: General program instructions for the Green Dot trademark, https://www.pro-e.org/the-green-dot-trademark, 10.08.2020.

The main factors that affect the costs related to the Green Dot system are the national infrastructure for waste collection and recycling as well as their recycling targets, laws and enforcement. Also, the source of packaging used to achieve the national recycling targets, the share of costs by the industry (may bear 100% of collection and recovery costs, or part of them, and the rest is paid by municipalities/consumer taxes). Costs also depend on the collection system used, the geographical location and population density, as well as the economic conditions of the country[466].

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464 J. Hodolič, Đ. Vukelić, M. Hadžistević, I. Budak, M. Badida, L. Šooš, B. Kosec, M. Bosak, *Reciklaža i reciklažne tehnologije*, op. cit.

465 Ib.

466 General programme instructions for The Green Dot trademark, op. cit.

For companies, the benefit of using the Green Dot system is that they are exempted from individual obligation to take over and/or recycle packaging waste. The system operates in an economically efficient and environmentally friendly manner. The Green Dot helps to manage waste at a national level, contributes to a reduction in the use of resources and landfill space, and at the same time interferes with the reduction of packaging production. The symbol is recognized worldwide, facilitates trade, and provides consumers with information about the product that they buy and cares for the environment.

Usage of the Green Dot on the example from Lenovo

If a packaging company wants to join "The Green Dot" system, it is necessary to conclude separate trademark contracts with the national Green Dot organizations in the respective country that sells their packed products. In order that there is no special procedure for obtaining the label, a license is obtained by paying per kilogram of packaging waste.

The scope of Lenovo's activities includes two ways of recycling that may be used to reduce our share of municipal solid waste. It redirects the material which would otherwise be sent to a landfill or may contribute to the preservation of natural resources or reduction in the amount of waste material generated from processes which use raw or virgin materials. This is also one of the main tasks of the "Green Dot" members. In the Lenovo specifications for recyclable packaging materials, there are requirements regarding the use of the green dot which they are obliged to comply with and which are mandatory for the packaging[467].

The "Green Dot" was originally developed by a privately owned non-profit German company, in 1991. Since then, it has been adopted by other countries of the European Union. The presence of this symbol on packaging means that the manufacturer of the packaging has purchased a license for the right to use the "Green Dot" trademark. The accumulated license fees finance a system not only of recovery and recycling of packaging materials, but also of minimizing the use of packaging materials, and of creating packaging that is easier to recycle (it is not a recycling mark). This mark is mandatory in some European countries and should be applied to all Lenovo primary packaging, most likely a corrugated carton, but it can also be placed on a paperboard insert used in a retail blister pack[468].

The "Green Dot" is mandatory in many European countries. In today's supply chain a product can be shipped from anywhere to anywhere, therefore the mark should be placed on all Lenovo packaging, regardless of their origin or destination. The symbol should be placed on the packaging itself or on the label

[467] O. Peng, *Lenovo Packaging Specification 41A0613*…, op. cit.
[468] Ib.

and it is compulsory to place it on primary packaging, with the exception of specific, duly justified cases in which there is a degree of flexibility, as provided by law. Placing it on the secondary or tertiary packaging is optional. It is listed in the chart under the Paper heading, but it could also be placed on other materials based on the product’s primary package or on the label itself.

5. Environmental product declarations based on life cycle assessment

(Igor Budak, Boris Agarski, Milana Ilić Mićunović)

5.1. Environmental Product Declaration (EPD)

As previously mentioned in the first chapter, EPDs, or type III environmental declarations, are defined by the ISO 14025 standard, and contain quantitative environmental data using the previously defined parameters based on LCA. Information and data from an EPD can be used for the following communication[469]:

1. Internal environmental management – the use of EPD's enables monitoring and improvement of performance of products. The current product can be evaluated through LCA and the EPD can be created as a baseline. Production processes and the product itself can be gradually improved over time and improvements can be monitored and measured;
2. Business-to-business – the EPDs provide relevant and reliable data for communication between companies. In order to present the environmental information required by the market, companies in a supply chain can benefit from developing the EPDs. Thanks to the EPDs, companies in the supply chain improve their management efficiency and obtain valid environmental information from their partners;
3. Business-to-consumer – Product packaging and marketing materials can contain an EPD to inform consumers. This way, the consumers are informed about the product and its environmental impact. Simple, fast and understandable information should be used for consumer products;
4. Professional buyers – the EPD verifies that the product is systematically evaluated by the program operator and PCR. Information about the product quality, environmental impacts, and use of resources from the supplier can be checked in the EPD according to professional purchaser requirements.

[469] Communicating environmental product declarations (EPD), https://www.environdec.com/What-is-an-EPD/Brochures/, 10.08.2020.

EPDs have to provide transparent comparison of various environmental performances of the products at all stages of its life cycle[470]. In order to be fully comparable, the EPDs must have the same:

1. Content and validity period,
2. The definition of a product category, purpose and scope, as well as the functional unit and system boundaries that cover the same life cycle phases,
3. Life cycle inventory with the same procedures and data collection methods,
4. Characterization models (factors) and impact categories for assessment of environmental impacts,
5. Additional environmental information (such as risk assessment, hazardous substances, etc.).

Product category rules (PCR)[471] represent a set of specific rules, requests and instructions for the development of an EPD for one or more products in a category. PCR are guidelines that define how information should be collected for the EPD and what calculations should be carried out. The program operator must ensure that the product categories are defined using a harmonized and transparent procedure. When a PCR document is prepared, a product category must first be defined. Then, the relevant LCA is performed and finally basic purpose for the product category is defined, together with rules and instructions for collecting and organizing the EPD data. The relationship between the ISO standards, LCA, EPD and PCR is illustrated in figure 25.

According to the PCR, all EPDs must contain the following information[472]:

1. Identification of the organization that is the owner of an EPD,
2. Date of issue and validity period,
3. Program name, information on the program operator, PCR identification,
4. Product description,
5. Information and results from LCA and LCI,
6. Additional environmental information,
7. Statement that a comparison with other EPDs might not be possible.

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[470] ISO 14025:2006, Environmental Labels and Declarations – Type III Environmental Declarations – Principles and procedures; ISO 14044:2006, Environmental Management – Life cycle assessment – Requirements and Guidelines.

[471] Ib.

[472] Ib.

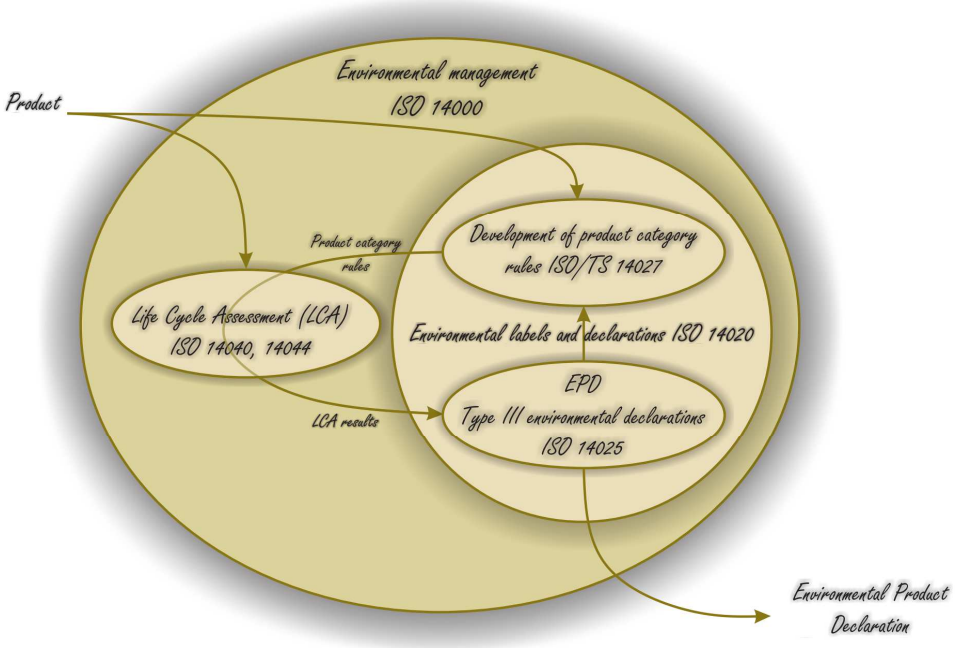

Figure 25. Relationship between the LCA, EPD and PCR

Source: own work based on: ISO 14025:2006, Environmental labels and declarations – Type III environmental declarations – Principles and procedures.

Development and use of the EPD program and declarations is voluntary. Figure 26 shows the basic steps in the development of the EPD program, PCR and EPD itself according to ISO 14025, IES (International EPD System) and EcoLeaf program operators. The first step is to develop the EPD program and publish general program instructions. The program development is followed by the development of PCR. The third step is to perform an LCA according to the PCR and to prepare a declaration in the form of a report. The final step is to verify, register and publish the EPD.

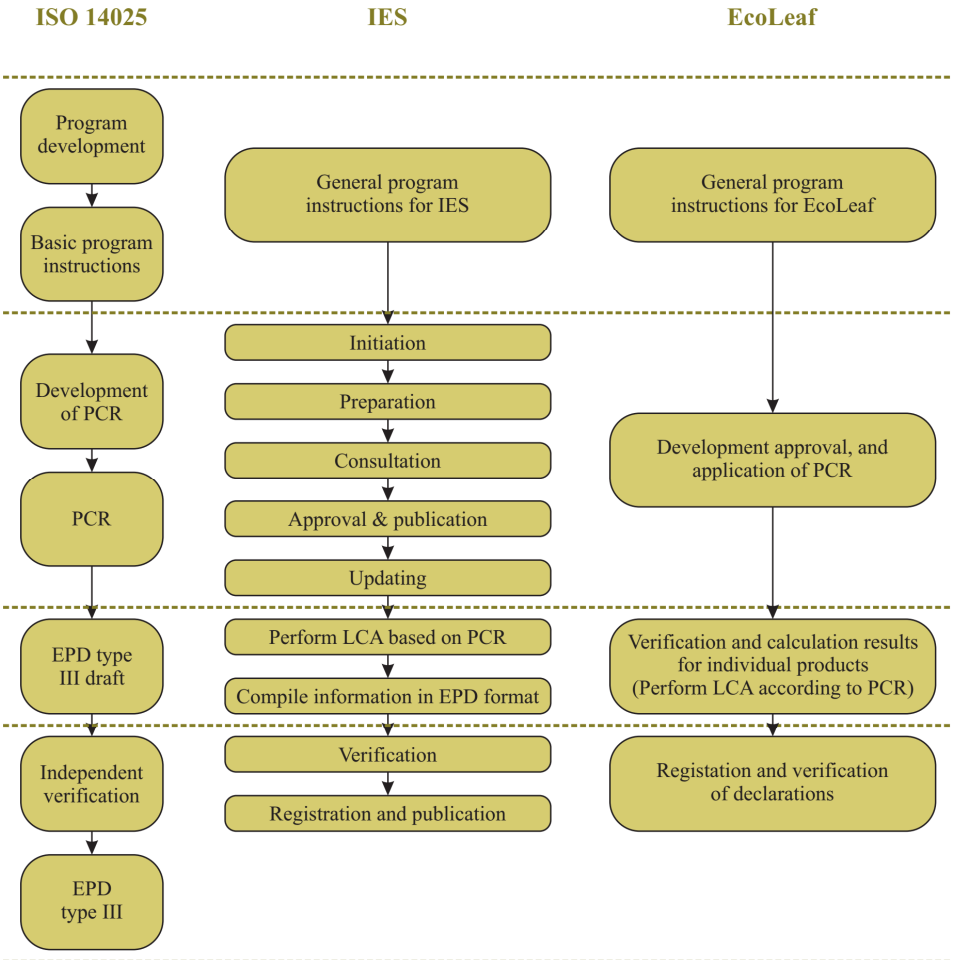

Figure 26. Development of EPD program – three models: ISO 14025, IES, EcoLeaf

Source: own work based on: PCR development, https://www.environdec.com/PCR/PCR-Development/, 10.08.2020.

Within the PCR development, the IES procedure[473] has the following phases:

1. Initiation phase – includes the definition of the product category, consideration of available PCRs, appointment of a PCR moderator, search for cooperation with other parties to take part in the PCR Committee, planning of the PCR development, and announcement of the PCR development,

[473] PCR development, https://www.environdec.com/PCR/PCR-Development/, 10.08.2020.

2. Preparation phase – includes the use of the PCR Basic Module as guidelines and PCR template, specification of the LCA-based content of the PCR document, selection of LCA-based parameters/indicators, selection of additional environmental information, and quality check before consultation,
3. Consultation phase – includes the following elements: 1) constitution of the PCR Stakeholder Consultation Group, 2) preparation of the open consultation procedure, 3) invitation of stakeholders to take part in the open consultation, 4) collection of comments during the open consultation,
4. The approval and publication of PCR documents – include the following elements: 1) preparation of the final draft PCR, 2) review of the PCR, 3) publication of the PCR, 4) announcement of the publication. Finally, the last phase of the PCR development is updating. A PCR is valid for a pre-determined period of time to ensure that it is updated at regular intervals.

The steps to create an EPD according to IES are[474]:

1. Performance of the LCA based on PCR – this is a mandatory step for all EPDs, and the LCA should be consistent with ISO 14040 and ISO 14044, the general purpose of EPDs is the collection of data, and the methods and assumptions used according to the ISO standard 14025, and IES general program instructions and PCRs,
2. Compilation of information in the EPD form – the EPD reporting form should contain accurate and verifiable data according to ISO 14020, while rating, judgements, or direct comparisons with other products should be excluded,
3. Verification – there are two verifications in IES that should be conducted and approved by an accredited certification body: the EPD verification and EPD process certification. The EPD verification verifies the LCA data, additional environmental information, and other information, while the EPD process certification is the verification of an internal organizational process aimed at developing EPDs based on the general program instructions and appropriate PCRs covered under the scope of the certification,
4. Registration and publication – once the verification is finalized, the EPD with other documentation can be submitted to the IES secretariat. When the complete documentation is received, the EPD will obtain the registration number and will be published at the IES website. The published EPD is valid till its expiration date.

[474] Steps to create an EPD, https://www.environdec.com/Creating-EPDs/Steps-to-create-an-EPD/, 10.08.2020.

Distribution of published EPDs and program operators

An overview of program operators for EPDs can be found in table 43. It must be noted that some of these program operators are not active. Although the majority of listed program operators use ISO 14025 as the main guideline there are differences between them. Over 75% of the 39 EPD programs are fully compatible with ISO[475]. Approximately 10% are not or are partly conformant; because of the operation without published general program instructions, differences in the used terminology, the mandatory content for general program instructions or PCR is not followed, etc. Due to the insufficient publicly available information (or information not available in English) the ISO conformance cannot be proven for the remaining 15% of analysed EPD programs. The "building and construction" program operators hold a large share of the entire sector.

Comparability of the EPDs published by different program operators is still an issue that needs to be addressed. Differences in program operators are the reason why it is necessary to harmonize the EPDs of various program operators on a global scale.

Table 43. Overview of EPD programmes

EPD program name	Program abbreviation	Origin	Language	Scope – Geographic	Scope – Sector	Year of foundation
The International EPD® System	IES	SE	English	International	Generic	1998
Earthsure at the Institute for Environmental Research and Education	IERE	US	English	International	Generic	2000
SCSglobal	SCS	US	English	International	Generic	2000
ECO-LEAF	ECO-LEAF	JP	English/ Japanese	International	Generic	2002
Korean Environmental Industry & Technology Institute EDP	KEITI EDP	KR	Korean	International	Generic	2002
The Association for Environmental Relevant Product Information	MRPI	NL	Duch	National	Building and construction	2002
The Norwegian EPD Foundation	EPDN	NO	English/ Norwegian	International	Generic	2002
Institut Bauen und Umwelt e.V	IBU	DE	English/ German	International	Building and construction	2004
Instytut Techniki Budowlanej	ITB	PL	English/ Polish	International	Building and construction	2004
European Aluminum Association	EAA	EU	English	Europe	Aluminum	2005

[475] N. Minkov, L. Schneider, A. Lehmann, M. Finkbeiner, *Type III Environmental Declaration Programmes and harmonization of product category rules: status quo and practical challenges*, "Journal of Cleaner Production" 2015, Vol. 94, pp. 235–246.

Danish Environmental Protection Agency	EPD-DK	DK	English/ Danish	International	Generic	2006
Environment and Development Foundation	EDF	TW	Taiwanese	Unclear	Unclear	2006
FDES INIES	FDES	FR	French	International	Building and construction	2006
PlasticsEurope	PE	EU	English	International	Uncompounded polymer resins, or reactive polymer precursors	2006
PEP ecopassport	PEP	FR	English/ French	International	Electric, electronic and HVACR products	2007
BRE Global Limited	BRE	UK	English	International	Building and construction	2008
Sistema Declaraciones Ambientales de Productos por la construccion	DAP	ES	Spanish	National	Building and construction	2008
The Green Standard	TGS	US	English	Unclear	Unclear	2008
Carbon Leadership Forum	CLF	US	English	International	Building and construction	2009
Agence de l'Environnement et de la Maîtrise de l'Energie þ AFNOR	ADEME	FR	French/ English	International	Generic	2011
Confederation of European Paper Industries	CEPI	EU	English	Europe	Paper	2011
FP Innovations	FP	CA	English	Unclear	Wood products	2011
ift Rosenheim	ift	DE	German	National	Building and construction	2011
NSF International	NSF	US	English	North America	Generic	2011
The Spanish Association for Standardisation and Certification	AENOR GlobalEPD	ES	Spanish	International	Generic	2011
UL Environment	UL	US	English	International	Generic	2011
Canadian Standard Association Group	CSA	CA	English	International	Generic	2012
Declaracion Ambiental de Productos de Construccion	DAPCO	CL	English/ Spanish	National	Building and construction	2012
Global GreenTag (old name: ecospecifier)	GGT	AU	English	International	Generic	2012
ICC Evaluation Service	ICC-ES	US	English	North America	Building and construction	2012
ASTM International	ASTM	US	English	North America	Generic	2013
National Ready Mixed Concrete Association	NRMCA	US	English	International	Ready mixed concrete	2013
Product Environmental Footprint	PEF	EU	English	Europe	Generic	2013
Slovenian National Building and Civil Engineering Institute	ZAG EPD	SL	English/ Slovenian	National	Building and construction	2013

The Austrian EPD Platform	EPD-AT	AT	English/ German	Europe	Building and construction	2013
The DAPHabitat system	DAPH	PT	Portuguese	National	Building and construction	2013
The International EPD® System Türkiye	EPDT	TR	Turkish	National	Generic	2013
Australian and New Zealand EPD System	LCANZ/ALCAS EPD	AU/NZ	English	International	Building and construction	2014

Source: own work based on: N. Minkov, L. Schneider, A. Lehmann, M. Finkbeiner, *Type III Environmental Declaration Programmes and harmonization of product category rules: status quo and practical challenges*, "Journal of Cleaner Production" 2015, Vol. 94, 235–246.

A study by Toniolo et al. (2019)[476] explored the valid EPDs of the European program operators, which represent 56% of program operators in the world, and found that 4888 EPDs were collected mainly released by the Institut Baum und Umwelt e.V. (IBU) and PEP ecopassport (PEP). The countries with the greater number of EPDs are France and Germany and construction products are the most frequently labeled product types. Figure 27 shows the number of EPDs by languages. There are 55% EPDs written in English while the remaining 45% are in other languages.

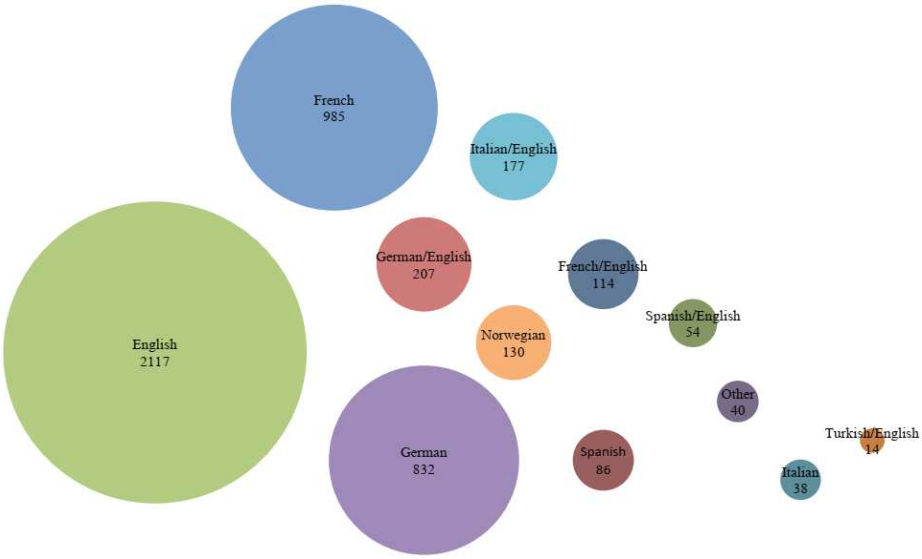

Figure 27. Number of EPDs identified by the main language

Source: own work based on: S. Toniolo, A. Mazzi, M. Simonetto, F. Zuliani, A. Scipioni, *Mapping diffusion of Environmental Product Declarations released by European program operators*, "Sustainable Production and Consumption" 2019, Vol. 17, pp. 85–94.

[476] S. Toniolo, A. Mazzi, M. Simonetto, F. Zuliani, A. Scipioni, *Mapping diffusion of Environmental Product Declarations released by European program operators*, "Sustainable Production and Consumption" 2019, Vol. 17, pp. 85–94.

Figure 28 shows the number of EPDs according to countries in which they were published. France and Germany dominate with 1794 and 1134 EPDs per county respectively, out of 4888 EPDs identified in total.

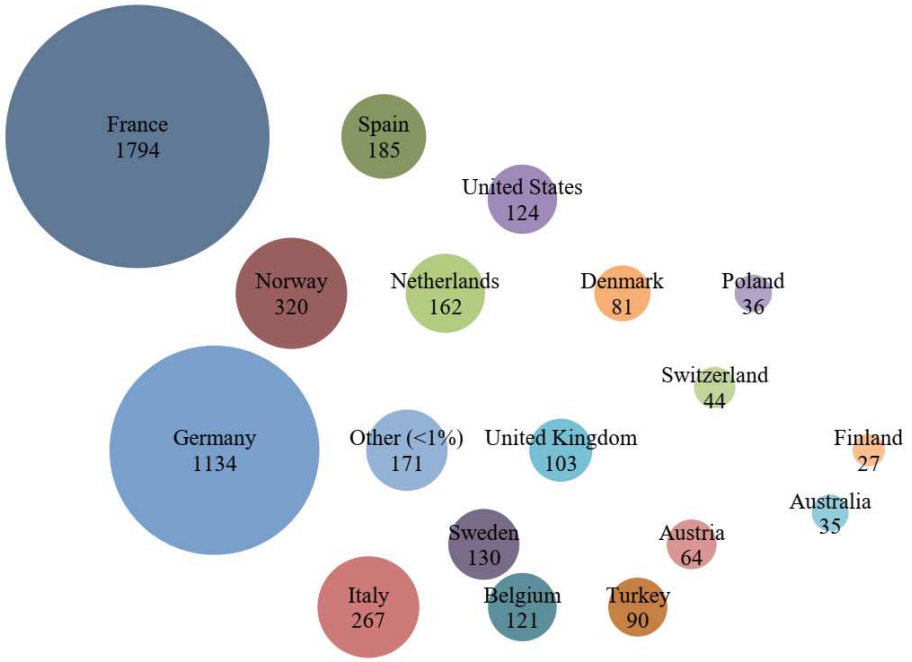

Figure 28. Number of the EPDs released by Europe-based program operators

Source: own work based on: S. Toniolo, A. Mazzi, M. Simonetto, F. Zuliani, A. Scipioni, *Mapping diffusion of Environmental Product Declarations released by European program operators*, "Sustainable Production and Consumption" 2019, Vol. 17, pp. 85–94.

Issues of PCRs and EPDs generated by different program operators

A study from 2012[477] analysed the PCRs of different program operators. Thanks to a specially developed template, it turned out that the level of PCR coherence was influenced by four key factors: the purpose of the different PCRs, the overarching standard applied, the level of product classification, and the independent development process. The PCRs differed in terms of scope, system boundaries, impact categories, and standards applied. In some cases, duplicate PCRs were created for the same category of products. Language difficulties in various PCRs presented a clear problem in interpreting and comparing PCRs.

[477] V. Subramanian, W. Ingwersen, C. Hensler, H. Collie, *Comparing product category rules from different programs: learned outcomes toward s global alignment*, "Internatinal Journal of Life Cycle Assess" 2012, Vol. 17, pp. 892–903.

Questionnaire results from 55 companies that had products certified by an IES program operator were analyzed in a study from 2016[478]. The results showed that the main disadvantages of EPDs were: consumers are unfamiliar with EPD (80% of companies), high costs of LCA needed for EPD, poor international standardization of PCR (45%), and difficult interpretation of EPD information (30%).

The comparability of EPDs can be compromised, if the LCA results are presented using different impact categories in EPDs[479]. Since various program operators can independently develop PCRs, overlapping PCRs appeared. Inconsistencies in PCRs include dissimilar rules used for similar product EPDs and incomparable LCA studies. Despite the intention that the EPDs should provide consistent, complete, transparent and trustworthy information about environmental performance of products, a study carried out in 2017[480] showed that this is not the case. In the construction products category, among 50 investigated EPDs, 38% lacked the information required by the ISO 14025 standard, and 8% contained self-contradictory information. The lack of harmonization and the poor quality of several underlying PCRs limited the comparability between EPDs in the same product categories (ranging from 1 to 24%) and even between those written into the same PCRs (8-83%). Gelowitz and McArthur[481] concluded the following issues related to EPDs for the construction sector:

1. Significant differences in the used LCA methodology, LCI databases, and impact categories, made the majority of EPDs incomparable,
2. The EPDs based on the same PCR were characterized by high levels of discrepancy,
3. The verification suffered from poor practices which resulted in a large number of EPDs with self-contradictory data and without providing PCR mandatory information in EPD,
4. The European harmonization standard EN 15804 for the construction sector was not a complete success. EPDs based on EN 15804 PCR were noticeably more comparable than the EPDs from non-harmonized PCR. On the other side, percentage of invalid comparisons of EPDs based on EN 15804 PCR ranged between 25 and 100%.

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478 V. Ibanez-Fores, B. Pacheco-Blanco, S.F. Capuz-Rizo, M.D. Bovea, *Environmental Product Declarations: exploring their evolution and the factors affecting their demand in Europe*, "Journal of Cleaner Production" 2016, Vol. 116, pp. 157–169.

479 M. Ilić Mićunović, B. Agarski, M. Hadžistević, B. Kosec, Đ. Vukelić, *Comparability of life cycle assessment results in type III environmental declarations*, [in] 13. International Scientific Conference "Flexible Technologies" – MMA, Faculty of Technical Sciences, Novi Sad, 28-29 September, 2018, pp. 323–326.

480 M.D.C. Gelowitz, J.J. McArthur, *Comparision of type III environmental product declarations for construction products: Material sourcing and harmonization evaluation*, op. cit.

481 Ib.

Potential improvements in addressing the above-mentioned issues towards harmonization of EPD policies and standards[482] are as follows:

1. Increased program oversight (increased regulation or uncompromised oversight for program operators and their associated PCR committees, stricter guidelines for authoring and verification),
2. The use of consistent Functional Units (development of PCR for industry specific products and development of an alignment standard for PCR for specific and general products),
3. The use of specific impact category characterization factors,
4. The use of the same cut-off and allocation rules,
5. Improved transparency of information (the quality of LCA data should be clearly stated including "coverage, precision, completeness, representativeness, consistency, reproducibility, sources, and uncertainty" as required by ISO 14025).

Reverse use of EPD and LCA

In the LCA, more specifically the LCI, background and foreground processes can be distinguished. According to Frischknecht (1998)[483], the background process (system) consists of processes on which no or, at best, indirect influence may be exercised by the decision-maker for which an LCA is carried out. The foreground process (system) consists of processes which are under the control of the decision-maker for which an LCA is carried out. Usually in the LCA practice the LCI databases are used for background processes because it would be time-consuming and irrelevant to unwrap all the associated processes in the production chain. For example, if the purpose of the LCA study is to analyse the environmental impacts of glass bottles, then the production of an excavator that will be used for the extraction of silica sand can be identified as a background process and the appropriate LCI database activity (process) could be selected for a working hour of an average excavator.

In LCA cases where LCI data are unavailable or hard to obtain for unit processes that are not of great impact on the investigated product, it is possible to use an EPD in order to describe the background processes. The procedure where EPD and LCA are used in reverse is not a common practice, but feasible in certain cases (figure 29).

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[482] Ib.

[483] R. Frischknecht, *Life cycle inventory analysis for decision-making*, ESU-services, Zurich 1998.

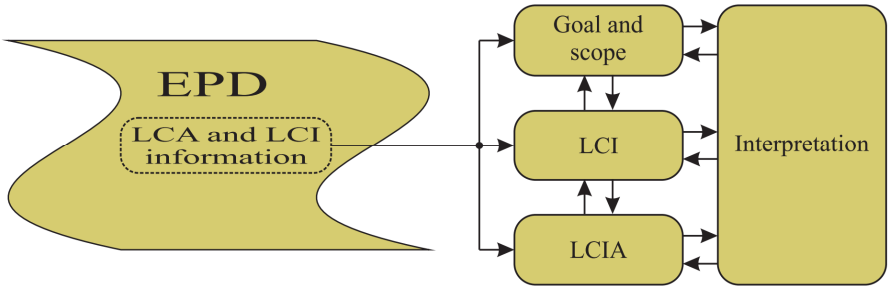

Figure 29. Use of EPD to obtain information for LCA

Source: own work based on: C. Strazza, A. Del Borghi, F. Magrassi, M. Gallo, *Using environmental product declaration as source of data for life cycle assessment*, "Journal of Cleaner Production" 2016, Vol. 112, pp. 333–342.

In 2016 a group of authors[484] analysed the effects of using the environmental performance indicators retrievable from EPDs into a non-conventional LCI procedure for LCA, replacing the inventory background data from secondary datasets. If the EPD is available for a product of interest it can be used as a source of information when the LCI is assembled. This reverse approach is compared with traditional practice in a case study that analysed glass to plastic water bottles distributed on a cruise ship. The results show that the reversed approach for the LCI is consistent with the collection of input/output data from literature, supporting the same conclusions for the decision making process.

Single-issue EPD

Single-issue EPDs refer to EPDs that assess a product or a service through the single impact category on the environment. As with conventional EPDs, the single-issue EPD is not a mandatory certification system, but a system in which businesses may participate voluntarily. The benefits of single-issue EPDs are similar to those of conventional EPDs. The single-issue EPDs often refer to the carbon or water footprint. Although there are more program operators that provide single-issue EPDs, here the EPDs for carbon footprint of products (CFP) will be shown for three program operators: the IES single-issue EPD program, the EcoLeaf Environmental Labelling Program for CFP, and the Korean CFP.

The IES allows for the possibility to adapt the information provided to specific user needs and market applications by introducing the concept of "single-issue EPDs", focusing on a single environmental impact category. A single-issue EPD can only be published, if a full EPD for the same product is published. Information on where to find additional information is to be included

[484] C. Strazza, A. Del Borghi, F. Magrassi, M. Gallo, *Using environmental product declaration as source of data for life cycle assessment*, "Journal of Cleaner Production" 2016, Vol. 112, pp. 333–342.

in the single-issue EPD. The single-issue EPD should contain at least the following information[485]:

1. Information about the product,
2. Information about the company,
3. Declaration of the environmental impact for the chosen issue based on the relevant indicator and impact category as displayed in the EPD,
4. Mandatory statements according to the IES's instructions regarding the content and format of EPD,
5. Information on how to obtain information about other environmental impacts of the declared product through the published EPD, and a statement that: "This single-issue EPD only addresses one environmental impact category and does not assess other potential social, economic, and environmental impacts arising from the provision of this product. These aspects may be of equal or greater importance than the single impact category displayed".

EcoLeaf CFP started in March 2012 as a 3-year government pilot project and was completed and provided to the Japanese Environmental Management Association for Industry (JEMAI) in April[486]. It was renamed as the CFP Communication Program with some changes to improve its cost-effectiveness. Since 2017 the Japanese CFP program has been integrated with the EcoLeaf Environmental Labeling Program. "The EcoLeaf CFP program conforms to ISO14040, ISO 14044 and ISO/TS 14067"[487]. The EcoLeaf CFP logo represents a kitchen scale with the idea that CO2 (GHG) is not visible but scalable.

EcoLeaf CFP provides information and analysis of CO_2 emissions from each stage of a product's life cycle and enables businesses to understand the hotspots of the CO_2 emissions and to promote their reduction efforts. It also enable consumers to be more conscious of the CO_2 emissions from their activities, i.e. the purchase, use, and disposal/recycling of the product. In the CFP system, the carbon footprint of products is displayed on the packaging which allows consumers to obtain fast and reliable information about GHG emissions and make environmentally friendly decisions during the shopping. Therefore, consumers can play a major role in the CO_2 reduction efforts by choosing and purchasing the CFP certified products.

According to the Korean CFP[488], there are three phases of certificates in the carbon footprint labelling: certification of carbon emissions (phase Ⅰ), certification of low carbon products (phase Ⅱ), and certification of carbon neutral products (phase Ⅲ).

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485 General programme instructions for IES, https://www.environdec.com/The-International-EPD-System/General-Programme-Instructions/, 10.08.2020.

486 Japanese CFP program, https://www.cfp-japan.jp/english/, 10.08.2020.

487 Overview, CFP Program, 2019, https://www.cfp-japan.jp/english/overview/index.html, 10.08.2020.

488 Korean CFP program, http://www.epd.or.kr/eng/cfp/carbonIntro00.do, 10.08.2020.

There are two types of Korean CFP labels:

1. Certification of Carbon Emission (Phase I). This is the certification based on the quantitative calculation of greenhouse gas emission during the product's life cycle according to preparation guidelines,
2. Certification of Low Carbon Products (Phase II). A product with a carbon emission mark certified when the amount of carbon emission is reduced and the carbon emission is lower than the average amount from products of the same type.

5.2. The International EPD System

The International EPD® System (IES) is a global program for environmental declarations based on such standards as ISO 14025 and EN 15804. The IES was launched in 1999, and was the first international EPD program. The IES online database in the year 2020 contained more than 1400 EPDs for a wide range of product categories by organizations in 45 countries (figure 30). Construction products have 961 EPDs in total and dominate the total number of published EPDs from the IES program operator. On the other side, services have 54 PCRs in total, followed by food & beverages (38) and construction products (35). It should be noted that the presented figures represent the total number of PCRs including the ones that are active, basic modules under development and subject to an update. The same applies to EPD, where their publication, update and expiry are under consideration.

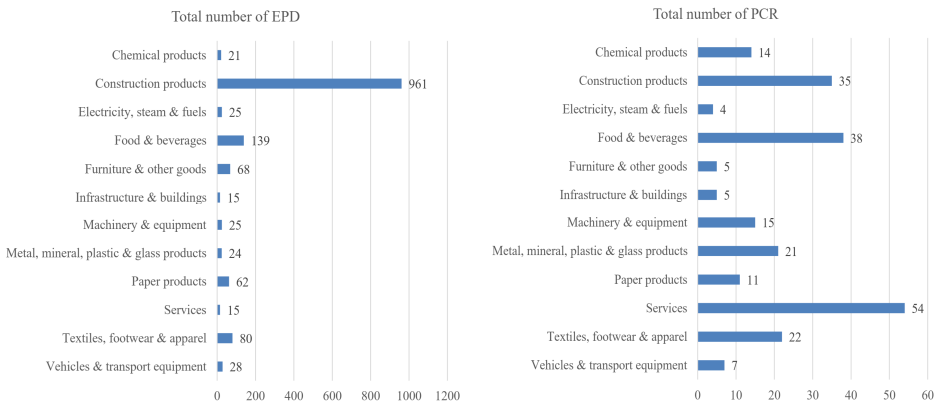

Figure 30. Total number of EPDs and PCRs published by IES in 2020

Source: own work based on: General programme instructions for IES, https://www.environdec.com/The-International-EPD-System/General-Programme-Instructions/, 10.08.2020.

The main objective of the IES is to enable the support of organizations in any country to provide quantitative environmental information on the life cycle

of their products in a credible, comparable, and understandable way. This is done by:

1. Offering a voluntary program for verified Type III environmental declarations according to ISO 14025, ISO 14040/14044, and other relevant standards or methodology guides,
2. Contributing to making standardized, verified, and life cycle-based environmental information a useful tool for different applications, e.g. by facilitating different applications and increasing digitization,
3. Seeking cooperation and harmonization with other programmes and initiatives on environmental declarations (national, regional, sectorial, etc.) to help organizations expand the use of EPDs in the international market.

In the IES, the life cycle stages are grouped as follows:

1. Upstream processes: this includes raw material acquisition and refinement as well as production of intermediate components,
2. Core processes: manufacturing processes,
3. Downstream processes - this includes the use and end-of-life stages.

The description of procedures for the development of PCRs and creation of EPDs according to IES is provided in section 5.1. (Development and use of EPDs).

An EPD example from the IES program

Although there are many EPD program operators in this example, a summary for only one EPD will be presented. Other EPDs can easily be accessed through the website of an EPD program operator or owner of the EPD. This example comes from an international EPD system program operator and corresponds to the EPD International PCR 2019:07. T-Shirts, Tops, Singlets and Other Vests: UN CPC 282. product category rules according to ISO 14025. Version 1.01 (2019). The EPD is owned by Fristads, a Swedish workware producer. The EPD's front page shows general information (table 44).

Table 44. General information of EPD for T-shirt

Owner of the EPD	Fristads AB Prognosgatan 24, 501 11 Borås, Sweden Contact person: Lene Jul, Product Management Director, lene.jul@fristads.com, www.fristads.com
Name and location of production site	Portugal (GOT) and Bangladesh (HSJ)
Programme	The International EPD® System, www.environdec.com
Programme operator	EPD International AB
EPD registration number	S-P-01760
Publication date	2020-03-04
Validity date	2025-03-04
Geographical scope	Global

Source: Fristads EPD: Green T-shirt 7988 GOT and Acode heavy T-shirt 1912 HSJ, Registration number S-P-01760, 04.03.2020, https://www.environdec.com/Detail/?Epd=17061, 10.08.2020.

After a brief introduction to the company and sustainability policy, the EPD contains a description of products: the Green T-shirt 7988 GOT and the Acode heavy T-shirt 1912 HSJ (hereinafter GOT and HSJ). These two T-shirts are shown in figure 31.

GOT T-shirt HSJ T-shirt

Figure 31. Analysed products in Fristads' EPD

Source: Fristads EPD: Green T-shirt 7988 GOT and Acode heavy T-shirt 1912 HSJ, Registration number S-P-01760, 04.03.2020, https://www.environdec.com/Detail/?Epd=17061, 10.08.2020.

LCA information in this EPD is organized as follows[489]:

1. Goal of the study – an LCA study has been conducted in accordance with ISO 14044 and the requirements stated in the General Programme Instructions by the IES. The goal of the present LCA study has been to calculate environmental impact values for Fristads' GOT and HSJ T-shirts in order to create this EPD, to be used for communicating environmental performance to customers,
2. Scope of the study – the scope of this study is cradle to gate and includes all processes up until the t-shirt is manufactured (figure 32). Garment manufacturing, retail, use and end-of-life processes are not included in the system boundaries. All material and resource consumption is tracked back to the point of raw material extraction, mainly by using cradle to gate data from the Ecoinvent database. The functional unit of the study is 1 (one) garment, in accordance with the PCR,
3. Data collection – the inventory for the LCA study was carried out during 2019, collecting data for 2018 and 2019. The data for textile processing

[489] Fristads EPD: Green T-shirt 7988 GOT and Acode heavy T-shirt 1912 HSJ, Registration number S-P-01760, 04.03.2020, https://www.environdec.com/Detail/?Epd=17061, 10.08.2020.

is provided by the Fristads' suppliers. Data for confectioning was collected by the Fristads' staff,

4. Allocation – whenever it was necessary to partition the system inputs and outputs, mass criteria were applied in accordance with the PCR. Such situations occurred, for example, when the share of energy and water consumed by an entire production plant was allocated to a specific fabric based on the total production volume (mass) of the plant,
5. Cut-off rules –the PCR states that the LCI data for a minimum of 99% of total inflows to the three life cycle stages (up-stream, core and downstream modules) must be included and a cut-off rule of 1% regarding energy, mass and environmental relevance must apply,
6. Assumptions and limitations – some general assumptions have been made about transport vehicles to enable the data from the Ecoinvent database to be used as primary data. Country electricity mix datasets were used for electricity when the site reported that they used the country electricity grid. Generally, the LCA data should be used with caution, if interpreted for purposes other than this EPD,
7. Data quality – the data quality has been considerably improved by the experience gained from similar studies in the past,
8. Additional information about the LCA study – is left blank,
9. Time representativeness: 2018-2019,
10. Database(s) and LCA software used: SimaPro version 9.0.0.486, ecoinvent version 3.57,
11. Calculation methods – resource use values are calculated on the basis of the Cumulative Energy Demand V1.10. Potential environmental impacts are calculated using the EPD (2018) v1.00 method as implemented in SimaPro: CML-IA baseline v3.05 for eutrophication, global warming, ozone depletion and abiotic resource depletion; CML-IA non baseline method for acidification; AWARE v1.02 for water scarcity and ReCiPe 2016 Midpoint (H) v1.1 for photochemical oxidation. For global warming potential, the default characterization factors are the IPCC (2013) factors as implemented in the CML baseline method. However, the latter does not provide the same resolution in EPD (2018) V1.00 as is specified in the EPD template (fossil, bio-based respective land use and land transformation), wherefore instead the method Greenhouse Gas Protocol V1.02 is used,
12. Description of system boundaries: cradle to gate,
13. LCA practitioner: Sandra Roos, RISE, PO Box 104, SE-431 22 Mölndal, Sweden,
14. Third party reviewer: Marcus Wendin, Miljögiraff AB, Övre Hövik 25b, SE-430 84 Göteborg, Sweden.

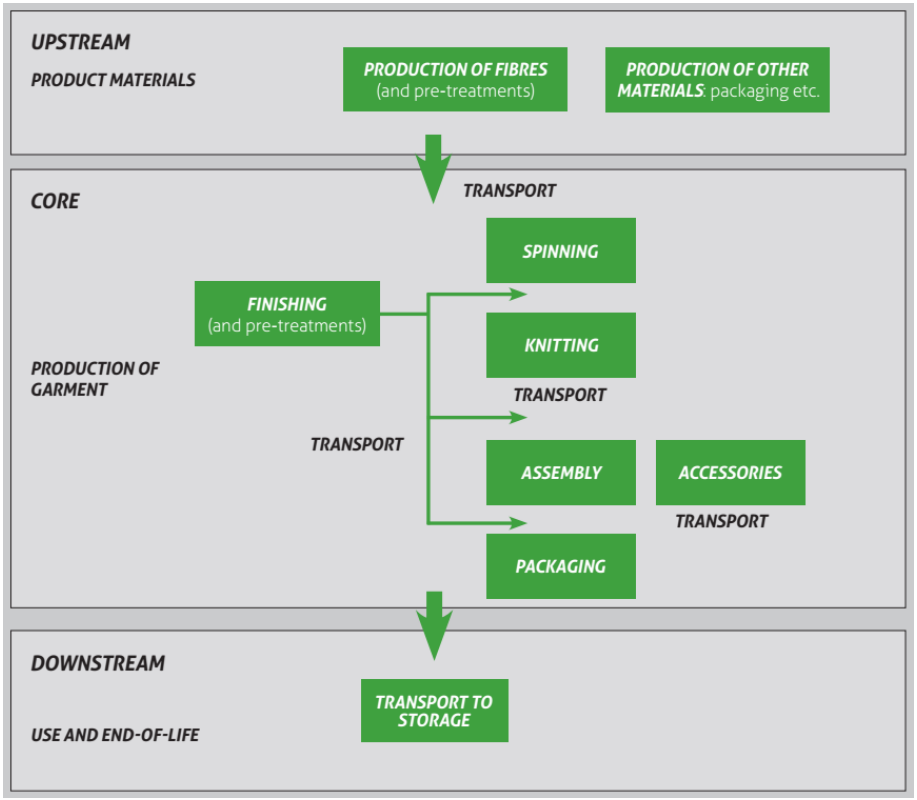

Figure 32. System boundaries

Source: Fristads EPD: Green T-shirt 7988 GOT and Acode heavy T-shirt 1912 HSJ, Registration number S-P-01760, 04.03.2020, https://www.environdec.com/Detail/?Epd=17061, 10.08.2020.

The scope of the study is important because the system boundaries and functional units are defined. A common way to present the system boundaries is the block diagram which visually shows the relationship between unit processes which are grouped in upstream, core and downstream processes according to IES program operator. Some program operators use the system boundaries with more than three life cycle stages and thus, the results are presented for more than three life cycle stages. One T-shirt is a functional unit, and it is common to have the whole product as a functional unit in the LCA. In LCA information, this EPD indicates which LCIA method, LCA software and LCI database were used for the calculation of LCA results. The information provided about the LCIA method, LCA software and LCI database can be helpful, however this information may not be available in EPDs of other companies.

The environmental performances and the results from the LCA, are grouped in three tables: potential environmental impact (table 45), use of resources (table 46), and waste production (table 47).

Table 45. Potential environmental impacts of T-shirt

Parameter		Unit	T-shirt	Upstream	Core	Total
Global warming potential (GWP)	Fossil	kg CO_2 eq.	GOT	0,47	0,71	1,25
			HSJ	1,16	0,88	2,26
	Biogenic	kg CO_2 eq.	GOT	0,06	0,58	0,64
			HSJ	0,05	0,12	0,19
	Land use and land transformation	kg CO_2 eq.	GOT	0,00	0,01	0,01
			HSJ	0,00	0,01	0,01
	Total	kg CO_2 eq.	GOT	0,47	0,82	1,37
			HSJ	1,16	0,93	2,31
Acidification potential (AC)		kg SO_2 eq.	GOT	0,003	0,005	0,008
			HSJ	0,009	0,005	0,018
Eutrophication potential (EP)		kg PO_4^{3-} eq.	GOT	0,001	0,003	0,004
			HSJ	0,004	0,002	0,006
Formation potential of tropospheric ozone (POCP)		Kg NVMOC	GOT	0,002	0,004	0,006
			HSJ	0,005	0,004	0,011
Water scarcity potential		m^3 eq.	GOT	7,31	0,93	8,24
			HSJ	22,29	1,34	23,65

Source: Fristads EPD: Green T-shirt 7988 GOT and Acode heavy T-shirt 1912 HSJ, Registration number S-P-01760, 04.03.2020, https://www.environdec.com/Detail/?Epd=17061, 10.08.2020.

Table 46. Use of resources for T-shirt

Parameter		Unit	T-shirt	Upstream	Core	Total
Primary energy resources – Renewable	Use as energy carrier	MJ, net calorific value	GOT	1,4	3,6	5,1
			HSJ	13,6	2,6	16,3
	Used as raw materials	MJ, net calorific value	GOT	0	0	0
			HSJ	0	0	0
	Total	MJ, net calorific value	GOT	1,4	3,6	5,1
			HSJ	13,6	2,6	16,3
Primary energy resources – Non renewable	Use as energy carrier	MJ, net calorific value	GOT	4,8	11,1	17,1
			HSJ	16,5	15,6	35,6
	Used as raw materials	MJ, net calorific value	GOT	0,24	0,00	0,24
			HSJ	0,38	0,00	0,38
	Total	MJ, net calorific value	GOT	5,0	11,1	17,4
			HSJ	16,9	15,6	35,9
Secondary material		kg	GOT	0	0	0
			HSJ	0	0	0
Renewable secondary fuels		MJ, net calorific value	GOT	0	0	0
			HSJ	0	0	0

Non-renewable secondary fuels	MJ, net calorific value	GOT	0	0	0
		HSJ	0	0	0
Net use of fresh water	m^3	GOT	0,36	0,01	0,37
		HSJ	4,21	0,02	4,23

Source: own work based on: Fristads EPD: Green T-shirt 7988 GOT and Acode heavy T-shirt 1912 HSJ, Registration number S-P-01760, 04.03.2020, https://www.environdec.com/Detail/?Epd=17061, 10.08.2020.

Table 47. Waste production for T-shirt

Parameter	Unit	T-shirt	Upstream	Core	Total
Hazardous waste disposed	kg	GOT	0	0	0
		HSJ	0	0	0
Non-hazardous waste disposed	kg	GOT	0,01	0,09	0,10
		HSJ	0,005	0,07	0,07
Radioactive waste disposed	kg	GOT	0	0	0
		HSJ	0	0	0

Source: own work based on: Fristads EPD: Green T-shirt 7988 GOT and Acode heavy T-shirt 1912 HSJ, Registration number S-P-01760, 04.03.2020, https://www.environdec.com/Detail/?Epd=17061, 10.08.2020.

Table 45 shows results for the following impact categories: global warming potential (GWP), acidification potential (AP), eutrophication potential (EP), as well as formation potential of tropospheric ozone (POCP) and water scarcity potential. Among these, the first four (GWP, AP, EP, and POCP) are common impact categories used in EPDs of various program operators. There are program operators that provide results for more than four impact categories. In this EPD, the use of resources is provided for material and energy resources, both renewable and non-renewable (table 46). Other EPD program operator may use other parameters to present the use of resources, such as crude oil and iron ore equivalent. This EPD shows the production of hazardous and non-hazardous waste (table 47), which may not be available to other EPD program operators. In the case of the two products analysed in this EPD, it can be concluded that the GOT T-shirt has lower environmental impact than the HSJ T-shirt for all impact categories (table 45). The GOT T-shirt uses less non-renewable and renewable resources (table 46), but on the other hand, the GOT T-shirt generates more non-hazardous waste than the HSJ T-shirt (table 47).

This EPD provides also information about product's characteristics based on various standards and regulations (composition, fabric, mass per unit area, tensile properties, color fastness, rubbing, etc.), cotton, organic cotton, company, and references which are not presented in this example.

Challenges

(*Bożydar Ziółkowski*)

The environmental labels and declarations presented in the book deliver a concise overview of environmental mechanisms created in various regions of the world. On the one side, the three ISO-type ecolabels could be perceived as quite simple for understanding and application. On the other side, the huge divergence of procedures throughout many ecolabelling schemes is a serious barrier for managers, decision-makers and social stakeholders.

The ecolabelling is just one of many instruments which constitute the field for the perspective research agenda, first of all in the circular economy (CE). The new Circular Economy Action Plan from the year 2020 showed the political framework of future initiatives in the European Union. The CE policy plans focused mainly on such areas as[490]:

1. "Climate neutrality by 2050",
2. "Resource-efficient and competitive economy" decoupled in growth from resource use (dematerialisation of economy),
3. "Closed loop models" and fostering entrepreneurship among SMEs,
4. "Innovative models based on a closer relationship with customers, mass customisation, the sharing and collaborative economy, and powered by digital technologies, such as the internet of things, big data, blockchain and artificial intelligence",
5. "High-quality, functional and safe products, which are efficient and affordable, last longer and are designed for reuse, repair, and high-quality recycling" and „sustainable services, product-as-service models".
6. "Increase the effectiveness of the current Ecodesign framework for energy-related products, including by swiftly adopting and implementing a new Ecodesign and Energy Labelling Working Plan 2020-2024",
7. "Establish a common European Dataspace for Smart Circular Applications with data on value chains and product information",
8. "Promoting the uptake of green technologies through a system of solid verification by registering the EU Environmental Technology Verification scheme as an EU certification mark",
9. Support of waste prevention, packaging and plastics (incl. microplastics, bio-based plastics, biodegradable or compostable plastics), textiles, construction and buildings, food, water and nutrients, "EU market for

[490] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A new Circular Economy Action Plan for a cleaner and more competitive Europe COM/2020/98 final.

secondary raw materials", "facilitating preparing for re-use and recycling of waste",

10. EU Ecolabel Regulation, the Product Environmental Footprint, EU GPP.

As a policy tool, ecolabels should be a part of a broader strategy at all management levels. Both in enterprise strategies and public policies, the ecolabelling programs benefit from integration with other instruments, but this is not always a recipe for successful ecolabelling. The possibility of supporting ecolabels by other mechanisms, as e.g. "environmental management system (EMS), Green Public Procurement (GPP), Ecodesign Directive, (…) Energy Label and Environmental Technology Verification (ETV)"[491], can open quite new horizons for business and society. The need for exploration of these domains is vast, because of the low research contribution so far.

Research and practice of environmental labels and declarations face at present many challenges and trends. The following statements are worth mentioning in this context:

1. New types of ecolabels are created, e.g. Korean CA-labelling (Clean air-labelling), international Climate Neutral Certified label, Plastic-free (certified by Flustix), for ecofruit and vegetable by-/co-products and many more,
2. "Demand for mandatory labels that provide information regarding negative attributes, such as the content of heavy metals"[492],
3. "Attributes with a negative impact, e.g., heavy metal content in seafood, will not be labeled voluntarily"[493],
4. Better understand "interactions between various label types and between labels and other types of information available to the consumers"[494],
5. "To simplify and harmonize standards through geographic and economic regions", without scarifying their "quality, credibility, consistency and transparency"[495],
6. Better understand the impact of ecolabelling on consumer behavior[496],
7. Better understand the "WTP for an antibiotic-free label, usage of a nutritional label, a carbon footprint label, a total environmental impact

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491 L. Marrucci, T. Daddi, F. Iraldo, *The integration of Circular Economy…*, op. cit.

492 F. Alfnes, X. Chen, K. Rickertsen, *Labeling farmed seafood: A review*, "Aquaculture Economics & Management" 2018, Vol. 22, No 1, pp. 1–26.

493 Ib.

494 Ib.

495 K. Harris, S. Divakarla, *Supply chain risk to reward: Responsible procurement and the role of ecolabels, [in] International High-Performance Built Environment Conference - a Sustainable Built Environment Conference 2016 SERIES (SBE16)*, IHBE 2016, L. Ding, F. Fiorito, P. Osmond, P (eds), Vol. 180, UNSW Built Environm; Low Carbon Living CRC, http://www.lowcarbonlivingcrc.com.au/, 17.08.2020; UrbanGrowth NSW, 2017, https://architectureau.com/organisations/urban-groth-nsw/, 17.08.2020.

496 K.M.R. Taufique, M.J. Polonsky, A. Vocino, C. Siwar, *Measuring consumer understanding and perception of eco-labelling: Item selection and scale validation*, "International Journal of Consumer Studies" 2019, Vol. 43, No 3, pp. 298–314.

label, interaction effects of labels, and labels related to the contents of negative attributes such as heavy metals in farmed seafood"[497],

8. "Design more effective, uniform and standardized product labeling programs"[498],
9. "Better understand the impact of confounding factors on eco-labelling"[499],
10. Increase in transparency requirements,
11. "Web-based comparison tools such as International Trade Centre's Standards Map (intergovernmental) and the Sustainability Standards Comparison Tool (government-NGO partnership)"[500],
12. "Smartphones equipped with sustainability applications ('apps') could help connect consumer decisions with their environmental and biodiversity impacts"[501].

The presented phenomena offer two perspectives, the first one concerns the efforts to adapt to the new situation and the second one concerns the areas which require further studying.

There is a chance for all interested parties to derive maximum benefits from the ecolabelling implementation. This depends on the dissemination of new educational tools for environmental labels and declarations and the development of the regulatory instruments in public policy. Systemic thinking in this process should facilitate the conversion of the created solutions into intrinsic components of the circular economy model.

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497 F. Alfnes, X. Chen, K. Rickertsen, *Labeling farmed seafood: A review*..., op. cit.

498 J. Hilger, E. Hallstein, A.W. Stevens, S.B. Villas-Boas, *Measuring willingness to pay for environmental attributes in seafood*, op. cit.

499 Ib.

500 OECD, *Environmental labelling and information schemes. Policy perspectives*, 2016, https://www.oecd.org/env/policy-persectives-environmental-labelling-and-information-schemes.pdf 25.05.2019.

501 T.P.L. Nghiem, L.R. Carrasco, *Mobile applications to link sustainable consumption with impacts on the environment and biodiversity*..., op. cit.

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https://ecolabelling.prz.edu.pl/en/

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Annex 1. Webpages of organisations promoting the environmental labels and declarations

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2. Cradle to Cradle: https://www.c2ccertified.org
3. ENERGY STAR®: https://www.energystar.gov
4. Environmental Choice New Zeland: https://www.environmentalchoice.org.nz
5. EU Ecolabel: https://ec.europa.eu
6. FSC: https://fsc.org
7. Green Dot: https://www.pro-e.org
8. Green Seal: https://www.greenseal.org
9. LEED: https://www.usgbc.org
10. Mobius loop: https://www.mobiusloop.co.uk
11. Nordic Swan: www.nordic-ecolabel.org
12. The International EPD System: https://www.environdec.com/

Podręcznik może być udostępniany w otwartym dostępie na platformach e-learningowych partnerów projektu z Serbii, Czech, Słowacji i Węgier oraz innych zainteresowanych.

The handbook can be made available in open access on the e-learning platforms of Project Partners from Serbia, Czech Republic, Slovakia and Hungary and other interested stakeholders.

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