ECOLOGICAL DESIGN – A SOLUTION TO MULTIPLE PROBLEMS

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Abstract. *The article discusses the problem of pollution and highlights the importance of ecological design in reducing its impacts. Here are provided examples of ecological design solutions, such as renewable energy systems, sustainable building materials, and natural pest control methods. Additionally, are explained the financial advantages of solar energy and argues that it is more cost-effective in the long term to obtain electricity from the sun than to buy it.*

Keywords*: pollution, plastic waste, recycling, renewable energy, solar panels.*

Introduction

Pollution is an enormous problem nowadays. Great quantity of the thrown trash consists of plastic packs, more than 90% percent of which aren't reused. According to the EPA (Environmental Protection Agency) almost 36 thousands of tons of plastic were produced in 2018 in the United States, from which almost 27 thousand were landfilled [1]. Hence colossal quantities of plastic are thrown, subsequently being swallowed by marine animals, which can lead to a significant reduction of the number of individuals of certain species or even their complete extinction. Therefore, we could end up in a totally different world, without lots of nowadays animals, like turtles or whales.

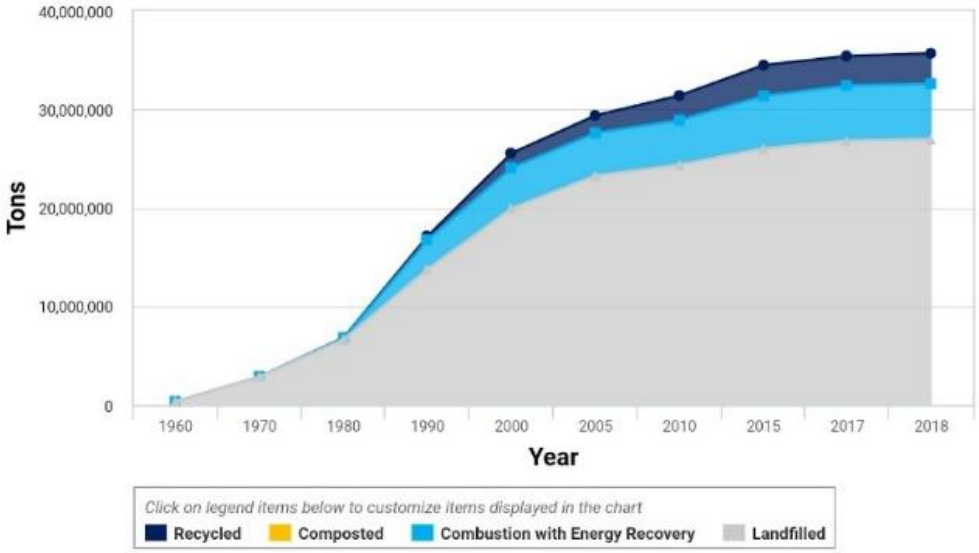

Figure 1. Plastic waste [1]

Looking over the last century, plastic waste increased from 390 thousands of U.S. tons in 1960 to 35,680 thousands of U.S. tons in 2018. Percentage of recycled plastic varied between 0.29% in 1980 to 8.66% in 2018. The highest percent of recycled plastic was in 2015 - 9.04%. This data shows that recycling took more popularity over the last decades, but unfortunately the quantity of generated plastic increases much faster than the quantity of reused plastic. Thus, if in 1960 only 390 thousands of U.S. tones were landfilled, then in 2018 - 26, 970 thousands of U.S. tones. Hence, even if more plastic is being recycled over the last years, that still is much smaller than the quantities of landfilled plastic (fig.1) [1].

How to reduce the impacts of that problem? There are two ways: recycling and the implementation of ecological design. If the first approach focuses on the reusing of such materials as plastic or paper, then the second one is about the process of integrating environmental considerations into design and development with the aim of reducing environmental impacts of products through their life cycle [2]. In this article we will focus on ecological design, explaining what that means, the best ways of implementing it and giving examples of its successful implementation.

Examples of ecological design

Over the past three decades ecological design has been applied to an increasingly diverse range of technologies and innovative solutions for the management of resources. Ecological technologies have been created for the food sector, waste conversion industries, architecture and landscape design, and to the field of environmental protection and restoration [3]. Ecological design is an approach to designing products, services, and systems that takes into account the relationship between humans and the natural environment. Here are 8 examples of ecological design:

1. Renewable energy systems such as solar, wind, and geothermal
2. Sustainable building materials such as bamboo, straw bale, and mud brick
3. Green roofs and living walls that help reduce air pollution and increase insulation [4].
4. Rainwater harvesting systems that capture and store rainwater for use in irrigation
5. Natural wastewater treatment systems that use plants and bacteria to purify wastewater
6. Green transportation systems such as electric vehicles and bike-sharing programs
7. Natural pest control methods such as companion planting and using beneficial insects
8. Low-impact farming techniques such as permaculture, agroforestry, and no-till farming [5]

Besides those examples there are many other forms of ecological design. One of them are being implemented more, others less, but still, they all have the same goal – to prevent pollution and to save our environment. Unfortunately, many people think that eco-friendly approaches take more cost, but in fact it depends on the concrete situation. For example, in the next chapter we will show that using solar energy is more much convenient in long-term than the use of network energy. If the solar energy, is convenient to use, then the ecological design is worth implementing, and brings a lot of income in long-term.

The financial advantages of solar energy

Someone might argue that ecological design takes too much cost to implement and the investments are recouped extremely slowly. Therefore further it will be shown that actually it's more convenient to obtain electricity from sun than to buy it, even if the cost of solar panels might seem high at first. For this purpose, we have developed the following algorithm, based on the research paper *Energetic Problem* [6], with a few adjustments:

1. Choosing the type of photovoltaic panels
2. Finding out the price of the chosen panels
3. Finding out the current price for electrical energy
4. Determining the amount of energy, equivalent in cost with the price of the panel, by the following formula:

$$E = \frac{C}{p} \tag{1}$$

Where C is the price of a monocrystalline panel, p – the price of electricity (lei/kWh)

5. Finding out E_{med} – the average consumption of energy per household (kWh/year)
6. Computing the expression:

$$t = \frac{E}{E_{med}} \tag{2}$$

Where *t* is the time during which the cost of a solar panel would be recouped.

Using the presented algorithm it will be shown that in long-term it is more convenient to use solar energy than to buy it. For this purpose we have chosen monocrystalline photovoltaic panels because they have high efficiency and life-time [6].

1. Monocrystalline photovoltaic panels were chosen, due to their high efficiency and life-time
2. In Moldova their price varies between 5000 lei and 7000 lei. Let's consider the maximum price, 7000 lei, for determining the maximum amount of time during which the costs might be recouped.
3. The current price for electrical energy at Premier Energy is 3.42 lei/kWh [7].
4. The amount of energy, equivalent in cost with the price of the panel will be

$$E = \frac{C}{p} = \frac{7000\ lei}{3.42\ \frac{lei}{kWh}} = 2047\ kWh \tag{3}$$

5. We could not find more recent data, therefore we used those from 2016. During 2016, the average consumption of energy per household was: [8]

$$E_{med} = 1495.2 \text{ kWh} \tag{4}$$

We supposed that this number didn't change too much since then, because, in average a household consumes the same amount of energy per year, with just a little insignificant variation

6. The time during which the price would be recouped is:

$$t = \frac{E}{E_{med}} = 1.36\ years = 16.32\ moths = 1\ year\ 4{,}32\ months \tag{5}$$

The presented investigation shows that, in long-term it is more convenient to use the solar than the network electricity. By considering the current prices, the amount of money payed for a monocrystalline panel would be recouped in less than 1 year and 5 months and afterwards its owner will get a great income, because he/she will not have to pay for electricity. Hence, considering that most manufacturers offer a guaranty term of 25 years for monocrystalline panels, the time during which one will have free electricity can be estimated at 22-23 years. In fact, this is a very big income and it is worth the investment of 5000-7000 lei.

Of course, many factors weren't taken into consideration, like the cost of the installation, the fact that the efficiency of the panel during the night decreases considerably, the necessity to buy accumulators in order to stockpile a part of produced energy. But even with all those the period of recouping will not increase too much. Hence, in 4-5 years one might consider to have absolutely free electricity. And taking into account that most manufacturers offer a guaranty of 25 years for monocrystalline panels, their owner would have free electricity for almost 20 years.

Those small computations show that we can implement ecological design at a low cost. But unfortunately it's financial benefits are negated, because people are thinking of a short term, and not 10-20 years or more. So, maybe the problem of pollution and environment destruction is not caused by the financial losses, but rather by our mentality and short-term thinking? The ecological design is not just a solution to environmental problems, but also a chance to receive a greater income in long-term, Hence, it should be implemented in all the aspects of industry, without the fear of financial losses.

Conclusions

Ecological design provides a promising solution to the problem of pollution by taking into account the relationship between humans and the natural environment in the design and development of products, services, and systems. Through the implementation of innovative technologies and sustainable practices, ecological design can lead to a reduction in environmental impacts and a more sustainable future. While there may be high initial costs associated with implementing ecological design, the financial benefits in the long-term, such as those demonstrated by the example of solar energy, make it a worthwhile investment. By incorporating ecological design into our lives, we can work towards a healthier planet for ourselves and future generations.

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