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# Sustainable resource management policy of national economic development

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**Abstract.** The article considers the mechanism of possible full supply of strategic resources for the purpose of implementing the concept of sustainable development. Two main approaches to the accumulation of resources are indicated: i) the first approach, aimed at maintaining a strategic stock of energy resources, which involves the concentration of resources to ensure the stability and security of energy supplies; ii) the second approach consists in the accumulation of financial assets through the receipt of income and allows the formation of a financial reserve. In the case of the first approach, the country like the United States strategically accumulated crude oil reserves, exemplified by the establishment of the Strategic Petroleum Reserve (SPR) in the 1970s. The percentage ratio of US crude oil exports relative to their daily oil consumption in the United States from 1980 to 2023 was calculated and detailed in the research, with trends such as a decline of 1% in 2005 and a subsequent increase of 156% in 2023 being revealed, and the impact of technological and geopolitical factors on these changes was determined.

## 1. Introduction

In an increasingly interconnected world, the imperative for sustainable development policies transcends borders, highlighting the urgency for global cooperation and a collective commitment to address these critical challenges for the well-being of our planet and future generations. In recent decades, the depletion of natural resources and the increase of anthropogenic influence have become important subjects of world attention. Observing the dynamics of ecological crises, the growth of pollution of the atmosphere, water bodies and the land surface, as well as the worsening of climate change problems indicate the need for immediate measures to preserve the environment and ensure sustainable development.

In this context, sustainable development policy becomes a strategic initiative aimed at ensuring economic growth, social justice and environmental sustainability. However, the success of sustainable development policies depends on the joint efforts of all stakeholders, including civil society, governments, and businesses. This requires developed mechanisms of cooperation, mutual understanding and responsibility towards present and future generations.



## 2. Related works

The policy of sustainable development in the use of useful resources of national economies is the subject of discussion and research by a large number of scientists and experts from various fields of science and the public sector [1,2,3,4,5]. This issue is critical in today's world, as our society is faced with limited resources and the need to use them efficiently to meet the needs of present and future generations.

In the field of sustainable development policy research and the use of useful resources, several outstanding scientists and experts stand out, whose contributions have significantly influenced the development of this field. Thus, Gro Harlem Brundtland (also known as the Brundtland Report) introduced the concept of sustainable development and recommended an action plan to ensure the balanced use of resources [6].

Herman Daly substantiated the need for a balanced approach to the use of natural resources and support for sustainable development [7]. He actively contributed to the development of strategies and policies aimed at preserving nature and reducing the negative impact of economic activity on the environment [8]. Donella Meadows reviewed forecasts and models of world population growth, industrial production, environmental pollution and resource use for the future. They warned that without balanced strategies and limits to growth, global society could face serious problems related to the depletion of resources and the environment.

Ernst von Weizsäcker actively researched the issue of resource conservation and the development of a more ecological and efficient economy [9], where the concept of "factor 4" and methods of its implementation were considered. The authors emphasize the importance of a balanced use of resources to ensure sustainable development and reduce the negative impact on the environment, which is becoming increasingly relevant in today's world with limited resources and growing environmental problems.

Amartya Sen developed the concept of the "expanded concept of freedom" (Capability Approach) [10], in which he defined freedom as the ability of people to realize their potential and have access to various opportunities. His work focuses on the fact that in order to achieve sustainable development, it is necessary to ensure comprehensive development and allow equality of opportunity for all members of society.

Thus, the sustainable use of useful resources has become an important problem in the modern world, as inappropriate use leads to a decrease in living standards, destruction of natural environments, and threats to economic sustainability. The concept of sustainable development, which includes balanced use of resources, economic growth and social justice, is key to solving these problems. Scientists and experts from different fields of science work together to develop strategies and policies to achieve sustainable use of resources [11,12,13].

This includes developing new technologies, improving legislation, creating incentives for sustainable consumption and other measures. It is clear from this that cooperation between academics, governments, civil society organizations and the business environment is essential for the successful implementation of sustainable development policies. Despite the complexity of the tasks, sustainable use of useful resources is a necessity to ensure long-term sustainability and well-being of present and future generations [14].

The literature review points to the need for continued research and policy development on sustainable development and the use of useful resources both nationally and internationally to ensure sustainable and prosperous development for the entire world.

The purpose of the study is to evaluate the implementation of the strategy of sustainable development in relation to the use of fossil resources.

Hypotheses:

- 1 Sustainable development involves reducing the extraction of natural minerals.
- 2 The standard of living of future generations directly depends on the actual level of well-being of the current generation.

### 3. Method

The research was conducted using various methods of research and analysis. First, a literature review was conducted to identify previous research and theoretical frameworks relevant to each of the selected topics. Secondly, analytical research methods included the analysis of statistical data, the study of legislation and regulatory provisions, factor analysis, comparative analysis and forecasting. For each aspect of the research, specific methods were applied, which made it possible to study and analyze the selected topic in detail and provide the information necessary for formulating conclusions and recommendations regarding the policy of sustainable development in the use of useful resources of national economies.

Two models were used to analyze the accumulation of funds and assess the risk of loss of income. The first model, a simple mathematical one, determined the accumulation of funds through the volume of exports and the impact factor, and this model was simplistic because it did not consider many other factors. The second model, the Value at Risk (VaR) model, was used to estimate the maximum possible loss of revenue, considering the level of credibility and the time horizon. It involved preparatory steps, such as determining the time horizon, confidence level, calculation of income and statistical parameters. In addition, there was a more complex formula for calculating the probability of using welfare funds, which considered more factors and probabilities. Both models are useful for analyzing financial risks and making managerial decisions in the modern economic environment.

### 4. Results

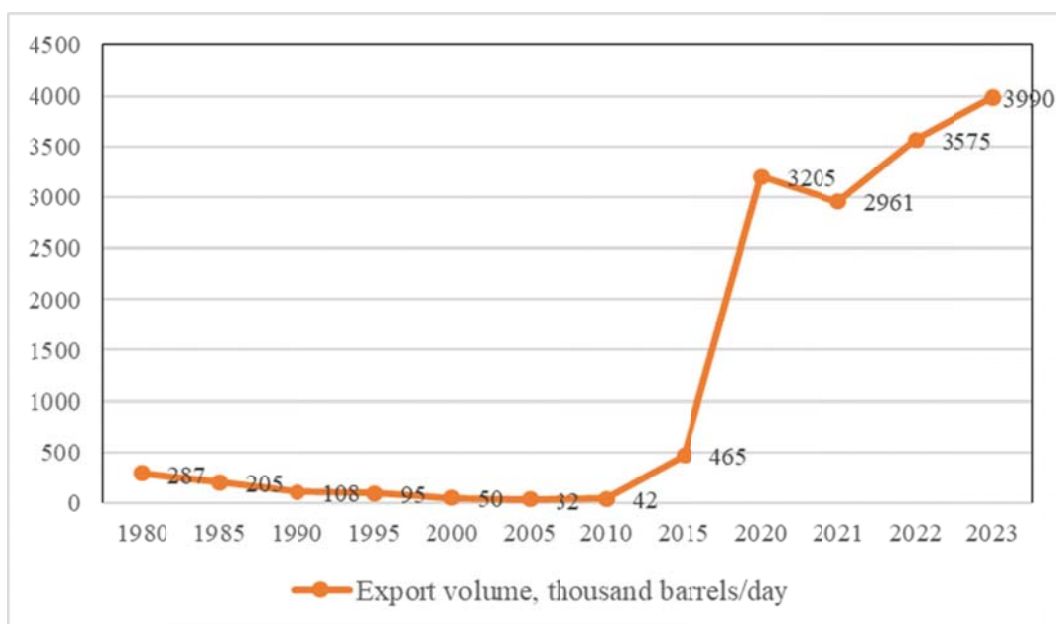
The concept of sustainable development was initiated in the report of the Brundtland Commission. It is based on the ratio of meeting the needs of the present generation and the future. The needs determine the level of use of the resources that the constraint sets. Therefore, the problem of the use of natural resources in modern production is the main one in this concept and makes demands on the economic policy of countries. For some countries, it means obtaining the appropriate resources, which are in limited quantities, for others, it means the formation of such a foreign economic policy that would allow to ensure the growth of the well-being of the modern population of the country and the transfer of appropriate resources to future generations.

In the world, different countries solve the problem of preserving raw materials in different ways. For example, the United States imposed a ban on the export of crude oil outside the country in 1975 in order to protect against a possible repeat of the oil energy crisis that occurred in the 1970s. However, it is important to consider that this policy had root causes that began to take shape as early as the 1950s, when US oil costs rose due to increased demand for automobiles. After that, the abandonment of the gold standard in 1971 caused a devaluation of the dollar and a decrease in oil prices, which affected oil importers. As a result of the Doomsday War, which also contributed to inflation, the Nixon government imposed tight controls on oil prices, which led to production restrictions and increased dependence on imports. In summary, the US oil export policy had root causes, including changes in oil demand, currency policy, inflation, and geopolitical events, and these policies changed according to the world market situation and the needs of the US oil industry (Figure 1).

US crude oil exports during 1980-2023 show a decreasing trend until 2005, when they reached a low level of 32,000 barrels/day, after which they increased sharply. The largest increase was seen after 2015 due to new production technologies, including hydraulic fracturing of shale rocks, and further growth is forecast to 3,990,000 bbl/d by 2023, reflecting the impact of technological and geopolitical factors on US crude oil exports.

Thus, as a result of the energy crisis of the 1970s and the economic policy to guarantee the national security of the United States, four natural underground oil storages were created on the coast of the Gulf of Mexico in Texas and Louisiana - Bryan Mound - Freeport (Texas); Big Hill - Winnie (Texas); West Hackberry - Lake Charles (Louisiana), Bayou Choctaw - (Louisiana) [16].

These natural storages became part of the Strategic Reserve of Crude Oil, which was created in order to guarantee national security and stability in the supply of oil in case of crisis situations.



**Fig. 1** Export volumes of crude oil in the USA.

Source: calculated by the authors based on [15].

However, despite its original purpose, this reserve has been used intermittently in different periods for different reasons. The first case of using the strategic oil reserve occurred during the Persian Gulf War in 1991. At this time, a large part of the reserve was activated, as military operations significantly affected the supply of oil from the region. In 2004, part of the strategic reserve was also used to ensure the stability of oil prices after a sharp increase in demand. In 2013, another increase in the strategic oil reserve was conducted when the US Congress could not reach an agreement on the federal budget, and this affected government operations and national security. In 2021, it was decided to use the strategic reserve to reduce speculative oil prices and ensure market stability.

Therefore, it can be considered that the national policy of the USA regarding the reservation of hydrocarbon resources raises doubts about its effectiveness, because in the event of military actions or other crisis situations, the presidents of the USA constantly reduce strategic reserves for various purposes, which can lead to the limitation of national security and the stability of the energy market.

Another measure of regulation of natural resource stocks is the creation of sovereign funds or funds of national welfare. In terms of economic content, these are state investment funds, which are accumulated by the government of the national economy in order to preserve the well-being of the population for future periods. These funds include various financial instruments (bonds, shares, precious metals and property). Such funds began to be created as a protection system against the energy crisis of 1973. The UAE was the first country to create it. Subsequently, such funds began to be implemented in other countries. The main characteristics of the global welfare funds of national economies are listed in Table 1.

Note that the funds are not analogous to state pension funds, they operate outside the pension social component. National welfare funds are formed at the expense of state budget revenues from the sale of fossil resources, mainly oil and gas (for example, Norway Government Pension Fund Global, Abu Dhabi Investment Authority).

However, some funds are accumulated through non-commercial sources (for example, Caisse des dépôts et consignations in France). The assets of these funds can be very large, in some cases reaching hundreds of billions of dollars (for example, Norway's Government Pension Fund Global with assets of \$1.478 billion).

**Table 1.** Characteristics of world welfare funds of national economies.

<b>Fund</b>	<b>Country</b>	<b>Inception</b>	<b>Origin of source</b>	<b>Assets, billions US \$</b>
Government Pension Fund Global	Norway	1990	Oil & Gas	1,478
Caisse des dépôts et consignations	France	1816	Non-commodity	1,416
China Investment Corporation	China	2007	Non-commodity	1,350
SAFE Investment Company	China	1997	Non-commodity	1,019
Abu Dhabi Investment Authority	United Arab Emirates	1967	Oil & Gas	853
Kuwait Investment Authority	Kuwait	1953	Oil & Gas	803
Public Investment Fund	Saudi Arabia	1971	Oil & Gas	777
GIC Private Limited	Singapore	1981	Non-commodity	770
Exchange Fund (Hong Kong)	Hong Kong	1935	Non-commodity	514
Temasek Holdings	Singapore	1974	Non-commodity	492
Qatar Investment Authority	Qatar	2005	Oil & Gas	475
Central Provident Fund (Singapore)	Singapore	1980	Non-commodity	381
Caisse de dépôt et placement du Québec	Canada	1965	Non-commodity	335
Investment Corporation of Dubai	United Arab Emirates	2006	Oil & Gas	320.4
Mubadala Investment Company	United Arab Emirates	1984	Oil & Gas	287.5
Turkey Wealth Fund	Turkey	2017	Non-commodity	279.3
Korea Investment Corporation	South Korea	2005	Non-commodity	201
Abu Dhabi Developmental Holding Company	United Arab Emirates	2018	Non-commodity	159
Russian National Wealth Fund	Russia	2008	Oil & Gas	148.4
Future Fund	Australia	2006	Non-commodity	135.8
Emirates Investment Authority	United Arab Emirates	2007	Oil & Gas	87
Alaska Permanent Fund	United States	1976	Oil & Gas	79.4
Brunei Investment Agency	Brunei	1983	Oil & Gas	73

Source: created by the authors based

This allows funds to generate profits and invest them in various financial instruments. The main purpose of these funds is to ensure the well-being and future stability of the national economy. They can be used for investments in various industries and projects that contribute to the development of the economy and the social well-being of the population. The creation of national welfare funds is explained in the scientific literature as an important regulatory tool. However, financial resources are not physical reserves of resources, it is their similarity, according to which under certain conditions (changes in the world currency, changes in political power) these assets will remain just a piece of paper and will have no value for the future generation.

Therefore, a dual system of guaranteeing sustainable development for future generations was formed in the world. The first is the American one, which is characterized by the preservation of the main energy resource of modern technocratic civilization - crude oil in natural physical parameters. Another system is a stock system, which accumulates not natural resources, but financial assets in dollars. At the same time, such formation occurs due to the export of national natural resources, mainly energy carbohydrates. Each of these systems has its own characteristics and strategies that affect the preservation and use of natural resources, in particular, energy hydrocarbons, such as crude oil (Table 2).

**Table 2.** Comparative characteristics of existing energy resource conservation systems.

<b>American natural system (storage of crude oil reserves)</b>	<b>Stock fictitious system (investment in financial assets)</b>
<i>Storage of physical stocks:</i> This system is mainly based on the physical preservation of strategic oil reserves. That is, real oil is stored in specially equipped tanks on the coast of the Gulf of Mexico and other regions of the United States.	<i>Financial asset accumulation:</i> In this system, the main strategy is the accumulation of financial assets, usually in dollars, due to the export of natural resources, especially energy hydrocarbons. Earned money is invested in various financial instruments.
<i>Market and price regulation:</i> The US uses these reserves as a tool to regulate the world oil market. They can increase or decrease their reserves to influence oil prices and stabilize the market.	<i>Risk diversification:</i> One of the main principles of this system is the distribution of risks. Funds place their assets in different asset classes to reduce the impact of price fluctuations on a particular type of resource.
<i>Energy security control:</i> Conserving physical oil reserves helps ensure US energy security in the event of a crisis, such as war or an interruption of oil supplies from other sources.	<i>Investment profit:</i> The main purpose of such funds is to earn profit by investing in various assets. These profits can be used to develop the economy and ensure the well-being of the nation.

Source: created by the authors

Currently, the noted schemes of sustainable development regarding the preservation of natural raw resources are undergoing significant changes. The American natural system reduces the physical volume of strategic oil reserves in order to regulate the world oil market and control crude oil prices. Using its reserves, the United States can intervene in the work of the world oil market, increasing or decreasing the amount of reserves depending on the circumstances. This could affect the overall level of supply and demand, and therefore crude oil prices.

Transformations are also taking place in the stock system. Thus, in 2022, significant losses of funds were observed in this system. This is a consequence of geopolitical conflicts and instability in world markets. Global events, such as wars or crises, can lead to rapid fluctuations in the prices of financial assets. In addition, the fund system is based on the income received from the export of natural resources, in particular, energy hydrocarbons. If these resources are subject to fluctuations in price or demand, this may affect the return of the fund. Market reaction to shock events is often based on psychological factors. Excessive panic or euphoria can cause price swings and affect investment decisions. Loss of money can also be the result of poor asset management. Inexperience or ineffective investment strategies can lead to negative results.

According to the simplest mathematical modeling, the accumulation of funds is calculated according to the formula:

$$N=a \cdot E+b \quad (1)$$

where:

$N$  - accumulation of funds;

$E$  - volume of export of natural fossil resources;

$a$  - the coefficient that determines the impact of the volume of exports on the accumulation of funds;

$b$  - a constant that considers the initial level of fund accumulation and other important factors.

This model predicts that an increase in the volume of exports of natural fossil resources will lead to an increase in the accumulation of funds by  $a$  unit, considering the initial level of  $b$ . However, this formula is very simplified and does not consider many other factors, such as resource price dynamics, taxes, mining costs, external economic factors and many others.

Modern realities of the global economy increase the level of riskiness of savings losses. Accordingly, we will estimate the possibility of losing funds through the Variants model ( $VaR$  - Value at Risk), which estimates the maximum possible loss of income at a certain level of credibility and a certain time interval. Different approaches can be used to calculate  $VaR$ , such as historical  $VaR$ , MonteCarlo method and analytical  $VaR$ .

The calculation of Value at Risk ( $VaR$ ) to assess the risk of loss of income requires considering the following factors:

Determination of the time horizon: the period of time during which you consider the risk of loss of income is determined. For example, it can be 1 month, 1 year or any other appropriate period.

Determination of confidence level: the confidence level required for the risk assessment is chosen. For example, 95% or 99%. The confidence level indicates the probability that losses will not exceed the calculated  $VaR$ .

Income calculation: The daily or monthly income or change in the value of the fund's assets for the entire period of the study is calculated. This calculation helps to obtain a historical data series for analysis.

Determination of statistical parameters: based on historical data, average daily/monthly income and standard deviation of income are determined. The mean return indicates the expected return, while the standard deviation measures the distribution of random variation.

After these preparatory steps, one can proceed to the calculation of  $VaR$  using an appropriate statistical methodology, such as the normal distribution method or the Monte Carlo method.  $VaR$  helps estimate the maximum possible loss of income over a given time horizon with a specified level of confidence.

The analytical calculation of Value at Risk ( $VaR$ ) for the selected confidence level is based on the following formula:

$$VaR = Z \cdot \sigma \cdot \sqrt{T} \quad (2)$$

where:

$VaR$  - Value at Risk;  $Z$  - a coefficient that is determined by the level of confidence and can be found in tables of the standard distribution (for example, for 95% confidence,  $Z$  is -1.645);  $\sigma$  - the standard deviation of income;  $T$  - the time horizon expressed in years (or days if you are using daily data).

The obtained  $VaR$  result indicates the maximum possible loss of the fund's income with the specified confidence level and time horizon.

At the same time, this model ignores the following elements, such as the correlation between different assets of the fund, the unfairness of the internal risk structure, changes in the market, etc.

Calculating the probability of using welfare funds can be viewed from an even more complex perspective, considering more factors and probabilities. However, this more complex formula may be situation-specific, and its determination requires more specific data and modeling. One of the more complex calculation methods can look like this:

$$P = 1 - \prod_{i=1}^n (1 - p_i \cdot q_i) \quad (3)$$

where:

$P$  - overall probability of using welfare funds;  $n$  - number of possible projects or use of funds;  $p_i$  - probability of using funds for the  $i$ -th project;  $q_i$  - the probability that the  $i$ -th project will be offered for financing (this probability may consider government decisions, priorities, the political situation, etc.).



This formula is more detailed as it considers the probability that projects will be proposed for funding (using  $q_i$ ). It also assumes that the use of funds for each project  $p_i$  is independent events.

The mathematical model provides an answer to the possible use of these funds in the implementation of relevant projects. However, in a strategic vision, the use of funds should be based on the specific challenges of the national society. The standard of living of the future generation depends on the constantly growing life of the present generation. Therefore, such funds should serve a single task - to improve the decent living conditions of the current generation. Therefore, the main global problem of the life of the future generation remains the problem of war. An urgent solution to this problem is a condition and guarantee of decent living conditions for future generations of humanity.

All these factors demonstrate that changes in modern natural resource conservation systems require adaptation to complex global conditions and flexibility in choosing strategies to ensure sustainable development and resource conservation.

## 5. Discussion

Regarding the policy of sustainable development in the use of useful resources of national economies, there are different points of view and strategies. One of these points of view is support for the idea that it is necessary not to transfer money to funds, but rather to invest it in the creation and development of social, household and environmental infrastructure, which will remain for the benefit of future generations [17,18]. This position is argued by the fact that investing in infrastructure can have a long-term positive impact on society and the environment [19, 20]. The creation of efficient infrastructure, such as convenient public transport, water supply and waste management systems, can contribute to improving the quality of life of citizens, reducing CO<sub>2</sub> emissions, and increasing access to education and health services. It can also create new jobs and contribute to the economic growth of national economies.

On the other hand, critics of this position point to the possibility of abuse and insufficient management efficiency of such infrastructure projects [21, 22], and the need to fund emergencies and crisis response [23, 24]. They emphasize the importance of creating funds that can provide a financial reserve for emergencies and investments in sustainable resource use [25, 26].

In our opinion, it is necessary to find a balance between investing in social and environmental infrastructure and creating financial mechanisms that would ensure sustainable support for the development of national economies and the preservation of useful resources for future generations.

## 6. Conclusions

Thus, the world system of economic regulation to guarantee sustainable development in order to provide for the future generation has developed two mechanisms. The first is the American model, when strategic energy reserves (oil) are stored in a physical state and preserved for use in the future period. It should be noted that the conservation of crude oil is not a perfect mechanism for meeting the needs of the future generation, but is a mechanism for influencing the stock price parity of oil, especially in critical moments (wars, revolutions, etc.). The second is a system of accumulation of financial assets, when resources are stored for future generations in the form of financial instruments, which may depreciate or sharply decrease in value at any time. Mathematical calculations of the filling and activity of funds are marked only by the market environment, which does not consider the factors of possible alternative development of the world community. Therefore, the well-being of future generations depends on the peaceful coexistence of national economies and political structures without war, and the accumulation of resources for future generations becomes of secondary importance. At the same time, with the development of science and technology, resources are replaced (coal for gas, oil, gas for hydrogen). The two existing models do not solve sustainable development for future generations, but act as tools of the geopolitical game.

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