Brief information about the project

Title	IRN AP25794979 «Development of fundamentals for the creating of polyoxide catalysts for greenhouse gas utilization»
Relevance	The relevance of this project lies in the synthesis of cobalt, magnesium, and other-based catalysts with tailored properties, in the absence of noble metals (the most expensive components), as well as the potential use of locally sourced natural clay in catalyst formulation. Additionally, the project emphasizes a significant reduction in energy consumption during catalyst preparation by employing modern methods such as self-propagating high-temperature synthesis (SHS) and solution combustion synthesis (SCS), which enable the production of ready-to-use catalysts within 5 minutes under atmospheric pressure. This project addresses the environmental challenge of air pollution in Kazakhstan by targeting the purification of toxic exhaust gases from motor vehicles. The objective is to improve the hydrocarbon composition of motor fuels and to neutralize toxic components in vehicle emissions.
Goal	The aim of the project is to synthesize new highly efficient and thermostable catalysts with specified properties and determine the optimal technological parameters for catalytic processes of processing methane, the main greenhouse gas in order to neutralize harmful emissions.
Tasks	To achieve the project goal, the following tasks will be solved: - Synthesis of catalysts based on cobalt, magnesium, etc. with specified properties, including carriers (including Kazakhstan deposits) prepared by modern methods of self-propagating high-temperature synthesis (SHS) and solution combustion synthesis (SCS). - Determination of the effect of the composition and method of preparation of catalysts deposited on the support by testing under various technological conditions and determining their activity under optimal process conditions (temperature, volume velocity, pressure, ratio of initial reagents and oxidants, etc.) in the process of processing methane, the main greenhouse gas in order to neutralize harmful emissions. - Study of the activity and stability of synthesized catalytic systems of selective action in the process of

	processing methane, the main greenhouse gas in order to neutralize harmful emissions. - Investigation of the elemental and phase composition, structural and porous characteristics, as well as morphology and texture properties, adsorption and redox properties of catalysts by physicochemical methods (XRD, TEM, SEM, BET, TPR, TPD, TPO, TGA-FTIR) and establishing the relationship between the physicochemical characteristics of catalysts and their catalytic properties.
Expected and Achieved Results	Expected outcome: - In 2025: Catalysts based on Co, Mg, etc., deposited on natural and synthetic media by SHS and SCS methods will be synthesized. - The activity and selectivity of synthesized catalysts in the process of processing methane, the main greenhouse gas will be investigated in order to neutralize harmful emissions. - In 2026: The influence of temperature, volumetric velocity and ratio of initial reagents on the process of catalytic conversion of methane in the process of processing methane, the main greenhouse gas in order to neutralize harmful emissions will be determined. Synthesized catalysts will be studied by XRD, BET, PEM and SEM methods. - Highly efficient and thermostable catalytic systems will be synthesized, allowing the selective processing of methane, the main greenhouse gas in order to neutralize harmful emissions. - In 2027: The stability of synthesized catalysts for processing methane, the main greenhouse gas, will be investigated in order to neutralize harmful emissions. The adsorption properties of catalysts and the shapes of adsorbed molecules will be investigated by the methods of TPD, TPR, TPO and TGA-FTIR. - The relationship between the physicochemical characteristics of the catalysts and their catalytic properties will be established. The influence of the technological conditions of the process, as well as the chemical composition, textural properties, microstructure and morphology of the catalysts on the effectiveness of the reaction under study will be evaluated for subsequent analysis and establishment of the fundamental characteristics of the process. - A final report will be prepared. - For the period 2025–2027: Two (2) articles will be published in journals ranked in the top three quartiles by

	impact factor in the Web of Science database or in journals with a Cite Score percentile of at least 50 in the Scopus database.
Names and Surnames of Research Group Members with Their Identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and Links to Corresponding Profiles	1. Magira Zhylkybek – Hirsch index (Scopus) – 1, Scopus Author ID: 57914315700, https://www.scopus.com/authid/detail.uri?authorId=57914315700. ORCID ID 0000-0002-3837-3991 2. Tolkyn Saparbekovna Baizhumanova – Hirsch index (Scopus) – 7, Scopus Author ID: 36052521200, https://kz.h-index.com/en/author/36052521200. Researcher ID: AAQ-8035-2020 ORCID ID 0000-0001-9851-2642
Publications list with links to them	1. M. Zhylkybek, B. Khussain, A. Sass, I. Torlopov, T. Baizhumanova, S. Tungatarova, A. Brodskiy, G. Xanthopoulou, K. Rakhmetova, R. Sarsenova, K. Kassymkan and Y. Aubakirov., et al. Cobalt–Magnesium Oxide Catalysts for Deep Oxidation of Hydrocarbons // Catalysts, 2024, 14(2), 136. https://doi.org/10.3390/catal14020136. Q2. Percentile 78. IF 4,501. 2. B. Khussain, A. Sass, A. Brodskiy, K. Rakhmetova, I. Torlopov, M. Zhylkybek, T. Baizhumanova, S. Tungatarova, A. Khussain, M. Zhurinov, A. Kenessary, R. Tyulebayeva, A. Logvinenko and Y. Narimanov., et al. Patterns of Formation of Binary Cobalt–Magnesium Oxide Combustion Catalysts of Various Composition // Catalysts, 2024, 14(7), 425; https://doi.org/10.3390/catal14070425. Q2. Percentile 78. IF 4,501.
Patent information	M. Zhylkybek, T.S. Baizhumanova, S.A. Tungatarova, A.S. Sass, I.I. Torlopov, Y.A. Aubakirov. Method for preparing an oxide catalyst for deep methane oxidation // Utility model patent of the republic of Kazakhstan No. 10113, Bulletin No. 4, published on January 24, 2025.