Green industry: how to make production eco-friendly

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Abstract. The relevance of the study is determined by the fact that green industry is a new area of the economy aimed at preserving the well-being of society through the efficient use of Earth resources. The development of humankind is impossible without the impact on the environment and the use of natural resources: factories are built, waste is incinerated, minerals are mined, forests are cut, and smoking factories are launched. Almost all human actions affect the ecosystem of the Earth; hence, the article discusses whether it is possible to make this impact less harmful. Studies are given on the harm caused by large-scale production to the environment and how to reduce it; how the environmental policy of cities is changing and enterprises are transformed; what is a 'green industry' and how to organize production according to its principles. The empirical basis of the study is the research report of the World Health Organization; American scientists and experts of the Swiss company IQAir, the data of the rating of the US Blacksmith Institute (Pure Earth NGO) for the study of the toxic cities, as well as Eric Hobsbawm's scientific works. The practical significance of the research is aimed at the rational use and organization of work with natural resources, their economical consumption, the use of environmentally friendly technologies in production and in life, and the creation of sustainable conditions for investment in such projects not only by the government authorities, but also by the private sector.

1 Introduction

Harmful emissions, the dominance of plastic and environmental degradation. We traditionally associate all this with the consumer society. However, today green technologies for production [1, 2] are trying to solve this problem and achieve a balance between economic benefits and consumption of the planet's resources.

Climate change, melting glaciers, the extinction of rare animal species and the collapse of entire ecological systems — all this is real these days. The reason for that is you and me. The development of humanity is impossible without the impact on the environment and the use of natural resources. We build factories, incinerate wastes, extract minerals, cut down forests, and launch smoking factories. Almost all of our actions affect the Earth's ecosystem, but is it possible to make this influence the less harmful?

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What harm does large-scale production cause to the environment, and how to reduce it? How does the environmental policy of cities change and how do enterprises transform? What is the 'green industry', and how to organize production according to its principles? There are answers to these questions in this research.

2 Research methodology

The famous British historian Eric Hobsbawm described the industrial European cities of the XIX century as overpopulated, deprived of basic amenities and environmentally disadvantaged [3,4]. Today, industrial centers, of course, look different, but it is also impossible to call them 100% eco-friendly.

According to the rating of the American Blacksmith Institute, the most polluted megacities are in China and India. Here a large number of cars, the burning of ethanol and unsorted organic waste aggravate the situation. In some cases, additional factors also affect the situation: for example, Delhi and Beijing are suffocating in their own smog and dust, also because there are no winds.

Experts of the Swiss company IQAir also agree with American scientists, in their ranking of cities with the dirtiest air according to 2019. Indian Ghaziabad and Chinese Hotan are leading. They are followed by the Pakistani cities of Gujranwala and Faisalabad. By the way, there are five more Indian cities in the top ten [5,6].

Russia with its cities, towns, and settlements is also present in the rating. The researchers considered Krasnoyarsk to be the city with the most polluted air. It is followed in the all-Russian rating by the urban-type settlement Zyryanka in the Republic of Sakha (Yakutia), Vladivostok, Gelendzhik and Tolyatti. Moscow is at the seventh place, and St. Petersburg is at the ninth. In general, in the ranking of countries from IQAir Russia appears to look not bad, having placed on the 81st line out of 98 possible [7, 8].

Will alternative energy save us?

Yes, it will. However, not today and not all of us. The direction is promising. That is why more and more people are turning to it. For instance, solar power is widely used in Southern Europe, and Italy is one of the world leaders in its development. In 2015, solar energy accounted for 9% of the total electricity produced in the country. In Northern Europe, windmills are used more often. The world's largest operating offshore wind farm is located in the Irish Sea: it is capable of providing electricity to about 600 thousand UK households. And Brazil is considered a leader in the development and use of biofuels. Almost 50% of the fuel in this country is ethanol [9.10].

It seems ease at the first glance: the sun is shining and the wind is blowing. Just create some infrastructure and use it. This is what happens in general: for example, a solar power plant has been successfully operating in the south of Spain for more than 20 years. However, serious scaling of such projects is very difficult.

One of the most ambitious projects in the field of solar energy, Desertec, faced this, providing for the creation of the largest solar farm in the Sahara Desert. The creators expected to cover the electricity needs for the countries of the region, as well as to provide Europe with it by 15% [11]. Nevertheless, the project was repeatedly stalled: doubts were caused by its both economic efficiency and technological difficulties.

Wind turbines and solar panels occupy large areas that are needed for the agricultural purposes. It will also not be possible to simply place solar panels in one of the hottest places — the Sahara Desert. Only a third of its territory could cover the global demand for electricity, but it is too difficult to transfer that electricity to other continents. And although alternative energy has great prospects and is constantly developing, not the whole world today is ready to completely switch to renewable energy sources.

Getting rich is eco-friendly.
In the meantime, humanity still has to balance between Scylla and Charybdis — the need to develop the economy and the desire to preserve nature.

To describe this phenomenon, a specialized term 'decoupling' was coined, which actually means a decrease in the correlation between the growth of the welfare of the population and the impact on the environment (see Figure 1).

![Decoupling diagram](image)

**Fig. 1.** Correlation between population welfare growth and environmental impact: resource decoupling and impact decoupling [5,7].

This is a diagram illustrating the decoupling effect.

Decoupling is the gap between consumption and the well-being of the population. The decoupling effect is most evident when the economy is growing, but the negative impact on the environment remains the same or decreases. In the traditional economy, the growth of well-being is accompanied by an increase in resource consumption and an increase in the negative impact on the environment.

Decoupling implies a reduction of this dependence and is divided into two types: resource and impact decoupling. Resource decoupling involves the use of fewer resources for production. Impact decoupling involves reducing the level of negative impact of enterprises on the environment, for example, by reducing the amount of emissions into the atmosphere and the amount of production waste.

One of the countries to successfully practice decoupling in the issue of greenhouse gas reduction is the United Kingdom. Over the past 20 years, it has been able to increase its GDP while reducing emissions at the same time. First, this is due to the widespread use of alternative energy and the partial replacement of coal with natural gas. In August 2020, the last mine that worked for 200 years closed in England, and there are only two coal mining enterprises in the whole of the UK (in Scotland and Wales), which will also stop their operations in 2022 [12,13].

This issue is also acute for industrial cities, where historically they solve the problem with two unknown elements: the development of necessary industries and the preservation of the environment. In order for decoupling to start working at the city level, it is necessary to transform the work of its enterprises, putting it on green rails and successfully integrating them into the urban environment.
There are already successful examples: In Monaco, the incinerator is located just a few hundred meters from the Prince's Palace and the famous stadium the Stade Louis II. This neighboring has become possible thanks to green developments that provide for a high degree of waste treatment of the company's activities. Rotterdam in the Netherlands, which is considered one of the cleanest cities in Europe from an ecological point of view, has seven large factories: oil refineries and petrochemical, machine building, metalworking, food and light industry enterprises. At the same time, the proximity of the enterprises does not bother the people of Rotterdam.

There is a similar example in Moscow, where the oil refinery, which provides more than a third of the fuel market of the capital region, is also the greenest enterprise. Today, active environmental modernization, which began in 2011, continues here. This large-scale project is being implemented in three stages and will be fully completed only in 2025. By now, modernization has reduced the overall impact of the enterprise on the environment by 75%. For example, the Biosphere refining facilities that were stopped at the plant made it possible to transfer production to a closed water circulation cycle: they provide up to 99.9% of water purification, and 80% of its volume is reused.

Igor Makarov, Senior Researcher at the HSE Centre for Comprehensive European and International Studies, said:

'The level of environmental responsibility of each enterprise can be assessed in different ways. However, the main indicator is the ecological footprint that the company leaves on the environment. It is expressed in the number of hectares needed by the planet to replenish the resources used and absorb emissions. When an enterprise declares carbon neutrality, it is assumed that it will compensate for its carbon footprint through third-party projects, for example, planting forests that will absorb greenhouse gas emissions, or through investments in projects of another organization that deals with environmental problems.

How to "marry" the city and industry?

Working with industry, the city can solve environmental issues in two ways. The first is simply to withdraw all dirty production facilities beyond its perimeter, and use the vacated spaces for other purposes. The second is to integrate high-tech and eco-friendly enterprises into the city system so that they become an integral part of it, creating jobs and replenishing the regional treasury. London, for example, decided to expel toxic industries at some point. At the beginning of the 20th century it was considered to be one of the dirtiest cities in the world, but the situation changed dramatically when coal basins were closed here and the movement of gasoline transport was limited.

Moscow did not need to forcibly relocate enterprises; the problem was solved by itself: not all the factories of the capital survived the 1990s in Russia. At the same time, the remaining plants have significantly upgraded their capacities in recent years.

The lost factories were initially integrated into the image of modern Moscow, turning them, for example, into popular art spaces. Other buildings of former industrial giants remained in private ownership and were rented out for warehouses, offices, garages.

In 2017, the federal law on the integrated development of territories came into force, which makes it possible, including from the former industrial zones of Moscow, to make spaces convenient for work and life. The purpose of the law is not to turn the former factory territories into residential quarters. On the contrary, high-tech production facilities will appear on many sites, which will be adjacent to residential complexes, hospitals, kindergartens and shops. People will be able to not only live and relax comfortably here, but also work. A striking example is the redevelopment of the territory of the former reinforced concrete products factory on Oktyabrskoye Pole, where the technopark, housing, and the necessary public infrastructure will be located.

They adapt their production facilities and already operating factories. For instance, PepsiCo production facilities, which are also represented in Moscow, consistently reduce the
consumption of natural resources. Thus, energy consumption at factories decreased by 14-18% compared to 2010 (depending on the category), water - by 17-22%. The indicators of recycling of industrial waste also look very impressive: from 82% in drinks to 93% in snacks and 97% in juices. By 2025, the company also expects to develop fully recyclable, compostable and biodegradable packaging [12, 13].

Promising, dynamic and... green

And it's all about the economy. About the green economy. The examples of Monaco, Rotterdam and the capital's oil refinery are excellent illustrations of it. Essentially, what is it?

In fact, this is a new direction of the economy aimed at preserving the well-being of society through the efficient use of Land resources. Rge green economy provides the rational use and organization of work with natural resources, their economical consumption, the use of environmentally friendly technologies in production and in life, and the creation of sustainable conditions for investment in such projects not only by the government authorities, but also by the private sector.

Among the green projects for industry are the introduction of energy and resource-saving technologies, the production of electric traction equipment, the use of recycled materials and many others. The state and regional authorities can encourage enterprises to take these measures in different ways. For example, through environmental taxes and fees, offering profitable recycling schemes, providing specialized subsidies or payments, as well as various compensation schemes.

Green finance.

In 2007, even a separate type of securities appeared — 'green bonds', which are issued to raise funds for environmental projects. As a rule, they are subsidized by the states and have a lower rate. If the project is recognized as green, then the company has the right to issue such a bond. Many investment funds stipulate that a certain share in the portfolio should consist of green bonds. Raising funds for green projects becomes easier and cheaper than raising funds for conventional projects.

The presence of large industrial players working in the field of recycling significantly facilitates the solution of environmental problems for the city. For example, Ecopolis Corporation that operates in Moscow is specializing in the processing and disposal of electronic and electrical equipment waste. The company has three plants in total. Two in Moscow and one in Oryol oblast. The efforts of these enterprises, a complete chain of recycling of old created equipment, from a broken printer or monitor to the production of plastic pellets, which are high-quality secondary raw materials.

So, cooperation with retailers allows the company to collect old equipment, including the one taken from the population. Then it is sorted out: electronic boards are disposed of at the Oryol plant Aurus, and its plastic parts are processed into a pellet at the metropolitan production.

Today, the energy, chemical and transport industries have already become part of the green economy. Other industries also need to implement environmental initiatives. This is especially true of the pharmaceutical industry, since the production of medicines involves many stages, after which a significant amount of waste is generated that pollutes the atmosphere, hydrosphere and soil.

3 Conclusion

The study presents the decoupling effect as an integral part of the very idea of green industry. In fact, decoupling is an indicator of green economic growth, which is not accompanied by environmental degradation. There is a broad debate in the economy about whether green economic growth is possible.
In the modern world, more and more attention is paid to environmental problems. And it is important for us to understand that their solution, as practice shows, is possible without prejudice to economic well-being. The decoupling effect tells us that there may not be a dilemma whether to live well or to help nature.

The practical significance of the research is aimed at the rational use and organization of work with natural resources, their economical consumption, the use of environmentally friendly technologies in production and in life, and the creation of sustainable conditions for investment in such projects not only by the government authorities, but also by the private sector.

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