Simulation of Regional Development of Bioeconomy under Slowbalization

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Abstract: The article studies preconditions for stratification of regional economic systems. The study shows that development of greening processes is becoming much more complicated due to slowbalization of regional economies and the COVID-19 pandemic. It substantiates the need to coordinate regions' greening programmes with development of their economic systems and strategies stimulating bioeconomy to recover economies and achieve results of greening in the context of slowbalization. The article considers ongoing processes of protectionism of national economies at the regional level under slowbalization. It analyzes the world's real GDP by regions as an indicator of economic systems' activity. The authors give prospective assessment of development scenarios for economies of emerging markets and developing countries. It substantiates main tasks of bioeconomy development, implementation of which will ensure the economic growth required for the effective use of the biological system with minimal harm to the environment and, in general, harmonize the socioeconomic development.

1 INTRODUCTION

Over the past decades, extensive greening has been taking place in many European countries. At present, research centres are being established, scientific and technical programmes to support environmental innovative technologies are being organized. Sustainability issues are slowly but surely embracing the global community. The main research fields are global warming and alternative energy sources as a precondition of future survival and safety of the world population.

For example, Norway aims to be a country with virtually zero industrial CO_2 emissions by 2030. Germany is going to switch to 100% alternative energy sources by 2040, while Sweden wants to make the majority of houses fuel-free as early as in 2020 (Kharin and Purii, 2020). The Icelandic government actively promotes the use of green technologies (The Ministry of Economic Affairs and Climate Policy, 2019). To explain why this movement is intensifying, it should be marked that enhancement of environmental legislation and state subsidies play an important role.

However, the total greening rate at the regional level has bigger differences. It is obvious that highly developed regions have greater opportunities for investing in resource conservation and reducing the

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destructive impact on the environment. Concurrently, their negative impact on the world environment is growing with the development of industry. Meanwhile, underdeveloped regions have a sufficient level of environmental safety due to low rates of environmental destruction explained by low rates of industrial development in these regions. At the same time, the level of implementation of environmental innovations in these systems remains low.

Development of greening processes is becoming much more complicated due to slowbalization of regional economies and the COVID-19 pandemic. In 2020, the global pandemic and corresponding restrictive measures led to the worst economic crisis since the World War II. It mainly impacted the service sector, transport and carbon-intensive power generation. Installation of new capacities for wind and solar panels had higher growth rates during the crisis, which are expected to maintain the same high level in future (Arbidane et al., 2021).

However, in 2021, good economic recovery is expected in the G20 countries, judging by the first few months, as their GDP will surpass the 2019 value. In 2020, energy consumption retarded sharply, with the exception of China, but this was only a cyclical drop as in 2021 energy consumption will return to the level of 2019 (International Energy Agency, 2021).

Therefore, there is a need to coordinate regional greening programmes with the development rate of their economic systems and design of strategies that promote bioeconomy to recover economic systems and achieve goals of greening in the context of slowbalization.

The research aims to study correlation between changes in the environmental performance index (EPI) values and changes in the GDP growth in developing regions of Europe and substantiate the need to introduce basic principles of bioeconomy development for the effective use of the biological system with minimal harm to the environment.

Research methods. During the research, methods of analysis and synthesis are used. The study is based on official data from key world energy statistics, world economic statistics and Internet resources.

2 RESULTS

In the last decade, the world economy is transiting from total globalization to more restrained slow stabilization. Escalating tension between nationalism and globalization is going to become one of the most determinant into the next decade. Protectionism of national economies at the regional level will be the

key to further development in the context of slowbalization.

Current processes of slowbalization can strengthen regional ties within economic systems. However, regional de-globalization provokes new challenging conditions for development. For instance, between 1990 and 2010, most rapidly developing countries were able to partially bridge the gap between themselves and developed countries, which allowed them to compete on global markets. Although in the context of regional slowbalization, it will be even more difficult to bridge the gap between developing and developed regions. After all, developed regions will be able to make a rapid leap in their development due to high initial potential. At the same time, weak economic systems without such a foundation will depend on developed systems.

Thus, slowbalization will not solve the problems created by globalization, but will only cause even greater stratification of economic systems.

Rapid development of regional slowbalization during the coronavirus crisis has caused a slump in the GDP of many countries (Table 1) (The World Bank, June, 2021a).

Table 1: Real GDP in the world regions as compared to the previous year, %.

Region	2017y	2018y	2019y	2020y
World	3.3	3.2	2.5	-3.5
Developed economies	2.5	2.3	1.6	-4.7
Emerging markets and developing countries	4.5	4.6	3.8	-1.7
Eastern Asia and the Pacific region	6.5	6.5	5.8	1.2
Europe and Central Asia	4.1	3.5	2.7	-2.1
Latin America and the Caribbean region	1.9	1.8	0.9	-6.5
Near East and Northern Africa	1.1	0.6	0.6	-3.9
South Asia	6.5	6.4	4.4	-5.4
Africa to the south of the Sahara desert	2.6	2.7	2.5	-2.4

The global economy is expected to increase by 5.6% in 2021, this fact indicating the fastest recovery rate after the decline for the past 80 years. This recovery is uneven and largely driven by an increase in economic activity in some large countries. In many emerging markets and developing countries, barriers

to vaccination continue to hamper their economic activity.

About two-thirds of these economies will not be able to compensate for the decline in per capita income by 2022. At the global level, there is a predominance of a negative development risk. Possible new waves of COVID-19 and financial shocks against the background of a high debt level of developing countries are some of risk factors here. Policymakers will have to balance the need to foster economic recovery and maintain price and fiscal stability, as well as making further efforts to implement reforms that boost the economic growth.

Now, to overcome stagnation and stratification in European countries is an urgent problem. Central Europe is expected to increase its economy by 4.6% between 2021 and 2022, which is supported by restored trade. Exceptional stimulus policies are expected to continue throughout 2021. It is also expected to prolong the EU-provided large-scale finance packages intended for the EU Member States to compensate for the investment gap (The World Bank, June, 2021b).

In general, the economic growth is expected to stabilize at the level of 3.9% in 2022. However, the GDP per capita is forecast to be 5.3% lower as compared to expectations at the start of the pandemic (The World Bank, June, 2021b).

At the same time, in recent years, the trend of "greening" economic development can be observed in all the regions, yet, the rate and scale of transformations are far from the desired level.

The pandemic and the economic crisis have impacted almost every aspect of energy production, supply and consumption around the world. The pandemic set energy and emissions trends in 2020 reducing fossil fuel consumption for most of the year, while renewables and electric cars, two of the main building blocks of clean energy transition, were largely insensitive.

According to the latest statistics, since primary energy demand fell by almost 4% in 2020, global energy-related CO_2 emissions reduced by 5.8%, which had been the largest annual percentage decline since the World War II. In absolute terms, a reduction in CO_2 emissions of almost 2.000m t is unprecedented as, broadly speaking, it is compared to removing all European Union emissions from the global total. Fossil fuel demand hit the hardest in 2020, especially oil, which fell by 8.6%, and the coal industry, which reduced by 4%. The annual decline in oil was the largest ever accounting for more than half of reduction in global emissions. Global emissions from oil use fell by more than 1.100m t of CO_2, down from

about 11.400m t in 2019 (International Energy Agency, 2021).

These factors have influenced ranking values and dynamics of the most environmentally friendly countries in the world. The Environmental Performance Study measures a country's achievements in terms of the environment state and natural resource management based on 22 indicators in 10 categories that reflect various aspects of the natural environment and viability of its environmental systems; conservation of biological diversity, counteraction to climate change, the state of people's health, economic activity and its load on the environment, as well as effectiveness of the state policy in the field of environment protection (Table 2) (Wendling, *et al.*, 2020; Hsu, *et al.*, 2014; Yale Center for Environmental Law & Policy, 2016; Yale Center for Environmental Law & Policy, 2018).

Table 2: EPI ranking: European countries (2014y – 2020y).

Country	EPI			
	2014y	2016y	2018y	2020y
France	71.05	88.20	83.95	80.00
Denmark	76.92	89.21	81.60	82.50
Malta	67.42	88.48	80.90	70.70
Sweden	78.09	90.43	80.51	78.70
Luxemburg	83.29	86.58	79.12	82.30
Austria	78.32	86.64	78.97	79.60
Ireland	74.67	86.60	78.77	72.80
Finland	75.72	90.68	78.64	78.90
Spain	79.79	88.91	78.39	74.30
Germany	80.47	84.26	78.37	77.20
Belgium	66.61	80.15	77.38	73.30
Italy	74.36	84.48	76.96	73.00
The Netherlands	77.75	82.03	75.46	75.30
Greece	73.28	85.81	73.60	69.10
Cyprus	66.23	80.24	72.60	64.80
Portugal	75.80	88.63	71.91	67.00
Slovakia	74.45	85.42	70.60	68.30
Lithuania	61.26	85.49	69.33	62.90
Bulgaria	64.01	83.40	67.85	57.00
the Czech Rep.	81.47	84.67	67.68	71.00
Slovenia	76.43	88.98	67.57	72.00
Latvia	64.05	85.71	66.12	61.60
Croatia	62.23	86.98	65.45	63.10
Hungary	70.28	84.60	65.01	63.70
Rumania	50.52	83.24	64.78	64.70
Estonia	74.66	88. 59	64.31	65.30
Poland	69.23	81.26	64.11	60.90
Ukraine	49.01	79.69	52.87	49.50

Meanwhile, low-carbon fuels and technologies, in particular solar photovoltaic and wind energy, have reached the highest annual share in the global energy balance in history, increasing it by more than one

percentage point and exceeding 20% (International Energy Agency, 2021).

In 2020, energy-related CO_2 emissions reduced dramatically. One of the main reasons for that was a strong impact of the pandemic on the transport sector and the decline in fossil fuel power production. Yet, in the future, a jump is expected with energy intensity returning to its historical trends.

In particular, scientists predict recovery of the coal industry that in 2021-2022 will exceed the level of 2019 by 1%. A significant recovery in power demand is also expected + 3%. At the same time, not all strategic areas of the economy will be able to promptly restore their previous volumes. Gas consumption will decrease by 0.1%, the transport system will continue to stagnate (-4%), the oil industry will not be able to exceed consumption levels of 2019 (-2.9%) (Figure 1-3).

Comparison of changes in the EPI with those in the GDP growth in developing regions of Europe indicates a stable decrease in the level of their greening (Fig. 1-3). Dynamics of changes in the EPI values determines the nature of the dependence and enables building dependence equations for further prediction. According to the equations obtained (Fig. 1-3), $R^2 = 0.98$ which indicates significance of certain

dependences and allows you to forecast the EPI for the regions under analysis (Figure 4).

Reduction in energy demand, and consequently in emissions in 2020, will be actually offset in the forecast period, while the numbers of 2021-2026 will be lower than those in 2019, even in the context of a slow recovery of regional economies.

As can be seen from Fig. 4, the countries possessing natural resources are facing another problem – a strong dependence on the export of fossil fuels and products of "environmentally unfriendly" industries (metallurgy, chemical industry, etc.). This makes it difficult to implement greening in the countries that are reluctant to change their industry, while there is a strong demand for those products on international markets. High-income countries, especially those operating within the EU and OECD legal framework, are actively involved in greening their economies due to strict requirements imposed by these international organizations, financial and methodological support, technological cooperation and exchange of experience. Without international participation, commitments and implementation mechanisms, many countries tend to adopt predominantly declarative goals, not implementing their greening strategies and basically avoiding setting clear qualitative and quantitative targets.
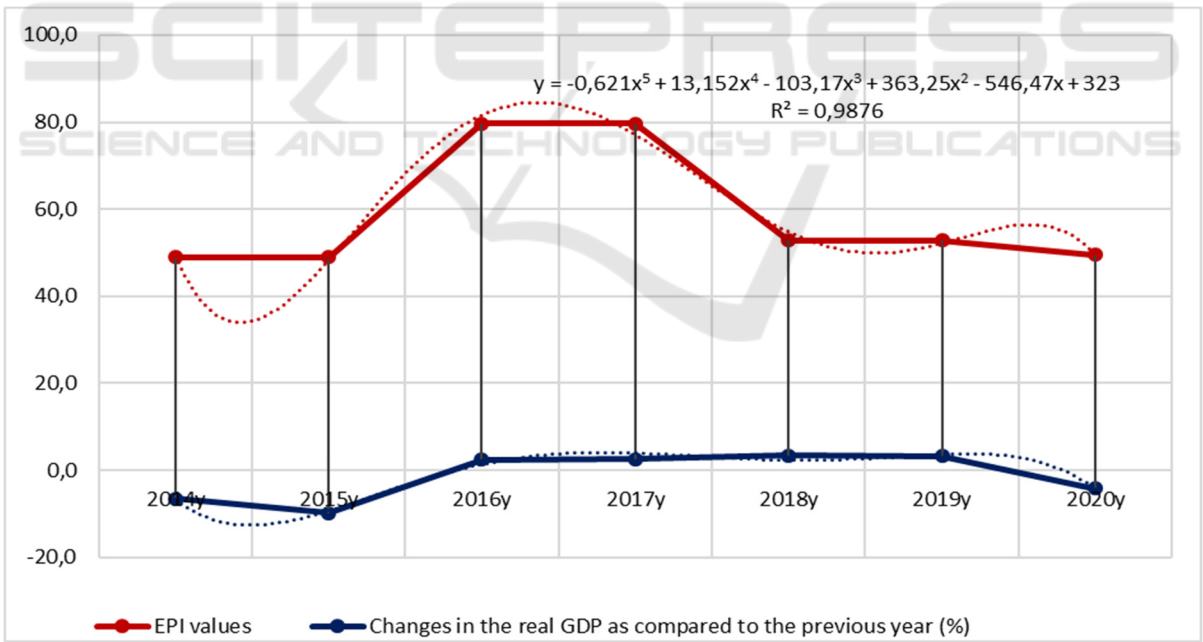

$$y = -0{,}4103x^5 + 8{,}7006x^4 - 68{,}318x^3 + 240{,}72x^2 - 362{,}29x + 224{,}92$$
$$R^2 = 0{,}9878$$
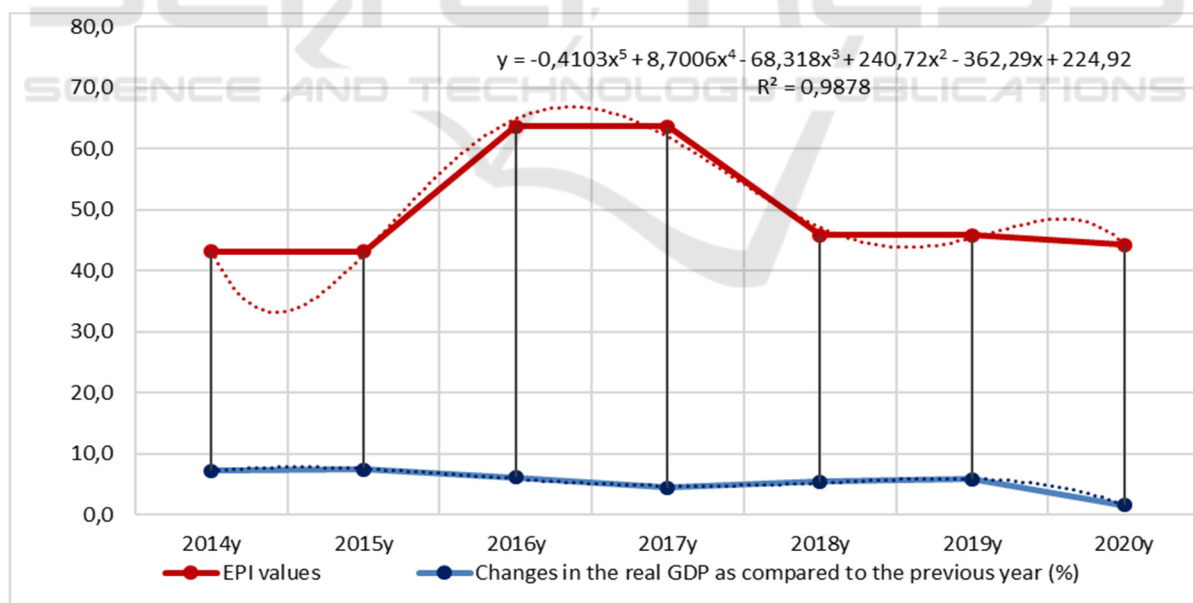
* forecast period

Figure 1: Comparison of changes in the EPI with those in the GDP growth in Uzbekistan in 2014-2020 (Wendling, et al., 2020; Hsu, et al., 2014; Yale Center for Environmental Law & Policy, 2016; Yale Center for Environmental Law & Policy, 2018; The World Bank, Dec, 2021a).
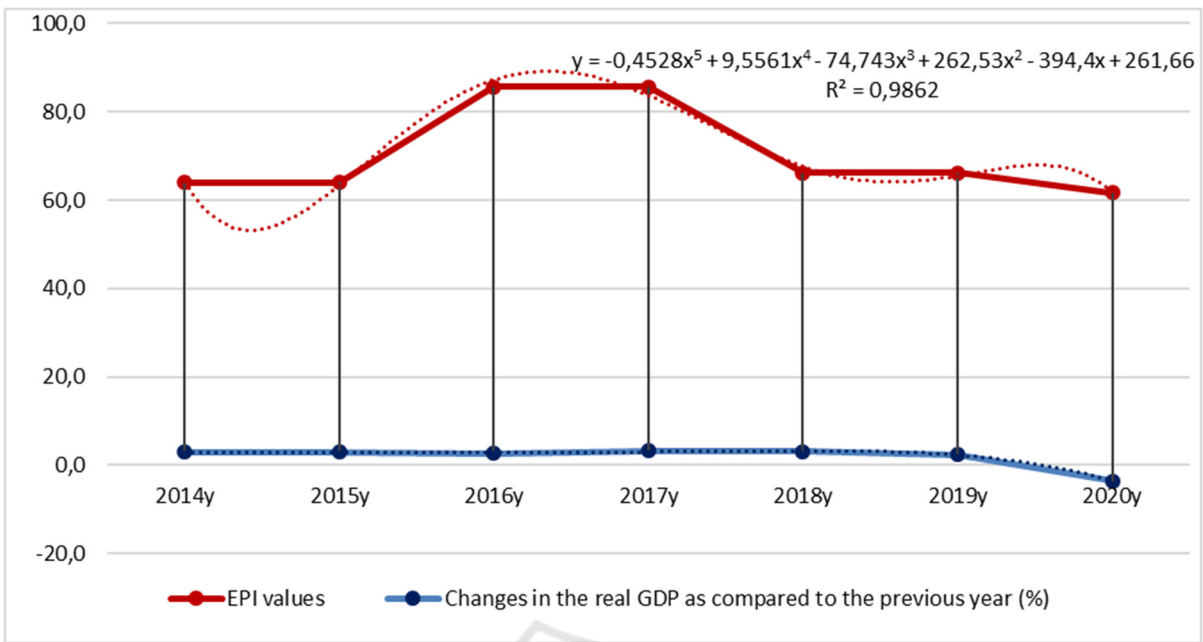
* forecast period

Figure 2: Comparison of changes in the EPI with those in the GDP growth in Latvia in 2014-2020 (Wendling, et al., 2020; Hsu, et al., 2014; Yale Center for Environmental Law & Policy, 2016; Yale Center for Environmental Law & Policy, 2018; The World Bank, Dec., 2021b).

* forecast period

Figure 3: Comparison of changes in the EPI with those in the GDP growth in Ukraine in 2014-2020 (Wendling, et al., 2020; Hsu, et al., 2014; Yale Center for Environmental Law & Policy, 2016; Yale Center for Environmental Law & Policy, 2018; The World Bank, Dec., 2021c).
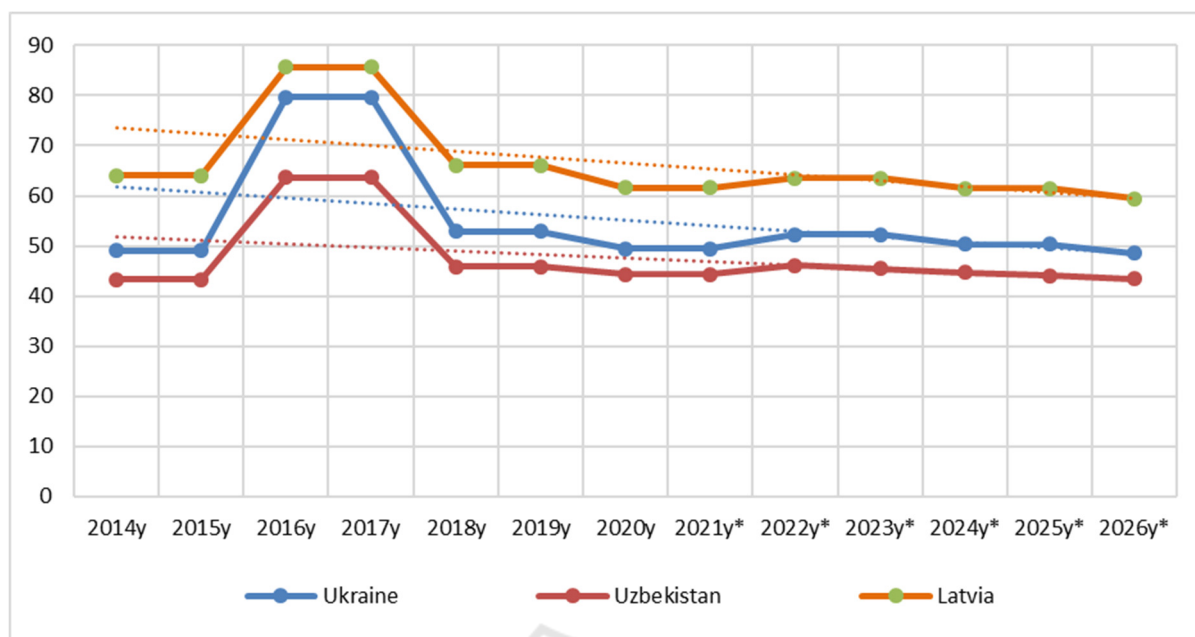
* forecast period

Figure 4: Dynamics and forecast of changes in the EPI in Uzbekistan, Latvia and Ukraine in 2014 -2026 (built by the authors).

At the same time, some European countries are actively involved in the greening agenda and have succeeded in that. Slovakia has become the leader in terms of greening indicators surpassing many developed countries, while Slovenia is the best in eco-innovations in Eastern Europe and Eurasia.

On the other hand, low-income countries continue to struggle with socio-economic challenges and poverty, rather than implement greening and sustainability strategies.

To some extent, the current energy systems and infrastructure inherited from the socialism times, as well as behaviour, managerial and business models represent a significant barrier to greening. On the other hand, lack of financial resources and experience in implementing the "green" approach also hinders rapid evolution of the socioeconomic system, especially in low- and middle-income countries. In this respect, international support (including financial assistance, technology transfer, knowledge exchange and potential development) is essential, and large-scale international cooperation with low-income countries should play a leading part in the greening process. Analysis of this region's countries indicates the key barriers to effective greening policies which include frequent political changes, lack of institutional potentials, insufficient financing, wrong priorities, corruption and dominant traditional businesses in elaboration and implementation of economic policies.

Total research and development costs in developing European countries are very low as compared to those in developed countries. This may result from poor patenting activity and lack of competence in major green innovations and technologies. For this reason, in this situation, green technologies can be based on borrowing foreign innovations and adapting them to local conditions, at least in the medium run.

The obtained results of regional development simulation in the context of slowbalization indicate the need to introduce basic bioeconomy principles to enhance the economic growth due to effective use of the biological system with minimal harm to the environment and, in general, harmonize socioeconomic development (Tilica, 2021).

Bioeconomy is the economy based on application of biotechnology with renewable biological raw materials. Development of bioeconomy sectors involves increasing energy efficiency, application of waste materials, development of renewable biomass energy, greening of the industrial sector, increased sustainability of agriculture, production of new food products, and development of medical technologies.

Implementing bioeconomy principles has resulted in recent environmental innovations, which ensure rapid greening of regional economic systems.

Among the latest green innovations are saving natural resources and reducing harmful effects on the environment (Figure 5).

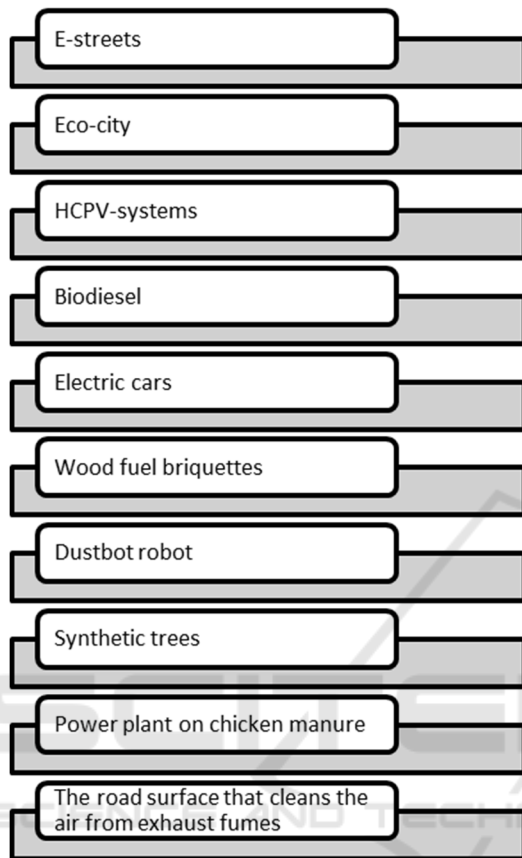| E-streets |
| --- |
| Eco-city |
| HCPV-systems |
| Biodiesel |
| Electric cars |
| Wood fuel briquettes |
| Dustbot robot |
| Synthetic trees |
| Power plant on chicken manure |
| The road surface that cleans the air from exhaust fumes |

Figure 5: The latest green innovations.

The latest green innovations, namely:

- E-streets as the illumination technology used in Europe;

- the autonomous eco-city of Masdar in the UAE designed to implement various eco-technologies without negative impacts on the environment;

- HCPV-systems as effective and inexpensive sources of power;

- biodiesel as a rapeseed oil-based fuel that is environmentally friendly and reduces carbon emissions;

- electric cars as personal vehicles not emitting exhaust gases (Kharin, et al., 2020);

- wood fuel briquettes for heating boiler rooms with minimal smoke emission;

- Dustbot robot cleaner removing rubbish and monitoring the air pollution level;

- synthetic trees for CO_2 absorption;

- a Chinese power plant on chicken manure that uses poultry farm waste as fuel;

- the road surface that cleans the air from exhaust fumes that is produced from concrete with added titanium dioxide (Dogaru, 2020).

Therefore, creation of an ecosystem for startups is a prerequisite for increasing the number of domestic "green" innovations. The process of invention and obtaining innovative products and technologies is time- and labour-consuming. There is a need for effective legal regulation and institutions, venture capital funds, support for product commercialization and market access. Currently, most innovations result from long-term corporate investments, while market barriers to innovations are still high.

3 CONCLUSIONS

International experience shows that the following environmental policies can contribute to the sustainable and "green" economic growth in slowbalization conditions:

- supporting an increase in natural, physical, and human capital (Botelho et al., 2021);

- increasing productivity in terms of renewable energy sources (Kharin, Purii, 2020);

- boosting "green policy" incentives for innovations to improve the environmental performance of firms and households in the regions (The Ministry of Economic Affairs and Climate Policy, 2019)

Introduction of "green growth" technologies in slowbalization conditions requires more active and effective integrated work aimed at controlling the market. "Green" innovations in the industrial policy should be intensified and accompanied by eliminating barriers that negatively affect "green" transformation. The research indicates that there is no single solution for different regions, as the best solutions for each region result from different institutional potentials, transparency, reporting and the degree of community involvement. At the same time, "green" growth strategies should meet specific requirements of each country. So, care should be taken when applying the best practices to real-life conditions.

Based on the above, it can be stated that development of bioeconomy requires cooperation between governments, businesses, academic and expert circles to solve the following tasks:

- creating the national greening strategy to achieve ambitious "green" results and developing a roadmap for fulfilling specific tasks;

- creating a system of greening indicators to monitor and evaluate the process, identify failures and develop corrective measures;

- adapting implementation mechanisms based on goals and objectives defined in the Greening Strategy: "green" taxes, pollution duties, subsidies for green transport and eco-technologies, elimination of fossil fuel subsidies, green purchases, green bonds, etc.;

- increasing awareness and provoking behavioural changes of firms and individuals: the faster people open up to greening, the faster and smarter it will be;

- building a potential for deep and widespread changes in the economy, production and consumption, expanding specialists' competencies and qualifications;

- supporting eco-innovations and "green" technologies, creating ecosystem startups;

- financial resources that are the foundation for greening and eco-innovations; venture capital required for domestic innovations and startups, as well as for adapting foreign innovations;

- international commitments and opportunities that can enhance the economic growth.

REFERENCES

Arbidane, I., Purii, H., Mamanazarov, A., Hushko, S., Kulishov, V., 2021. Digital Transformation Modelling in the Context of Slowbalization. *SHS Web Conf.,* 100, 01003.
DOI: https://doi.org/10.1051/shsconf/202110001003

Botelho, J. M. M., Mietule, I., Puriy, H., Maksymova, I., Kulishov, V., 2021. Economic Diplomacy Strategy for the recovery of the slowdown of Globalization (Slowbalization). Journal of European Economy, [S.l.], vol. 20 (2), 246-261.
DOI: https://doi.org/10.35774/jee2021.02.246.

Dogaru, L., 2020. Eco-innovation and the contribution of companies to the sustainable development. *Procedia Manufacturing,* 46, 294 - 298. [Electronic resource]. Retrieved from https://doi.org/10.1016/j.promfg.2020.03.043

Hsu, A., J. Emerson, M., Levy, A. de Sherbinin, Johnson, L., Malik, O., Schwartz, J., and Jaiteh, M., 2014. *The 2014 Environmental Performance Index. New Haven, CT: Yale Center for Environmental Law and Policy.* [Electronic resource]. Retrieved from https://sedac.ciesin.columbia.edu/data/set/epi-environmental-performance-index-2014

International Energy Agency, 2021. *Economic impacts of Covid-19. Global Energy Review 2021.* [Electronic resource]. Retrieved from https://www.iea.org/reports/global-energy-review-2021/economic-impacts-of-covid-19

Kharin, S., Purii, H., 2020. Innovative management of projects for electric mobility development: foreign experience and Ukraine. *Economics. Finances. Law*, Vol. 5 (1), 26- 30.
DOI: https://doi.org/10.37634/efp.2020.5.4

Kharin, S., Xamidov, O., Purij, G., Padalka, O., Sheludiakova, N., 2020. Investigation into International Innovative Management of Creating and Producing Electric Cars. *IOP Conf. Ser.: Earth Environ. Sci. 628 012005.* [Electronic resource]. Retrieved from https://iopscience.iop.org/article/10.1088/1755-1315/628/1/012005/meta

The Ministry of Economic Affairs and Climate Policy (EZK), Nov., 2019. *Integrated National Energy and Climate Plan 2021-2030.* The Netherlands Publication: No. 19410647.

The World Bank, Dec., 2021a. *Uzbekistan: Growth rate of the real gross domestic product (GDP) from 2016 to 2026.* [Data file]. Retrieved from https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=UZ

The World Bank, Dec., 2021b. *Latvia: Growth rate of the real gross domestic product (GDP) from 2016 to 2026.* [Data file]. Retrieved from https://www.statista.com/statistics/375248/gross-domestic-product-gdp-growth-rate-in-latvia/.

The World Bank, Dec., 2021c. *Ukraine: Real gross domestic product (GDP) growth rate from 2016 to 2026.* [Data file]. Retrieved from https://www.statista.com/statistics/296140/ukraine-gross-domestic-product/.

The World Bank, June, 2021a. *Pandemic, Recession: The Global Economy in Crisis.* [Electronic resource]. Retrieved from: https://www.vsemirnyjbank.org/ru/publication/global-economic-prospects.

The World Bank, June, 2021b. *A Strong but Uneven Recovery.* [Electronic resource]. Retrieved from https://www.worldbank.org/en/publication/global-economic-prospects.

Tilica, E., 2021. Bioeconomy and bioeconomics: are they the same thing? *International Journal of Innovative Technologies in Economy,* 1(33).
DOI: doi.org/10.31435/rsglobal_ijite/30032021/7470

Wendling, Z. A., Emerson, J. W., de Sherbinin, A., Esty, D. C., et al., 2020. *2020 Environmental Performance Index. New Haven, CT: Yale Center for Environmental Law & Policy.* [Electronic resource]. Retrieved from https://nonews.co/wp-content/uploads/2020/08/epi2020.pdf

Yale Center for Environmental Law & Policy, 2016. *Global metrics for the environment: Ranking country performance on high-priority environmental issues.* Yale University Center for International Earth Science Information Network, Columbia University In collaboration with the World Economic Forum With support from The McCall MacBain Foundation and Mark T. DeAngelis. [Electronic resource]. Retrieved from https://nonews.co/wp-content/uploads/2016/02/epi2018.pdf.