



Financing of Eco-innovations: Sources and Trends in Kazakhstan

Gaukhar Kalkabayeva^{1*}, Aibota Rakhmetova², Marina Assanova³

¹Department of “Bank Management and Financial Markets,” Karaganda Economic University of Kazpotrebsoyuz, Kazakhstan, ²Department of Economic theory and state and local governance, Karaganda Economic University of Kazpotrebsoyuz, Kazakhstan, ³Department “Marketing and Logistics”, Karaganda Economic University of Kazpotrebsoyuz, Kazakhstan. *Email: aisanatazhbaeva@mail.ru

Received: 05 September 2020

Accepted: 15 November 2020

DOI: <https://doi.org/10.32479/ijeeep.10762>

ABSTRACT

Nowadays most developed and some developing countries are moving to the path of “green” economy and strive to develop in the direction of sustainable development. An important aspect is the development of eco-innovations that contribute to reducing the negative impact on the environment through the creation of fundamentally new products, processes and systems with minimal use of natural resources and virtually zero environmental pollution. Such clean technologies are possible in the field of renewable energy, water resources management, “green” construction, waste reduction, etc. The vast accumulated international experience of countries that develop eco-innovations serves as a positive experience for the development of this direction in Kazakhstan. Energy efficiency and renewable energy resources should be considered as national priorities of the country, be integrated into energy and socio-economic policies, and become the basis for the development of state programs for sustainable development. Kazakhstan strives to achieve its goals for sustainable development, including improving the environmental situation in the country. This paper focuses on financial issues in eco-innovations, it represents analyses of current trends in this sphere in Kazakhstan.

Keywords: Eco-innovations, Sustainable Development, Regional Development, Financing of Ecological Innovations, Innovative Development

JEL Classification: O310

1. INTRODUCTION

Kazakhstan ratified the UN framework Convention on climate change in 1995, the Kyoto Protocol in 2009, and the Paris agreement in 2016. Within the framework of national strategic documents (“Concept for the transition to a “green” economy”, the Law of the Republic of Kazakhstan “on support for the use of renewable energy”), measures are being taken to develop renewable energy sources, waste processing, create conditions for “green” investments, introduce innovative approaches to rational consumption, etc. With the support of international organizations, a strategic document on low-carbon development until 2050 and a national plan for adaptation to climate change are being developed (Division for Sustainable Development Goals, 2020).

Target indicators in the field of eco-innovation are: achievement of RES share in total energy consumption of the country

in the amount of 3% of total generation by 2020, 10% - by 2030 and 50% by 2050; the share of recycled waste to 50% by 2050; reduce emissions of Sulphur and nitrogen oxides into the environment to the European level of emissions by 2030 (Greenkaz, 2013). It is predicted that by 2050, the transformation of the “green” economy will further increase GDP by 3%. However, achieving these goals requires adequate funding. The volume of annual investment should be 1-1.8% of GDP (\$3-4 billion).

The development and implementation of innovations require significant investment. This makes it necessary to find effective mechanisms for financing “green” innovations that determine the dynamics and depth of the processes of greening the economy. For modern Kazakhstan, “green” innovations represent a huge potential for obtaining positive economic and environmental effects.

In this regard, the following research goal is set – to analyze the main sources of financing of eco-innovations and their trends in Kazakhstan, as well as to identify the degree of participation of financial and credit institutions in the development of “green” technologies.

2. LITERATURE REVIEW

The research of the essence of innovations, their strategic role in ensuring sustainable development, and the search for sources of their financing is given great attention in the scientific literature.

Rozkrut (2014) analyzes the importance of creating, implementing and developing innovations that contribute to the transition to sustainable development. Attention is focused on the need for interaction between environmentally oriented innovations and investments that are at the heart of “green” economic growth.

A positive relationship between eco-innovation, innovation activity, R & d intensity and business financial performance was revealed in the study Scarpellini et al. (2019). Kiefer et al. (2019) note that domestic financial resources are the driving force of eco-innovation.

In turn, Malakhova (2015) concluded that the use of environmental innovations allows to get an ecological and economic synergetic effect. However, they require significant costs, which many subjects are not able to cope without state support.

Researchers Shen and Lin (2020) concluded that R&D capital is positively linked to the reduction of energy intensity, and heterogeneity exists in the relationship between energy intensity and R&D capital across industries. The Chinese government has a stimulating policy to develop R & d in order to create cleaner production and technologies. The authors point out that R & d subsidies have a significant positive impact on the intensity of R & d in high-tech industries.

The relationship between the effectiveness of the circular economy and the country’s existing environmental potential is explored in Horvath et al. (2019). The outcomes show that the poorly performing actors are in fact not far from a sustainable operation. Meanwhile, the countries with the most efficient material flow values present the widest development gap to reach the ideal level of circularity.

The study of Cecere et al. (2020) examines the impact of the type of financing on the development of eco-innovations. The results of an empirical analysis of the authors’ data showed that access to public Finance and other sources of Finance improves the company’s ability to implement eco-innovations.

The method of multiple regression analysis was used by Liao (2020) to study the impact of major and strategic eco-innovations on corporate financing of Chinese listed companies.

At the same time, with the further development and complication of economic processes, the emergence of new global challenges,

it is necessary to study new characteristics of environmental innovations, the system of their financial support and stimulation.

3. METHODS OF RESEARCH, DATA AND ESTIMATION TECHNIQUES

3.1. Methods of Research

A comprehensive review of the financing of eco-innovation in Kazakhstan was conducted to determine the relationship between the sources of financial resources and eco-innovation based on available statistical information. The goal was to provide a quantitative basis for discussion and to identify the possibility of further research. The database for analysis contains information on environmental projects implemented in Kazakhstan. The limit for this analysis was the approved portfolio of eco-innovation financing as of the end of 2018. The sources of funding were analyzed based on the database of the World Bank, the National Bank of Kazakhstan and The Committee on statistics of the MNE of Kazakhstan, Green Growth Knowledge Platform. The study showed the complementarity of sources of financing for environmentally friendly innovations. Special attention is paid to the indicators of development of renewable energy sources in Kazakhstan. It is important to note that the study does not provide an assessment of the effectiveness or results of financing eco-innovations. The research aims to reveal potential sources of financing for eco-innovations in Kazakhstan, and find out what factors contribute to or hinder this process.

For the empirical analysis of the data used in this article as an evidence base, econometric modeling methods were used, in particular, correlation and regression analysis with the construction of paired and multiple linear regression models. Graphical illustration of dependencies was performed in Excel. Statistical data were taken from the international database of the world Bank and the database Of the Committee on statistics of the MNE of the Republic of Kazakhstan for 1993-2018. In the framework of modeling dependency indicators, we tried to determine the degree of the greatest impact of various sources of innovation financing on the growth of eco-innovations.

3.2. Data

Currently, Kazakh companies have become aware that their future performance depends on upgrading their production assets, installing clean technologies on existing sites, and developing an environmentally friendly product based on low-carbon business models. Investors and clients are currently showing a preference for innovative companies that are fighting climate change. Therefore, Kazakh companies need to actively seek innovative solutions that meet the needs of society in a new way. In 2018, 253 Kazakhstani enterprises had environmental innovations (Table 1).

According to the intergovernmental International renewable energy Agency (IRENA), the global transition to a low-carbon goal will reduce the use of coal, oil and gas in the coming decades. At the same time, carbon taxes will be significantly increased and regulation in this area will be tightened. Thus, the introduction of a new Environmental code in Kazakhstan provides for a significant increase in environmental payments.

Table 1: Number of enterprises in Kazakhstan with environmental innovations*

Indicator	2014	2015	2016	2017	2018	Change
Number of enterprises with environmental innovations, units	247	338	312	252	253	+6
Level of activity in the field of environmental innovations, %	1	1.1	1	0.8	0.8	-0.2
Share of environmental innovations in the total number of innovations	12.7	13.1	10.8	8.5	7.8	-4.9

*Compiled according to the Statistics Committee of the Ministry of National economy of the Republic of Kazakhstan. Retrieved March, 2020, from <https://stat.gov.kz/official/industry/157/statistic/7>

In 2018, the share of environmental tax revenues in the GDP structure of Kazakhstan was 3.5% (Figure 1), while the average for OECD countries in 2018, the share of environmental tax revenues was 1.6% of GDP.

Stricter environmental requirements in Kazakhstan based on positive international experience should be the main incentive for the introduction of new technologies. In addition, there is a transition to the principles of Best Available Techniques. Currently, the transition to the principles of Best Available Techniques is being considered by 50 large enterprises in Kazakhstan, including 14 enterprises operating in the electricity sector, where the share of emissions to the environment is more than 40%.

Kazakhstan is one of the most energy-intensive countries in the world. Kazakhstan uses 1.7 times more energy per unit of GDP (at purchasing power parity) than the average in the OECD countries. This situation, according to World Bank experts, is largely due to the persistence of government subsidies for energy, which undermine incentives to improve energy efficiency (The World Bank, 2018).

According to the International energy Agency, Kazakhstan annually spends more than \$ 4 billion on indirect subsidies for energy and coal production (International Energy Agency, 2019).

In Kazakhstan, the problem of increasing pressure on the energy supply network and lack of investment in energy efficiency measures is becoming more acute. A promising development direction for Kazakhstan is the use of renewable energy sources.

Analyzing the current situation in this area, it can be noted that in 2019, Kazakhstan had 90 active renewable energy facilities with a total capacity of 1050.1 MW. The volume of installed capacity of renewable energy facilities increased by 2 times compared to 2018. The share of RES in total electricity production was 2.3% (UNDP, 2020).

The government of Kazakhstan and international organizations actively support initiatives on renewable energy projects. Thus, with the assistance of IRENA, a market auction mechanism for selecting renewable energy projects has been introduced. The first auction was held in November 2019 with the financial support of the Global environment facility for the construction of a 50 MW solar power plant in the Turkestan region. Development institutions also provide financial support for renewable energy projects. For example, the share of Kazyna Capital Management JSC in the authorized capital of the project to build a wind farm in the Akmola region is 23.55%. Baiterek IS also among the investors of renewable energy facilities (Baiterek, 2020). In

general, investments in the “green” economy of Kazakhstan in 2018 amounted to 73.2 billion tenge (Table 2).

Considering the sources of financing of environmentally friendly innovations in addition to the enterprises' own funds, several groups should be distinguished: state funds allocated for the implementation of green economy development programs; funds attracted in the domestic financial market of Kazakhstan; funds of foreign investors and funds, international organizations. These sources of funding complement each other, for example, in terms of funding types, goals, timing, or geographical coverage. There is a mechanism that allows you to optimally combine and manage these flows of financial resources. This means that the effective functioning of the financing mechanism for eco-innovation is impossible without any of the sources of funding. This is due to the fact that eco-innovations require significant investments, and the flow of financial resources is limited in scale, time frame, technical capabilities, etc. The important purpose of green Finance can be achieved by combining financial resources from various sources. The complexity of the procedure for creating and implementing eco-innovations may also require a flexible combination of financial sources.

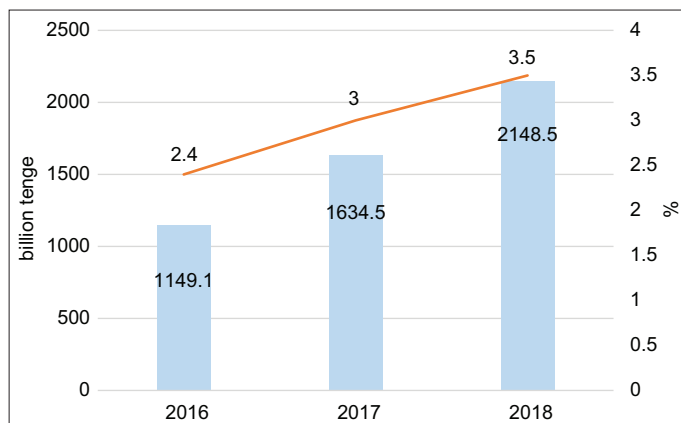
One of the sources of financing for eco-innovation is government grants and other support measures within the framework of national innovation programs and strategies aimed at achieving sustainable development. In most developed countries, large-scale government programs are being implemented to encourage the development of environmental innovations, and special funds and centers are being created. As stimulus standards, taxes, subsidies, etc. Thus, in the EU, in accordance with the 7th framework program of scientific and technological activities, 10 billion rubles were spent in 2007-2017. euros for the development of environmentally friendly technologies.

However, public resources are limited, so in the long term it is necessary to reduce the dependence on public investment to Finance eco-innovation. Kazakhstan has developed and implemented the “Concept for the transition of Kazakhstan to a green economy.” It notes that the total need for investment is 1-1.8% of GDP, or about 3-4 billion dollars. annually. At the same time, the main part of these investments should be made with the involvement of private investors. However, the measures taken are not sufficient to mobilize private investment in the development of “green” technologies. The country’s existing development institutions (the development Bank of Kazakhstan, the Damu entrepreneurship development Fund, and the Samruk-Kazyna National Welfare Fund) do not have clearly defined powers to support eco-innovation and the transition to a “green” economy (IGTIC, 2020).

Table 2: Investments in green economy in Kazakhstan*

Indicator	2013	2014	2015	2016	2017	2018
Investments aimed at environmental protection, billion tenge	77.5	103.5	82.9	43.9	86.9	111.2
Share of investments aimed at environmental protection in the total investment in fixed assets, %	1.3	1.6	1.2	0.6	1.0	1.0
Investments related to the “green” economy, billion tenge	12.2	3.1	16.9	1.7	42.5	73.2
The share of investments related to the “green” economy in the total investment in fixed assets, %	0.2	0.0	0.2	0.0	0.5	0.7

*Compiled according to the statistics Committee of the Ministry of national economy of the Republic of Kazakhstan. Retrieved March, 2020, from <https://stat.gov.kz/official/industry/157/statistic/7>

Figure 1: Ecological taxes in Kazakhstan

Based on data from the statistics Committee of the Ministry of National economy of the Republic of Kazakhstan

The banking sector can be an important source of financing for environmental innovations. Nevertheless, in Kazakhstan, the banking sector has small assets in comparison with the existing needs for investing in the green economy. In 2019, the ratio of Bank loans to GDP was less than 22%. The banking sector is burdened with problem loans and increasing risks in the economy. The limited role of the national banking sector in the development of environmentally friendly innovations should be noted. At the state level, there are no measures that encourage Kazakh banks to provide financial support for eco-innovations.

At the same time, the current situation requires a reorientation of the banking business to green lending. For example, in 2030, the Bank of America has committed to invest an additional \$ 300 billion in the field of sustainable energy, climate improvement and water resources, as it is convinced that the support of eco-innovations will provide it with long-term value (World Economic Forum, 2020).

Kazakhstan's pension sector has a growing investment potential. In recent years, Kazakhstan has seen an increase in the volume of pension savings accumulated by the Unified accumulative pension Fund, which amounted to 10800.5 billion tenge in 2019. The ratio of pension savings to GDP in 2019 was 15.7%. However, there is a conservative strategy for managing pension assets, which are largely invested in government securities. Thus, the role of pension assets in financing green innovations remains limited.

The domestic stock market of Kazakhstan is currently insufficiently liquid and inactive. It cannot be considered a significant source of long-term capital. Kazakhstan's securities market has not yet become an effective mechanism for redistributing monetary

resources. The country has developed a stock market that covers the circulation of a limited number of securities.

The solution to the problem of attracting resources to Finance eco-innovations can be green bonds. The growing demand for green bonds and other sustainable financial products indicates that investors are supporting environmental initiatives and investing in green technologies.

Globally, the issue of green bonds and loans in 2019 amounted to \$ 259.7 billion, increasing from \$ 170.6 billion in 2018 (*Climate Bonds Initiative*, 2019). The funds raised from the issue of green bonds and loans were used to Finance green energy (31.5%), energy efficiency of buildings (29.3%), and the transport sector (20.2%).

However, in Kazakhstan, “green” financial instruments have not received much development. It should be noted that the Astana international financial center is intended to provide assistance to “green” financing in the Republic of Kazakhstan by attracting investments in environmentally sustainable projects. For this purpose, the AIFC has established partnerships with the London stock exchange, NASDAQ, and the Shanghai stock exchange. An acceleration program for issuing green bonds was launched at the AIFC exchange. The partners of this project are the United Nations Environment Programme study for a sustainable financial system and the climate bonds initiative. The acceleration program includes: search and distribution of potential issuers by groups, formation of a portfolio of projects by sectors and determination of the most acceptable ones for issuing green bonds, covering the Issuer's expenses for mandatory external review for the first five green bonds, etc. Rules for issuing green bonds on the AIFC exchange have been developed, based on the principles of ICMA green bonds and climate Bonds Initiative systematics. The sectors where green projects will be implemented comply with the provisions of the Concept for Kazakhstan's transition to a green economy (AIFC, 2019).

In addition, the “International center for green technologies and investment projects” was established in 2018. One of the strategic goals of this Center is to create conditions for attracting “green” financing and redirecting funds of international financial organizations to “green” projects through participation in international programs of the EU, UNDP, UNIDO, as well as participation in tenders of the EBRD, World Bank, ADB, etc.

In the course of the research, problems were identified that hinder the process of attracting “green” investments to Finance eco-projects and eco-innovations. First, eco-innovations are associated with higher risks for investors and require higher capital investment, especially at the early stages of development, implementation and commercialization. Therefore, many

environmental projects do not fit into the credit and investment policies and criteria for selecting projects of commercial banks.

Secondly, the financial sector of Kazakhstan has a problem of lack of long-term financial resources that are necessary to finance eco-innovations. Meanwhile, the banking system is the most developed sector of the financial market in Kazakhstan. To solve this problem, the position of the regulator is important, which can encourage and encourage the activities of Kazakh banks to lend to environmental clean projects.

Third, the financial market of Kazakhstan is not adapted to “green” technologies. There is no methodology and terminology for eco-innovation, there is not enough statistical information on the development and implementation of environmentally friendly technologies, and there are not enough incentive support measures.

There is no accounting for internal financial flows in Kazakhstan, and data on green investments in Kazakh companies is not available (AIFC, 2018). Due to the identified information gaps, it is impossible to provide a complete picture of the financing flows of eco-innovations in Kazakhstan.

Fourth, there is a lack of attractive investment projects in the field of eco-innovation. It should be noted that Kazakh companies are not able to implement their own transformation. There is a problem of insufficient legislative activity on the part of the state in the field of development and promotion of eco-innovations and the lack of sufficient incentives and financial resources for enterprises to create and implement environmental innovations.

The study of foreign experience has shown that the dominant role in the development of eco-innovations is played by state support and state incentives based on the development and implementation of appropriate state programs and infrastructure. Thus, one of the mechanisms for supporting the implementation of eco-innovations in the European Union is the Eco-Innovator platform. Its functions include supporting research and innovation, implementing environmental policy measures, and attracting funding for the development of eco-innovations. The Eco-Innovator platform also finances scientific research (European commission, 2019). Eco-innovations are at the heart of the national technology platforms of the EU countries embedded in the common European technology platform.

At the same time, numerous measures of state stimulation of environmental innovations in the EU countries are implemented, as a rule, within the framework of the program-target approach (Medyanik, 2015). An extensive network of state institutions responsible for developing and implementing national policies in the field of environmental innovation has been created. The generalization of European experience in promoting eco-innovation demonstrates the key role of the state in the institutional design and formation of a diversified set of regulatory measures, based, in particular, on a program-oriented approach, foresight technologies and a network format of cooperation between the state and private structures.

To solve these problems, it is necessary to develop legislative frameworks, methodological aspects for eco-innovations, and identify market participants for “green” technologies. This will create a more transparent and understandable environment for foreign investors in Kazakhstan with economically attractive “green” projects.

Priority measures should also include tax incentives for investments in eco-innovations; state guarantees and subsidies for loans for the development of eco-innovations; scaling up investment programs in the regions; and state participation in co-financing eco-innovations to ensure long-term resources. The creation of a special state fund to support and develop eco-innovations could help solve the problem of reducing the risks of financing in this area. The concept should be supplemented with a more detailed Roadmap for the development of “green” technologies with specific deadlines for its implementation.

3.3. Model Specification

International and domestic experience shows that the use of a set of legal, financial, fiscal and other measures contributes to the activation of the processes of creating and implementing eco-innovations. The optimal combination of these measures to finance and support green innovation remains an urgent task.

To predict future environmental sustainability of Kazakhstan we have studied one of the most unutilized region - the Karaganda region, and we built a multivariate regression model in which the number of emissions of pollutants (Emis, kt) will depend on variables such as GRP (GDP, mln tenge), the total population of the region (Pop thousand), the number of enterprises with emissions of harmful substances into the atmosphere (Manuf, units) and motor vehicles (Car, thousands of units).

We have described the relationship between the emissions of pollutants and the volume of GRP by a polynomial of the second degree. This type of relationship between these indicators was described by Grossman and Kruger (1991), who suggested that economic growth leads first to an increase and then to a decrease in emissions.

That is, with the growth of GNP, the environment initially deteriorates: factories smoke, forests are cut down. But then there is a turning point, which many scientists explain as follows: with increasing income, the demand for improving the environment rises and there are more resources that can be invested in it.

In other words, wealthy citizens are, first, strongly interested in living in an environmentally friendly environment, thereby preserving their health and thinking about future generations, and second, can afford to invest in the environment of free money.

Thus, in order to save the environment, it is necessary not to restrict economic development, but, on the contrary, to develop it as intensively as possible, without wasting time on the environment.

However, in our opinion, a number of other factors influence the amount of emissions into the atmosphere, which we have included in the environmental model:

$$Emis = b_0 + b_1 GDP^2 + b^2 GDP + b^4 Pop + b^5 Manuf + b^6 Avto + u_i \quad (1)$$

The coefficients of the regression equation were estimated using the least squares method. As a result of approximation of statistical data for the Karaganda region, the following equation was obtained:

$$Emis = -711,7 + (-6,2E-11) GDP^2 + 0,0009GDP + 2,075 Pop + 0,029 Manuf + 9,85 Avto; R^2 = 0,7 \quad (2)$$

Since the coefficient $b_1 = -6,2E-11 < 0$, and coefficient $b_2 = 0,0009 > 0$, we get a convex up (\cap -shaped) curve that changes its direction relative to the inflection point from rising to falling.

Having differentiated the equality in terms of GDP, and equating the result to zero, we calculated the volume of gross regional product on average in the Karaganda region, for which the volume of pollution reaches the maximum value. It is assumed that the peak of pollution occurs at the level of $GDP = 7258064.5$ million tenge. Further increase in this indicator in the region leads to a decrease in air emissions of pollutants. The forecast of the environmental situation, according to the built regression model, for the next 3 years will be as follows:

$$\begin{aligned} Emis_{2020} &= 750.6 \text{ thousand tons;} \\ Emis_{2021} &= 841.6 \text{ thousand tons;} \\ Emis_{2022} &= 627.6 \text{ thousand tons.} \end{aligned}$$

This forecast was calculated based on the forecast values of the indicators participating in the model, which are shown in the following Table 3.

In conclusion, we would like to note that the transition to sustainable development and its management is a very long process, since it requires solving unprecedented social, economic and environmental problems. As we move towards sustainable development, the very concept of it will change and Refine, people's needs will be rationalized in accordance with environmental constraints, and the means to meet these needs will be improved. Therefore, the implementation of the principles of sustainable development should be considered in stages.

However, the use of economic and mathematical models to forecast the target indicators of the regional development Program in the context of the paradigm of sustainable development of the territory will have a beneficial effect on the entire management process, and

will contribute to improving the quality of regional development planning, development of regional development programs and their implementation.

4. CONCLUDING REMARKS

Weak participation of Kazakhstan in the formation and development of "green" technologies and eco-innovations increases the risks of maintaining the catch-up model of development, reducing the competitiveness of the national economy, reducing opportunities to attract "green" investments and participate in international programs for financing projects for the development of the "green" economy.

Kazakhstan has a weak system for accumulating financial resources and attracting investment to Finance eco-innovations. One of the ways to solve this problem may be the creation of a special Institute for the development of the green Finance market, following the example of the European center for the development of green Finance and investment at the OESD. This methodological center provides the development of principles, standards, classifications, guidelines and recommendations for stakeholders.

In Kazakhstan, there is a shortage in infrastructure – the lack of specialized institutions of the "Green economy," which can be links between non-governmental organizations, environmental organizations and state structures and contribute to achieving the goals of environmental regulation, compliance with the balance "nature-society-business." This interaction does not exist at the regional level.

Today, the main difficulty in managing regional development programs, even in terms of managing only a complex of natural resources, is the organization of the process of managing sustainable development programs in the region and its multi-entity nature. The current system of state regulation in many developed and developing countries does not allow organizing the process of managing socio-ecological and economic development of the region and the country on the principle of "one window."

The Republic of Kazakhstan is also actively involved in the search for an optimal development model. A huge number of ecological, social and environmental management problems for a long time did not allow development to be of the nature of sustainability. These include: dependence on rising prices for raw materials on world

Table 3: Forecast of target indicators of development of the Karaganda region for 2020-2022

Factors of social stability	Model	Forecast		
		2020	2021	2022
Gross regional product, million tenge	Economic	3751296.7	4353626.7	4356004.6
Total population, thousand people	Social	1364.7	1369.0	1374.6
Number of enterprises that emit harmful substances into the atmosphere, units	Trend $Manuf = 116,2t + 264,8$ $R^2 = 0,83$	1078.2	1194.4	1310.6
Number of vehicles, thousand units	Trend $Avto = 28,644t + 110,21$ $R^2 = 0,98$	425	454	483

markets, the use of a significant amount of natural resources, and a number of problems in quality of state planning and forecasting in the context of sustainable development of the region, the implementation of the “Green economy” model.

5. ACKNOWLEDGEMENT

This study was supported by the Kazakhstan Ministry of Education and Sciences, project APO5135183 Development of a mechanism for the system regulation of the activities of financial and credit institutions to support the innovation sector in conditions of ensuring sustainable macroeconomic effects?

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