

1 Article

2 **Modelling environmental actions of corporate sustainable activity**

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10 **Abstract:** Many sources have been noted that environmental protection measures are economically
11 beneficial as their application allows to increase the efficiency of resource use, reduce operating
12 costs and increase company's profit. The aim of the article is to analyze the relevance of the
13 environmental protection component of sustainable development in terms of its expression in the
14 corporate activities. The possibilities to integrate this component into the company's
15 developmental strategy are analyzed alongside creation of a model with a set of actions directed
16 towards increasing environmental sustainability. The elements of this model would define not only
17 the environmental actions to be taken, but would also provide structural basis for implementation
18 of these processes. Assessment of actions under the criteria selected will determine and justify the
19 sequence of processes to achieve the best results in the field of sustainability. The application of this
20 model in the company's daily activities would allow to gradually approaching environmental
21 sustainability and successfully manage environmental issues in any corporation. Research was
22 based on the systematic analysis of scientific literature, synthesis of information, modelling actions
23 according to their practical possibilities.

24 **Keywords:** corporate sustainability; environmental protection; actions of sustainable activity,
25 modelling

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28 **1. Introduction**

29 The enterprise's commitment to environmental sustainability and the impact on its performance are
30 often discussed in research. Scientific literature is strongly focused on the increasing necessity for
31 environmental activities, however, it lacks discussions of the specific actions aimed at environmental
32 protection that should be carried out at the company's level if one is in pursuit of sustainable
33 development. The activities of companies are enabled by the use of material, human resources and
34 energy acquired from the internal and external environment. Each company seeks to get the
35 maximum amount of added value with minimal resources. Unavoidably, waste is generated in the
36 process and then discarded into the environment. Global environmental pollution has been the first
37 signal that economic development can have serious consequences for future generations. These
38 assumptions have led to the emergence of a concept of sustainable development [1]. Barbien [2]
39 provides even a more categorical opinion that the economic system is completely dependent on
40 ecosystems.

41 Guidelines on how to achieve greater sustainability in order to improve economic performance
42 are still widely debated by scientists and practice-oriented minds. These guidelines could be later
43 used by start-ups and well developed companies concerned about environmental sustainability.
44 Absence of the universal model detailing implementation of actions directed towards environmental

45 sustainability is one of the greatest currently faced issues for both business theorists and
46 practitioners. Despite evidence indicating that sustainable activities have direct effect on the
47 performance of companies, there is little empirical evidence proving the suitability of selected
48 indicators to credibly represent sustainability level. The methodological potential for environmental
49 action selection is especially poor. High demand for the solution of this problem, its practical and
50 scientific topicality has led to a determination to undertake research in this field. *The aim of the*
51 *research* is firstly to examine the relevance of environmental protection as one of sustainable activity
52 components and secondly, to present a model for the implementation of sustainable development
53 environmental actions.

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55 sustainable activity components and secondly, to present a model for the implementation of
56 sustainable development environmental actions.

57 2. Methods

58 Research was based on the systematic analysis of scientific literature and synthesis between
59 theoretical and practical modelling of processes. Through analysis of researchers' opinions in the
60 discussion section were necessary to apply the methods of logical assessment, systematization, and
61 comparison of information, to select the most important information describing the environmental
62 sustainability, to evaluate the possibility of processes in the corporate product making in terms of
63 sustainability, to clarify and present possible actions and, basing on the information, to create new
64 model of environmental actions for corporate sustainable activity.

65 3. Discussion on the requirements for the process model of a corporate environmental 66 protection

67 Certain stakeholder groups may have an impact on the reduction of environmental effect [3].
68 Therefore, the corporate has to make an assessment of possibilities and present it to the
69 shareholders, employees, customers, the public, competitors, associations, and trade unions
70 explaining the potential positive effect of their probable actions. These entities must recognize that
71 environmental protection policy is undoubtedly beneficial in the long run as it increases the
72 company's profit by gradually increasing the stock and company value [4]. Surrounding
73 environment is the medium in which businesses perform its functions, therefore, companies must
74 protect and care after the environment as they must also rationally use its resources. According to
75 Paul *et al* [1] the environment protection at company's operational level can be either targeted at the
76 products or at the processes. Focusing on the products enforces greater efforts to ensure the product
77 quality and it protects the company's image from the negative light in which environmentally
78 unfriendly products are presented. Focusing on the processes involves minimization of waste,
79 introduction of environmental technologies for pollution prevention. Compliance with both
80 approaches can act as guidance cues and help companies follow environmental requirements.

81 According to Barbien [2], five elements are needed to support life: water, soil, air, ozone layer, and the
82 sun. Businesses affect the environment and negatively influence these elements [2]. Some researches
83 examine the impact that business activities have on environment [5]. They invite to pay attention to the
84 preservice of air, soil, water quality and biodiversity. Therefore, a sustainable system must be based
85 on resources that will not be depleted over a period of time and will not generate unacceptable
86 environmental pollution. Consequently, the model must entail components which would foresee and
87 account for the reduction of resource use. Obviously, reducing the use of materials would also reduce

88 negative environmental impacts and contribute to the more sustainable functioning of environmental
89 systems [6]. Therefore, a question emerges: how to achieve a customer-satisfying result with less
90 resource. Importance of this issue and distinguish between the positive impact on the environment
91 generated by the reduction of used material resources and used energy resources as described [7]. The
92 view that separates these two types of resources can be welcomed, since the origin of these resources
93 and the possibilities for reducing them are fundamentally different. The process of reducing the use of
94 raw materials and energy resources may also be aimed at changing (or improving) the technology, and
95 therefore the environmental action model should include the components which would direct
96 reduction of resource use.

97 The model should also entail a component that includes the assessment of the possibilities for
98 reducing the use of raw materials. Results of this assessment would allow companies to choose the
99 best appropriate actions for the current situation. The active search for the possibilities of energy
100 resource reduction is the goal and the cornerstone of many research studies [8]. Reduction of energy
101 resources is analyzed from different perspectives not only by energy specialists, but also by the
102 management scientists, who seek to determine models for the implementation of the latest scientific
103 achievements in the activities of companies.

104 Lately, many research studies have revealed the negative impact of industrial pollution on the
105 environment. For example, some researches examined the impact on the environment exerted by the
106 launched ecological product [9]. The aforementioned authors have found that production of organic
107 products has dramatically decreased the negative impact on the environment during the whole
108 product life cycle. They presented the results of the study by providing specific indicators detailing the
109 dynamics of air, water, soil. Also structured research data from various scientists that demonstrate the
110 negative impact of pollution on environment indicators was provided [10]. Consequently, the
111 pollution reduction processes must be reflected in the company's sustainable business model.

112 The introduction of pollution reduction processes is undoubtedly related to changes in waste
113 quantities. In order to have an uncontaminated environment, it is necessary to create an efficient waste
114 management system that helps to reduce the generation of waste and its negative impact on the
115 environment and human health. Production waste that may be still used in other activities cannot be
116 considered as waste. This is confirmed by authors, who present a waste management model tailored to
117 the company's sustainable activity [11]. The aforementioned researchers ensure that proper waste
118 amount management is one of the guarantors of the success of a sustainable activity. Authors claim
119 that a company can achieve better results by potentially reducing the amount of waste. Therefore, the
120 solution of waste reduction issues must be expressed in the corporate environmental action model.

121 The search of possibilities to apply actions foreseen in the model should reflect the essence of the
122 model. The model should also contain two additional components: one for the assessment of search
123 results, describing an assessment procedure and another component for strategic decisions based on
124 the evaluation results.

125 This section may be divided by subheadings. It should provide a concise and precise
126 description of the experimental results, their interpretation as well as the experimental conclusions
127 that can be drawn.

128 **4. Process model formation of a corporate environmental protection**

129 Sustainable development is a dynamic and, in principle, an endless process of society's
130 development, therefore its goals, tasks and their implementation means can change over time. In

131 order to move towards more sustainable development, it is necessary to change the thinking of an
132 individual and each organization, to formulate sustainable development goals, to determine the
133 direction of their implementation. Such would be the goal of the model being developed. The main
134 components of the constructed model should be: reduction of four factors – pollution, waste, use of
135 raw materials and use of energy resources. It should also include evaluation of the application of
136 these processes, result processing and strategic decision making. The need for these components is
137 reflected by requirements in the company's environmental action implementation model. In the
138 further stage of model formation, it is necessary to determine the sequential order of the above
139 components. For that purpose it is advisable to follow the cost-benefit analysis principle: giving
140 priority to those components that provide the least costly activity and which execution is most likely
141 to be the most effective. In this regard, the first steps should be taken in the resource reduction
142 component. Lower spending on resource purchases would increase the company's profitability and
143 direct the company's operations towards sustainability. The model for implementing environmental
144 actions is presented in the figure 1.

145 Companies which have decided to pursue sustainable environmental practices face difficulties in
146 determining the priorities in the implementation of measures mentioned in the model. This is a
147 multi-criteria task, since one tool may be more suitable for one criterion and another- more
148 appropriate for other ones. Therefore, it is necessary to apply multi-criteria assessment methods to
149 prioritize. The essence of the evaluation criteria is primarily to express the effectiveness of the
150 measures from the environmental point of view and the possibilities of the company. In the
151 following sections of this chapter there are detailed and based actions envisaged in the components
152 of the proposed model. It can be argued that a company that has implemented all the measures
153 provided for in the model will be environmentally sustainable.

154 However, the mere pursuit of realization of at least a part of them is welcome, since the foresight of
155 environmental measures in the company's strategy and their implementation will certainly bring
156 economic benefits [12].

157 Next, all the components of the model are explained, detailing the processes required to achieve
158 environmental sustainability

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160 *4.1 Reducing of raw materials use*

161 Rothaermel [13] argues that company's provisions for reducing resources must be reflected in
162 the company's strategy. The aforementioned author emphasizes that the implementation of
163 measures to reduce resources must give companies a competitive edge. One of reductions of
164 several resources use is the application of intensive technology. Intensive technology means a
165 tight production mode that uses certain tools to accelerate processes to get the best result at the
166 lowest cost [13]. Thus, the search for possibilities of resources reduction in various sources is a
167 continuous process. Therefore, corporate executives or responsible employees need to be constantly
168 interested in scientific advances in technology development, to follow global trends in the field of
169 new technologies in order to achieve a competitive advantage in the company's operations.
170 Companies - the market leaders, which have enough funds, can make orders in research institutions
171 for new technologies, saving on raw materials creation and the first ones can use the results of
172 inventions. Thus, the first way to reduce the use of resources must be related to the search for the use

173 of intensive technologies. The production process involves the use of various materials, some of
 174 which become waste or pollutants that are harmful to the environment.

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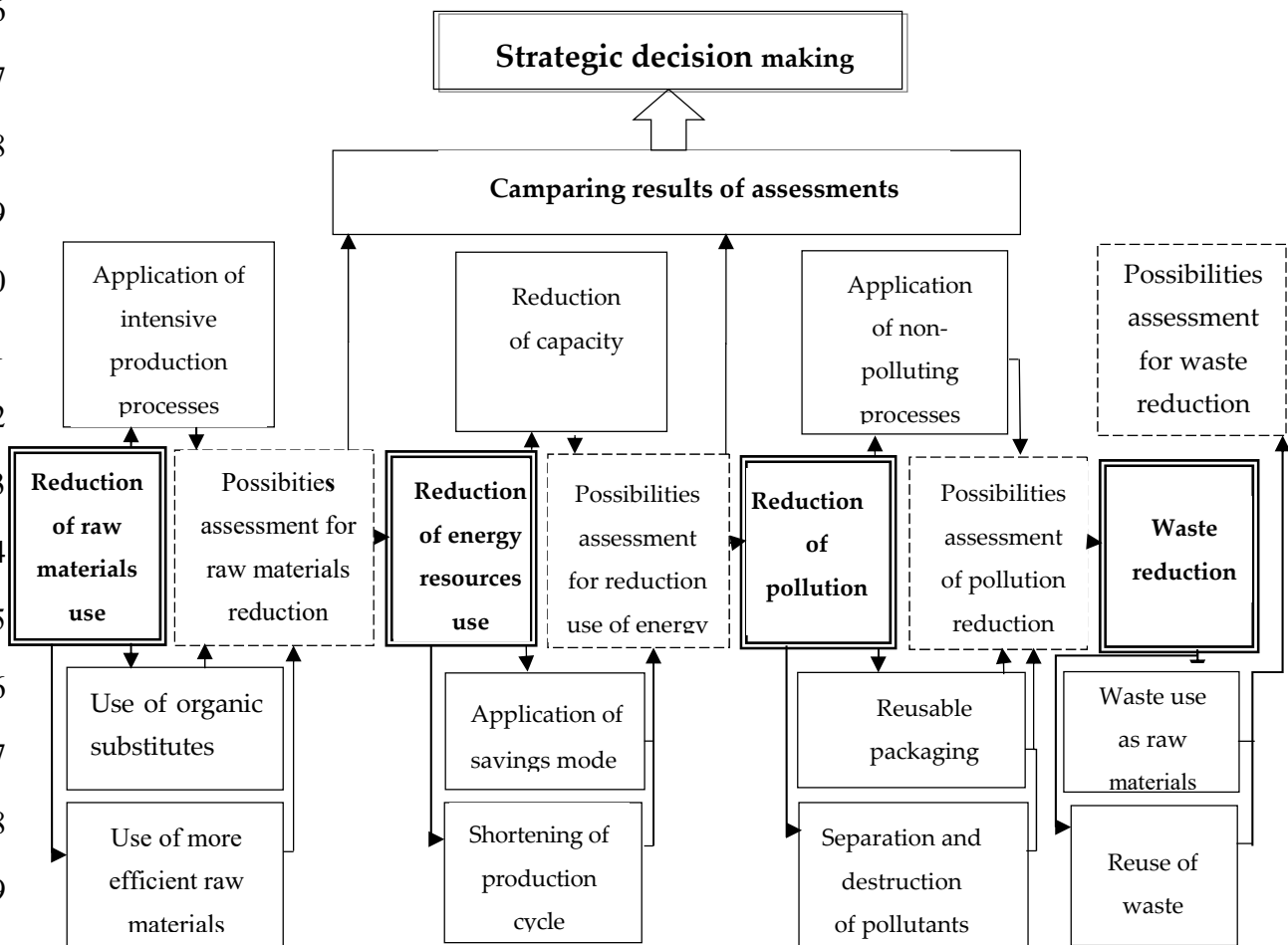


Figure 1. Process model of corporate environmental protection

The use of green substitutes could reduce the negative environmental impact. Together with the substitution search it is advisable to look for opportunities to use more efficient raw materials. Further there are suggested managerial solutions for reducing energy resources. Their technical justification is the object of engineering research.

4.1.1. Application of intensive production processes

Intensive production processes, when applied in practice, allows shortening the production cycle without reducing the quality indicators. Magnusson with Johansson [14] confirm that modern mass production becomes less significant because the product has to be adapted for the needs of consumers, for their personal use. Therefore, production changes and production process intensification is required. It has been observed that application of some intensive production technologies to the food or pharmaceutical industries does improve product quality indicators. In the field of medical services, the latest scientific achievements also make it possible to shorten the cycle of these services provision. The intensification of product manufacturing processes may also be related to the more efficient use of raw materials, which will be discussed in the next section and in somewhat other aspect. The process intensification is most often related to the creation and implementation of innovation. Therefore, usually intensification is based on employee knowledge,

208 and the development of new technologies is exclusively subjected to scientific institutions' activities.
209 It takes time for industrial enterprises to adopt such knowledge-based intensive technologies [15].
210 Better results in a competitive struggle are achieved by those companies which are quicker to
211 employ intensifying product manufacturing processes. Skocaj et al. [16] argue that sometimes the
212 usual production processes can be intensified through artificially created more favourable
213 conditions. The search for favourable conditions is characteristic of the agricultural, medical and
214 food industries. Companies need to actively and thoroughly analyze existing technological
215 processes in order to avoid unnecessary actions and thus reduce the cycle of manufacturing/service
216 provision and potentially reduce operating costs. In the services sector, costs are reduced by
217 technologies tailored to different users. Enhancing manufacturing activities will give companies a
218 competitive advantage, so constant exploration of options should be a permanent process for both
219 manufacturing and service companies. For example, in agriculture, it is expedient to use intensive
220 animal husbandry technologies (when certain growth-enhancing supplements are given to
221 livestock) and intensive crop production technologies [17]. In the construction sector, they use
222 certain ingredients [18], which provide better properties to materials (strength, durability). In the
223 pharmaceutical industry, reaction accelerators are used as well [19]. Confectionery industry uses
224 confectionery additives, which allow reducing the use of raw materials and achieving a result which
225 is just as good, etc

226 4.1.2. Use of organic substitutes

227 Quoting M. Porter the emergence of substitutes was named by Fifka and Berg [20] as a threat to the
228 company in developing and implementing a competitive strategy. However, the application of
229 substitutes in manufacturing is a possible first step towards the use of environmentally friendly
230 resources. The term of substitute is usually attributed to the use of alternative food products. We
231 know about meat substitutes, milk substitutes, substitutes for medicines, etc. The use of substitutes
232 in other industries must be already foreseen when designing a new product. The whole product
233 manufacturing cycle should be reviewed, in attempt to find any possibilities to replace
234 environmentally unfriendly materials for the friendly ones. Obviously, the use of environmentally
235 friendly substitutes will have less negative impact on the environment or not at all. The key is to find
236 a way to replace long-life materials in nature. The main uniqueness of the ecological substance is the
237 less negative impact on the environment than other products of the same type have, i.e. production
238 and recycling of an obsolete product generate less waste or less consumption of primary resources or
239 energy for its production. During the production, the environment is less polluted or there are less
240 harmful substances in the product itself, which are polluting the environment in both cases, during
241 the product use and after its recycling.

242 A welcome choice is to produce wooden furniture, toys instead of plastic ones, use environmentally
243 friendly, natural-looking wall-papers, organic glue instead of nails, avoid plastic packaging, and use
244 natural materials instead of the previously popular synthetic ones in the cosmetics industry.
245 Advanced green chemistry methods offer solvents derived from natural and/or renewable sources,
246 namely biologically based molecular solvents, ionic liquids consisting exclusively of biomaterials
247 and natural resources [21]. The efforts to explore the options in attempt to use materials that are
248 environmentally friendly should be a kind of checkpoint for business executives' activities and this
249 activity should therefore be included in the corporate strategy for sustainable business.

250 4.1.3. Use of more efficient raw materials

251 The use of more efficient raw materials is understood as the discovery of entirely new raw materials,
252 the use of which would speed up the production process or reduce the amount of other necessary

253 resources. In other words, it means the creation of more expensive materials with lower costs and
254 other use. This would reduce the risk of scarcity, and the impact on environment would not go
255 beyond the natural balance of our planet. In the production process, materials that reduce energy
256 consumption can also be called more effective. For example, in the chemical industry, the role of
257 such substances is played by catalysts. The catalyst reduces the activation energy of the reaction, and
258 therefore the chemical reactions that cannot normally take place are also supported by the catalyst.
259 Catalyst is a substance that increases the rate of chemical reaction but is not consumed in the
260 reaction. Such materials are being developed, refined and used not only in chemistry, but also in
261 medicine and food industry. Also, if applied materials can improve the quality of the final product
262 then it can also be called more effective. The use of such materials is particularly important in the
263 construction industry. The substances selected for usage allow the product life cycle to be extended
264 and it can also be called more effective. For example, take a computer upgrade to extend its lifespan.
265 Such upgrades include expansion of operational memory. New memory modules use the same
266 amount of power, but the speed of the computer increases. In addition, more efficient materials are
267 those that can give the product better properties, such as lower thermal conductivity, better
268 resistance to mechanical impact, frost, etc. With changing consumer needs, the constant search for
269 better-performing materials is an inevitable process. It is precisely the search for such materials that
270 is characteristic of the scientific institutions that create innovations in the construction industry.
271 Modern companies have to keep track of the latest news in the world of science regarding the
272 development or use of materials. They should seek to keep pace with global leaders in order to
273 overcome less flexible rivals in a competitive struggle for better performance. The emergence of
274 more efficient materials on the market requires the immediate reorganization of production/service
275 provision processes, which is inevitable for companies wishing to survive in a competitive struggle.
276 Hellstrom [22] is looking into the more efficient usage of materials and states that in the course of
277 development of eco-innovations, the following directions should be targeted: reduction of material
278 components in the product, reduction of the quantity of substances in the product, prolongation of
279 the product lifetime using more efficient substances. The aforementioned author suggests looking
280 for the opportunities to expand product use functions, i.e. use the product not for direct use, but also
281 to provide it with other functions. Such opportunities can arise from the use of more efficient
282 materials in the production of the product. Hellstrom [22] sees the use of more environmentally
283 friendly substances in the production process as an opportunity to reduce the risk of health hazards.

284 4.1.4. Assessment of the results of the search for raw materials reduction opportunities

285 Reducing the use of raw materials in the company is possible in three ways discussed in the
286 previous sections. After execution of the actions mentioned in the previous sections, aimed at
287 reducing the use of raw materials in the production/service delivery process, the next stage of work
288 would be to evaluate the search results of the raw material reduction possibilities. The purpose of
289 the evaluation is the ranking of all the aforementioned actions according to their importance and
290 application possibilities. The assessment should be based on the following criteria: financial
291 feasibility of the company, technical possibilities, possibilities for execution of tasks for staff, and
292 according to the forecasted achievement of economic indicators of the company, after
293 implementation of one or another of the abovementioned ways of reducing the use of raw materials.

294 The easiest would be an expert evaluation using the multi-criteria SAW method. The results of the
295 evaluation should reflect the future perspectives of reducing the use of raw materials, therefore,
296 these activities of the companies aiming for sustainable development should be envisaged in their
297 activities strategy.

298 4.2. Reducing of energy resources use

299 The main objective of the future energy is to ensure the state's security and sustainable development
300 in accordance with environmental requirements. For that, it is necessary to meet the consumption
301 needs of energy resources using a variety of primary energy sources, increase the efficiency of
302 energy production, transmission, distribution and consumption, guarantee the affordable cost of
303 these resources and provide reliable and of appropriate quality to the end users. It is believed that
304 in the future, the energy market will be expanded and improved, involving more and more
305 participants in this business and increasing the efficiency of the energy sector. In order to emphasize
306 the aspects of reducing energy resources due to their unique origin and importance, in the model
307 they are singled out with a separate component. Enterprises can foresee the reduction of their energy
308 resources in 4 directions: using alternative energy sources, reducing the capacity of the equipment
309 used, applying savings mode, regulating the use of energy resources or using more efficient raw
310 materials.

311 4.2.1. Use of alternative energy resources

312 As the population grows, there is a growing need for energy too. Already at the end of the last
313 century, in order to compensate for the bulk of fuel consumption in industrial enterprises, power
314 plants and heating houses, the import of petroleum products, especially fuel oil, from the exporting
315 countries of these products increased very quickly. Comparatively cheap oil products and natural
316 gas gradually have forced out local energy resources prevailing on a balance sheet of some countries
317 (Lithuania as well). The damage to nature and a human being caused by the use of fossil resources to
318 produce energy has been proven in many scientific works around the world. Scientists warn
319 manufacturing companies and predict catastrophic environmental and human impacts without
320 reducing the pace of use of such resources globally. In this respect, the proper application of
321 environmental measures is also closely related to the solution of social problems. So, the solution is
322 the use of alternative energy sources. Such sources as for example, agricultural enterprises include
323 biomass, timber, straw, energy plants and biogas, whose production would help to consume various
324 organic waste without harming nature, as well as companies that could harvest solar energy, wind
325 and other environmentally friendly sources. Incidentally, such energy production could also create
326 new jobs.

327 For example, in agriculture alternative sources of energy can be found in livestock facilities located
328 in a separate municipality, wastewater treatment plants (biogas), industrial plants that dispose of
329 organic waste, municipal waste, the sun, wind, hydropower, geothermal energy, etc. These would
330 be traditional alternative sources of energy. An alternative energy could be derived from flood-tides,
331 micro-organisms, and cosmic energy. These energy-generating methods are still the object of
332 research.

333 A more rational use of funds for energy production is the one when energy is produced centrally
334 and then distributed to enterprises and household customers. If companies are not able to obtain
335 energy from alternative energy sources in a centralized manner, it is appropriate, from the point of
336 view of sustainability, to organize energy production from alternative sources independently.
337 Alternatively, renewable power engineering is currently not only a fashionable term, but also a
338 relevant and promising field of energy production, so the executives of the companies seeking
339 sustainable business need to evaluate all possibilities of choosing an alternative source of energy. It
340 would be worthwhile to assess the effectiveness of investments, the degree of risk and make the
341 necessary conclusions.

342 4.2.2. Reduction of capacity required for the producing of products (or the provision of services)

343 In recent decades, companies around the world are struggling to find ways to increase energy
344 consumption efficiency. The increase of efficiency is aimed at reducing energy consumption because
345 of the constantly rising prices of energy resources, increasing energy demand and still tougher
346 up-to-date environmental requirements.

347 Another direction that could reduce energy consumption in the company would be the introduction
348 of energy saving equipment. Modern scientific discoveries are geared towards the creation of lower
349 capacity but higher productivity devices. Currently, only some of the individual components are
350 used in the automotive, food and heat industry, the application of which increases the scale
351 (capacity) of process execution without the use of additional energy resources. Nowadays, such
352 technologies are being developed that would reduce the electrical power of the equipment and allow
353 less electricity to be consumed without compromising the quality of the product and without
354 reducing production efficiency. Household appliances are also being designed and manufactured
355 with lower power engines, whose performance remains or even increases. For example, electricity
356 consumption is calculated according to the formula:

$$357 \quad P = \sum_{n=1}^n W \cdot T \quad (1)$$

358 here P - electrical power consumption, W - electrical power of equipment, T - operating time of
359 equipment, n - a number of equipment.

360 Knowledge of information about electricity consumption will make it easier for business executives
361 to decide on the choice of equipment. Global trends in equipment capacity reduce cause the need for
362 companies to continuously track global innovations related to the equipment used in the process
363 and to set reasonable deadlines for changing technological equipment. The change of equipment is
364 inevitable, as companies aim to gain a competitive advantage in their activities, and this is achieved
365 through the reduction of cost. The investment required for the purchase of new equipment, and its
366 return (payback time), is calculated as follows:

$$367 \quad N_t = \frac{K}{R} \quad (2)$$

368 here N_t - is the payback period indicator, K - amount of investment, R - annual net income. If the
369 net income is uneven, the payback period is determined by the sequential summation of revenue
370 and time calculation until the amount of net proceeds is equal to the amount of the investment. This
371 calculation is most often used by small businesses due to the possibility to assess the current

372 situation and business conditions. New equipment consumes less energy resources, or if made from
373 environmentally friendly materials - more compact, durable and reliable more.

374 4.2.3. Application of savings mode

375 One of the most important factors influencing energy consumption is its rationing. For example, at
376 present, in many manufacturing companies, the rationing index ω is used - the relative energy
377 consumption required for one product. It can be calculated for all types of energy used (electricity,
378 heat, etc.) This index indicates the efficiency of the use of energy resources. The efficient use of energy
379 resources affects product costs, and cost savings will allow to enlarge the company's profits, which
380 growth will probably make it possible to improve the working conditions of employees, and their
381 motivation to work even better. It is clear that the reduction of energy resources, expressed as an
382 environmental goal, will also help to achieve the economic and social goals of the company. The
383 comparative energy consumption indicator (ω) is convenient in that it is very easy to be determined:

$$384 \quad \omega = \frac{W_e}{n} \quad (3)$$

385 here W_e is the electricity consumption for a certain period of time; n- product quantity over the same
386 period.

387 It is useful for companies to know the dynamics of this indicator. Its downward trend indicates a more
388 sustainable use of energy in terms of sustainability. In order to use energy resources economically, it is
389 first and foremost to know their consumption. As a result, the automation, remote accounting
390 equipment is being used for the accounting of energy resources. Savings mode is only possible with a
391 clear view of the consumption of energy resources at each stage of the production / service provision.
392 Thus, reduction of energy resources use would enable economic, social and environmental policy
393 objectives to be realized.

394 4.2.4. Shortening of production cycle

395 Shortening of production cycle is always associated with a lower consumption of energy resources of
396 any kind of character in production, and therefore with a faster turnover of funds. According to
397 Liddell [23], in order to shorten the production cycle, it is advisable to follow Toyota's best practices,
398 i.e. try to avoid 7 losses that do not contribute to the value creation, i.e. transportation, stocks, surplus
399 movement, waiting, additional processes, surplus production, and defects. These 7 loss groups reduce
400 productivity, increase production costs, impede timely production deliveries, and extend the
401 production cycle. In order to avoid such losses, the volume of production processes should be tied to
402 real demand, while reducing the formation of unnecessary stocks in the supply chain. It is therefore
403 advisable for companies to move to a new production model, reduce batches, produce production,
404 taking into account customer needs, more precisely combining demand and production capacity.

405 The time of the production cycle can be reduced by other means, for example, by reducing operational
406 suitability. This can be done by installing advanced technologies, updating equipment, increasing
407 work efficiency by means of rationally harmonized operations. At many stages of production, there
408 are compulsory auxiliary processes of a certain type that do not contribute to the creation of value.
409 Therefore, another way is to look for ways to accelerate auxiliary processes by reducing the cost of

410 these processes. Process control does not add value so automating control operations can also shorten
411 the production cycle.

412 The reduction of the production cycle is, in principle, possible by other appropriate management
413 decisions. For example, shortening production breaks, rational organisation of workplaces and
414 distribution of work, proper planning of production processes, optimization of work and rest regimes,
415 i.e. using flexible production principles and rational work schedules.

416

417 4.2.5. Evaluation of the search results for reducing the use of energy resources

418 Search for energy resource reduction options is a constant concern for the company's executives, as
419 energy resources represent a high proportion of the cost of many products. First of all, it is expedient
420 for companies to review their business plans and look for organizational opportunities to reduce the
421 use of energy resources, because these measures require the least investment and are economically
422 beneficial for the companies. European governments provide programs which encourage business
423 entities to use renewable energy resources. In assessing the potential for reducing the use of energy
424 resources, the economic effect of the application of the measure is the most important, and also the
425 technical possibilities and the possible degree of solution of social problems must be taken into
426 account. For example, companies installing equipment for the use of renewable energy sources may
427 need to hire additional personnel to operate and maintain such equipment, which will partially solve
428 the problems of social unemployment in the region.

429 4.3. Reduction of pollution

430 The determination to reduce pollution or to carry out clean production is undoubtedly one of the
431 most important tasks for achieving sustainable business. In the context of sustainable development,
432 the environment has two main functions: to supply the natural resource to the economic sector and
433 to absorb waste generated in the production and consumption process, ensuring both production
434 and environmental stability. Companies do not often acknowledge that their activities have a certain
435 environmental impact in order to maximize profits at the lowest cost. According to Barbien [2] and
436 Paul et al. [1], the consequences are evident: air and water pollution is increasing, resulting in the
437 disappearance of the ozone layer and the increase of carbon dioxide concentration in the
438 atmosphere. Pollution can threaten human health, natural ecosystems and damage tangible
439 property. Environmental pollution can occur during manufacturing processes and due to improper
440 packaging handling.

441 4.3.1. Packaging of produce into a changeable package

442 Properly used packaging helps reduce environmental impacts and allows for more efficient use of
443 available resources while reducing pollution [24]. Reusable packaging saves raw materials, less
444 polluting nature with waste, although its processing requires more costs. The expediency of the use
445 of reusable packaging has to be determined through the Life Cycle Assessment (LCA) system [25].
446 Belanger and Crossler [26] argue that improving the packaging management process is advisable in
447 the best environmental sense through the use of universal reusable packaging, i.e. suitable for
448 packaging several types of products. Other authors suggest using a smart package (changing colour
449 over time, self-decomposing, etc.) to reduce environmental pollution.

450 Corporate executives must constantly follow the innovations and search for the opportunities of
451 packaging development and apply into company's activities new technological solutions allowing to
452 reduce environmental pollution in this regard. Therefore, while choosing suppliers, it is appropriate
453 to include the environmental requirements and to select the suppliers who deliver the raw
454 materials in the environmentally friendly package.

455 4.3.2. Application of non-polluting manufacturing processes in the activities of companies

456 Genc [4] identifies some of the directions of production improvement, which describe the
457 environmental manifestation of the company's activities. The first direction is to prevent pollution
458 from rising, reducing emissions, runoff and depletion levels. The second direction is the
459 management of the product, which focuses on the substantial reduction of emissions, and also the
460 reduction of unfavorable environmental impacts throughout the whole product life cycle. This is the
461 search for possibilities for the inclusion of the end of the product life cycle into the next product
462 launch start. The third and hardest option is to use "clean" technologies that do not cause any
463 harmful emissions at all. The use of natural substances in the production process obviously reduces
464 environmental pollution, as well as the absence of combustion procedures, after which combustion
465 products must be disposed of as pollutants and the choice of such a process that does not generate
466 any poisonous gas - these are the main measures allowing to protect nature from pollutants as well
467 as not to make environmentally negative effects. It should be emphasized that production processes
468 can be destroying pollutants (destructive) and non-destroying (non-destructive). Non-destructive
469 processes require the use of other methods for the destruction of pollutants.
470 Improvement or renewal of existing production processes in the company in order to reduce
471 environmental pollution is an opportunity to strengthen the competitive position. Modern activity
472 encourages the use of less resources and more orientated to raw materials obtained from recycling of
473 production waste. International regulatory documents provide for the development and application
474 of national or international standards for the emission of harmful substances in industrial processes
475 and other measures to achieve human health and environmental objectives and to improve
476 technologies for limiting toxic emitters.

477 4.3.3. Separation and destruction of pollutants

478 Separation of pollutants means the removal of certain amounts of them from air, soil / ground or
479 groundwater. Companies seeking to achieve environmental friendliness should strive to provide for
480 the possibility of separating contaminants so that they do not enter the air or soil. Physical methods
481 are the most suitable ones - this is the physical extraction of polluting substances from the
482 contaminated medium. In the general case, various filters, barriers accumulating harmful
483 substances, which then are removed, are being used. In this way, the waste is not necessarily
484 completely cleaned, but its spread is potentially stopped. A variation for physical methods is
485 thermal methods that are based on the combustion or ignition of pollutants. Chemical
486 decontamination is also possible, when pollutants are exposed to chemicals to form less hazardous
487 or completely non-hazardous compounds. Biological methods are the destruction or transformation
488 of contaminants by introducing new or activating naturally existing microorganisms [21].
489 Business executives need to be aware of all the possibilities for separating pollutants in production
490 processes and applying these methods in the product's production cycle. When poisonous
491 contaminants enter the air, soil or water, many living animals and plants die there, nature
492 disappears. Therefore, corporate environmental protection is one of the most important principles of
493 sustainable business.

494 4.3.4. Assessment of the results of the search for pollution reduction options

495 The potential for reducing pollution usually involves improving the production process or more
496 appropriate organization of work. Pollution reduction often requires additional investment. The
497 choice of method is determined by the level of environmental impact. Better is such a method whose
498 application more effectively has a less negative effect on the environment or the negative effect is
499 shorter. Start-up companies have the ability to choose the non-polluting manufacturing
500 technologies, and it is expedient for operating companies to find funds for the deployment of
501 low-emission technologies. The result of the feasibility assessment is the ranking of selected
502 methods, taking into account the level of negative environmental impact and the financial potential
503 of enterprises.

504 4.4. Reduction of production waste

505 The reduction of production waste is one of the success factors for each production or service
506 provision company, as the cost of a product / service decreases relatively to the amount of industrial
507 waste decline. And cost reduction is one of the sources of profit growth. Natural resources used in
508 the production process are emitted into the environment in the form of various types of waste [1,2].
509 The problem is that modern industry and society use natural resources and produce waste,
510 surpassing the capacity of nature to transform waste into environmentally beneficial materials and
511 resources. According to Dornfeld [27], sustainability can only be considered in the context of a
512 closed system. The amount of the existing substances on the Earth is limited. The more different
513 kinds of waste are emitted in a limited system, the less there will remain the high quality materials
514 suitable for use in the future. If the waste does not destroy, they pose a threat to the ecological
515 system. Part of the waste and products used can be returned for recycling.

516 4.4.1. Use of waste as raw materials

517 In the process of production, one or the other waste is usually generated. However, the application
518 of modern computerized inventory management methods, the implementation of "precise
519 timeliness" system, robotization of manufacturing processes, automation and other methods allow
520 minimization of waste quantities. The most appropriate scheme of organization of production in this
521 respect is the application of waste-free technology. The expression of such a scheme is the
522 consumption of one production waste in the production of another product, i.e. secondary recycling
523 when waste becomes raw material in another production. The most common examples of such
524 production are found in the construction industry, food production, etc.

525 Another way to recycle waste is to use it to improve the production processes of other products.
526 Organic waste can be used for feed, deposited, composted, ploughed in fields, and processed into
527 biofuels or biogas. The simplest way to consume waste is to burn it in order to obtain the heat
528 needed to produce the product, to heat the building or to sell it. For example, wood wastes, tire
529 recycling waste are sold. In this way, the processing of wood, the industrial waste sold by the rubber
530 industry, has the opportunity to receive additional income. In the presented model (Figure 1), the
531 waste reduction component consists of 2 parts: waste recycling as a production without waste and
532 the use of waste for improving the production processes of another product. They are different in
533 nature and content, but similar in result.

534 Production without waste is the result of future decisions. According to Poile and Safayen [28]
535 computable modelling is an appropriate method for developing such production schemes.
536 Computable modelling is a reliable computer analysis of processes, constructions and systems [28].
537 So, in turn, waste can be raw materials for other industrial or natural systems and have a positive
538 impact on the environment and the economy.

539 4.4.2. Assessment of waste reduction options

540 After analyzing the possibilities for industrial waste reduction in a start-up company, they should be
541 ranked according to the importance and predicted implementation results. Both the operating and
542 the start-up companies have to optimize the amount of production waste. Often exactly this process
543 is related to the search for waste reduction opportunities. For the reduction of waste in enterprises it
544 is sometimes sufficient to tighten control over the production / service provision or to introduce
545 certain control management systems. Control methods work in the face of staff negligence or
546 inappropriate work attitudes. The application of appropriate control methods to optimize waste

547 quantities is the least costly way. Optimising product production processes in terms of raw material
548 consumption, improving technological processes are methods that require more cost to reduce waste
549 quantities. The search for waste reduction options is a permanent task for the responsible staff to
550 achieve the company's goals, because the reduction of production waste also reduces labour costs,
551 which affect the company's profit. For companies, it is often appropriate to assess waste reduction
552 opportunities not only in terms of product cost and operating income. To that end, it is necessary
553 not only to calculate the estimated cost of a product by possibly applying any waste reduction
554 method and to predict the effect of these changes on revenue, but also to predict the likely positive
555 environmental impact over the next decades.

556 4.4.3. Processing of the evaluation results

557 It is possible to agree with Genc [4] categorical and precise opinion that environmental protection in the
558 company's activities is the compatibility of the company's social activities with the aim of preserving
559 biodiversity and ecosystems, efficient and responsible use of resources (energy, production materials,
560 etc.), protection of the environment and revitalization of abandoned land through the development of
561 activities, the creation and production of products suitable for recycling, which consume less resources
562 in the production processes, encouraging a more efficient use of energy and other resources. First of
563 all, it is advisable to choose the most appropriate assessment measures for each environmental
564 direction which were previously identified as the most effective in the current situation. Once the most
565 suitable one is being implemented, it would be advisable to assess and other measures according to the
566 same criteria, at the same time determining the order of their deployment.

567 Since the application of all the above mentioned methods must be the target of the enterprises
568 seeking sustainable development, it is therefore advisable to apply formula (4) for the determination
569 of priorities, which makes it possible to estimate the order of the actions taken. Drejeris et. al. [29]
570 suggested to apply this formula for determining the relative level of target achievement (R):

$$571 \quad R = \frac{\sum_{i=1}^n W_i \eta_i}{\sum_{i=1}^n W_i} , \quad (4)$$

572 here i – is the target index; W_i – estimate of achievement of the target (scope of environmental
573 targets); η_i – significance of the target.

574 It is advisable, by the expert method, to establish the implementation ranking of the previously best
575 evaluated measures according to all environmental protection directions, i.e. according to the
576 calculated R-index, it is possible to determine the measures to be taken in order to achieve the
577 company's environmental targets.

578 4.5. Strategic decisions making

579 Environmental elements also have a significant impact on other components of sustainable
580 development: the social and economic situation in the company. The choice of resource type, the
581 qualitative and quantitative use of energy clearly affects not only the environmental but also other
582 components of sustainable development mentioned [30]. It has been mentioned that it is difficult for
583 businesses to find a strategic solution for all the results of the actions envisaged in the model, as the
584 implementation of these measures is often foreseeable for a long time and requires considerable cost.
585 The speed of decision making depends on the experience of companies, the situation on the market.
586 The decision itself of companies to work towards sustainability is a positive and welcoming

587 phenomenon. However, some measures may be too complex for small companies starting their
588 activity (for example, the creation and application of technologies without waste, etc.). It is expedient
589 for such companies to choose the measures already taken by the leaders of the field and in this way to
590 go at least a step towards operational sustainability, by passing other companies that do not apply
591 environmental protection measures. Every step towards sustainability improves the long-term
592 economic results of enterprises [1]. However, often lack of strategic thinking prevents companies from
593 pursuing sustainable development [31]. Environmental protection is a crucial part of enterprise
594 business strategy. On the other hand, companies have the right to choose whether to include
595 environmental protection in their business strategy [32]. Mutual integration of economic and
596 environmental measures offers new opportunities, but companies can integrate environmental
597 elements into business strategy only in close cooperation with stakeholders who initiate
598 environmental protection actions. It relates to the competence and entrepreneurial skills of the
599 company's owners or founders and reflects the company's values and changes in philosophy and
600 culture of the organisation [4]. Taking into account the experience gained, companies can focus on the
601 environment at three levels: simple compliance with existing regulations, voluntary compliance with
602 stricter environmental requirements than those prescribed by regulations, be a leader in the field of
603 environmental protection, testing innovations in their activities, even proposing new legislative
604 amendments regulating the activities of companies according to the leader's achievements. For
605 companies pursuing sustainable development it is not enough to comply with universally accepted
606 regulations or wait for new legislation, but in the present situation it is necessary to constantly review
607 and evaluate all products and services that are produced from an environmental point of view [33]. It
608 remains to agree with Creel and Timothy [32] opinion that the environmental performance of an
609 enterprise can be effectively implemented by incorporating the company's strategy into international
610 standards, implementing and meeting them. Thus, the search for opportunities for implementation of
611 environmental protection measures, and the realization of the emerging opportunities are strategic
612 decisions, the continuous pursuit of which improves the position of enterprises in the market and
613 their performance results. After examining the proposed technical, organizational and financial
614 opportunities for applying environmental measures in the company, company executives have to
615 formulate alternatives to the development of strategic activities, which may include different amounts
616 of environmental protection measures, scale, implementation time, etc. The evaluation criteria are
617 offered by many researchers [34, 35, 36]. The criteria should be grouped in order to determine their
618 significance [37]. Expert evaluation is necessary for the strategic decision making. The best valued
619 strategic alternative will be considered as the basis of the company's strategy.

620 In recent times, a significant increase in the public attitudes towards nature and its protection, as
621 well as the cardinal revaluation of the formed values in the light of the requirements of sustainable
622 development, is characteristic of the whole world. Compliance with environmental protection
623 requirements is a common challenge for corporate executives, because there appears a need for
624 additional costs. According to Genc [4], the application of environmental protection measures and
625 company performance are closely linked. Environmental challenges are global in nature, thus any
626 measures that help to overcome these challenges are of great significance not only at the enterprise
627 level, but also become significant for the state or region. Enterprise executives need to understand
628 that environmental problems are systemic and require a strategic approach for determining the
629 environmental impact of human activities and the relationship between ecological processes [2]. The

630 need for a strategic approach was clarified by Paul *et al.* [1] stating that there must be a permanent
631 and lasting link between business and the environment.

632 The inclusion of environmental protection measures in the company's strategy demonstrates that the
633 company has chosen a sustainable development path that strengthens the company's
634 competitiveness, provides new opportunities for action and encourages the development of low
635 environmental harm technologies [38]. It cannot be admitted that sustainable development is an
636 absolute limitation. In fact, they mean the establishment of certain limits according to the current
637 level of technology and resources and the ability of the biosphere to absorb the effects of human
638 activity [39]. Sustainable development helps maintain a balance between nature and man makes the
639 world safer for all forms of life. Seeking sustainable development emphasizes long-term goals and
640 environmental commitments [40]. Enterprise sustainability is often not equal, companies which
641 implemented more environmental measures and, to a wider extent, are considered to be more
642 environmentally friendly [38]. The proposed model is not finite. It refers only to today's
643 environmental actions that can be improved depending on scientific achievements.

644 5. Conclusions

645 Both global trends and consumer needs create the interest of companies in pursuing sustainable
646 environmental protection activity. The application of environmental measures brings economic
647 benefits to companies. However, neither in science nor in the special literature there is information
648 provided on the environmental actions necessary for companies pursuing sustainable development.
649 The article discusses the relevance of sustainable development and its resolution in the
650 environmental protection activities of corporates, the possibilities and the need to integrate this
651 component into the company's strategy.

652 Based on the sources of literature a model has been prepared for realization of environmental
653 protection actions. The application of these actions in the company's activity would allow to
654 gradually approaching the sustainability of the company's activities. The model consists of the
655 following components: reduction of use of raw materials, reduction of use of energy resources,
656 reduction of pollution, reduction of waste, evaluation of the application possibilities of these
657 processes, processing of results and strategic decision making.

658 Reasonable sequence of these actions execution and content of all components of the model is
659 suggested. After examining the possibilities of applying the measures mentioned in the model,
660 company executives formulate strategic alternatives for business development, which is expedient
661 to be assessed by an expert method. The best alternative identified in the current situation becomes
662 the basis of the company's environmental protection strategy. The application of the model will
663 allow companies to objectively evaluate and determine the order of application of environmental
664 measures, their content and implementation of actions which will improve the company's economic
665 performance results.

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