Name of project: ИРН AP19677558 «Development of an integrated system for the bioconversion of carbon-containing waste»

Relevance:

In the past two decades, global green technology research programs have focused on discovering new and sustainable sources of energy, as the world economy can no longer depend on fossil fuels, and this is also important for carbon neutrality. In addition, the inefficient management of large-tonnage waste from processing plants and the resulting environmental pollution deplete valuable renewable production resources. In this regard, integration of hydrogen biosynthesis methods by dark fermentation using a single bacterial strain and the production of anaerobic digestion methane is proposed as a sustainable approach.

Goal: Increasing the sustainability of energy recovery from *Escherichia coli* biomass through integrated biosynthesis of hydrogen by dark fermentation and products of anaerobic fermentation of substrates based on sugar molasses and distiller's grains.

Expected results:

- for 2023: The main factors and indicators will be studied, the parameters of pre-treatment of raw materials using a combination of acid-hydrothermal and ultrasonic treatment, and microbial fermentation of sugar molasses substrates, distiller's grains and their mixtures using wild-type and mutant strains of Escherichia coli, contributing to efficient biosynthesis of molecular hydrogen. Along with this, in order to popularize science, disseminate information about the results, increase the likelihood of their implementation and commercialization of the project, a web page on the project implementation will be created on the KATU website.

- **for 2024:** The correlation patterns of selective factors (duration of hydrolysis, concentration and parameters of raw materials and hydrolyzing agent) for the biosynthesis of molecular hydrogen from sugar molasses substrates, distiller's grains and their mixtures using wild-type Escherichia coli and mutant will be studied. The adequacy of the data of the mathematical model will be verified with the results of experiments on the efficient synthesis of molecular hydrogen from the substrates of sugar molasses, distiller's grains and their mixtures. Stable parameters for the efficient synthesis of molecular hydrogen from the substrates of sugar molasses, distiller's grains and their mixtures will be substantiated. The research results will be presented at the International Conference in the USA or Europe, as well as published in peer-reviewed foreign or domestic publications, recommended by the KOKSNVO.

- for 2025: The most effective conditions and parameters for the production of biogas-methane will be worked out, the chemical demand for oxygen and the conditions for biomass synthesis will be studied. The results will be substantiated and recommendations for their use will be formulated through the integration of dark fermentation and anaerobic digestion.

Energy recovery from E. coli biomass will be improved based on the efficient integration of dark fermentation and anaerobic digestion of organic waste. Will be published in peer-reviewed scientific journals in compliance with the requirements of the competition:

- at least 2 (two) articles in peer-reviewed scientific publications indexed in the Science Citation Index Expanded and included in the 1st (first) and (or) 2nd (second) quartile by impact factor in the Web of Science database and (or) having a CiteScore percentile in the Scopus database of at least 65 (sixty-five);

- either at least 1 (one) article in a peer-reviewed scientific publication indexed in the Science Citation Index Expanded and included in the 1st (first) quartile by impact factor in the Web of Science database and (or) having a CiteScore percentile in the Scopus database of at least 80 (eighty).

1 study guide will be written in accordance with the recommendation of this competition. At least 1 PhD dissertation, and about 10 undergraduate and graduate qualifying papers will be completed..

Members of the research group:

Project manager – **Bekbayev Kairat Serikzhanovich,** candidate of technical science. Author of more than 80 publications, has more than 20 works on the subject of the project,

including 3 articles in peer-reviewed journals in Scopus and Web of Science databases. h index - 2, Researcher ID - G-7687-2019, https://orcid.org/0000-0001-9591-0370, Scopus Author ID - 57216826792.

Research group:

1. Toleugazykyzy Akerke - leading researcher, a graduate of the doctoral program at KATU in the specialty "Technology of processing industries" (2021). She has extensive experience in participating in scientific and educational projects. Author of more than 30 publications, including 3 (three) articles in scientific publications indexed in the Scopus database. h Index - 2, Researcher ID - AFI-8539-2022, https://orcid.org/0000-0002-2061-1699 , Scopus Author ID – 57216832008.

2. Bekbayeva Roza Serikzhanovna - senior researcher, candidate of technical science, specialty 05.18.12 – "Processes and devices of food production", system engineer. Author of more than 50 publications, including 2 articles indexed in the Scopus database, h Index - 1, https://orcid.org/0000-0002-3218-4591 , Scopus Author ID – 57415317600.

3. Nabiyeva Zhanar Serikbolovna - researcher, PhD in specialty 6D072800 "Technology of processing industries", biotechnological-engineer. Author of more than a hundred publications, including five textbooks, one monograph, five inventions. h index – 4, https://orcid.org/0000-0001-7258-746X, Scopus Author ID – 56031451100.

4. Sagyndykova Akmanar Kairatovna – trainee researcher, master of technical science in the educational program "Technology of processing industries". She has experience of participating in scientific research on the topic of the project.

Information for potential users:

The results of the project can be applied at sugar and alcohol production enterprises, thanks to which it will be possible not only to develop high-tech products from waste, but also to use energy for their production needs. Therefore, it is possible to solve the issue of disposal of large-tonnage waste and the sale of manufactured products with added value.

Additional information:

The implementation of the project results can contribute to the improvement of the socio-economic, environmental, scientific and technical condition of sugar and alcohol production enterprises, as well as the training of modern personnel for the industry.