Hydrogen in Kazakhstan: status quo and perspectives

Department of alternative energy
Hydrogen Technologies Research Laboratory
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Hydrogen Energy in Kazakhstan

НУР-СУЛТАН. КАЗИНФОРМ - Президент Казахстана Касым-Жомарт Токаев поручил определить водородную энергетику в качестве одного из приоритетов центра компетенции в новых технологиях, передает корреспондент МИА «Казинформ».

НОВОСТИ ПО ТЕМЕ

Глава государства принял министра обороны

Как поступят с незаконно работающими в Казахстане майнерами

На какой стадии переговоры по газификации севера и востока Казахстана

В Минэнерго прокомментировали вопрос строительства АЭС в Казахстане

«Я принял во внимание предложение компании Ernst & Young по производству водорода. Действительно, топливо будущего и Казахстан как энергетическая держава должен освоить технологию его получения, использования и экспорта. Эта работа уже начата, я внимательно за ней наблюдаю, и буду продолжать делать это в будущем», - сказал во время пленарного заседания Совета иностранных инвесторов Касым-Жомарт Токаев.

«Поручаю Министерству энергетики, НК «КазМунайГаз» определить водородную энергетику в качестве одного из приоритетов в деятельности создаваемого центра компетенции в новых технологиях. Мы продолжим активную работу по привлечению инвестиций. В данном направлении стремимся создать максимально выгодные и удобные условия именно для производителей и экспортеров в высокотехнологичных товаров и услуг», - отметил Президент РК.

По словам Касым-Жомарта Токаева, сегодня экспорт казахстанских сырьевых товаров почти в три раза превышает экспорт обработанных.

https://www.inform.kz/ru/kasym-zhomart-tokaev-dal-poruchenie-po-vodorodnoy-energetike_a3799500

- As part of the execution of paragraph 7 of fixing control over the execution of instructions of the President of the Republic of Kazakhstan following the results of the 33rd plenary meeting of the Council of Foreign Investors under the President of the Republic of Kazakhstan, the Ministry of Energy, together with the Ministry of Ecology, Geology and Natural Resources, and JSC NC Kazmunaygas, should develop proposals for the development of hydrogen energy as part of the activities of the Competence Center in new technologies being created. *10 June 2021*
- Coordination on the establishment of a Competence Center for Hydrogen Energy at KMG Engineering LLP chaired, Chairman of the Board of JSC NC KazMunayGas. *22 October 2021*
- Approval of the Supervisory Board on the new organizational structure of KMG Engineering LLP. January 19, 2022
- Official launch of the first Competence Center for Hydrogen Energy and Hydrogen Technology Research Laboratories in Kazakhstan. April 1, 2022
- The Center has been transformed into the Department for Alternative Energy in order to expand its activities since 1 November 2022

KMG Low-carbon development program

Strategic goals 2022-2031

SUFFICIENT RESOURCE BASE

Total reserves increase ~ 2.2 bn barrels

PERFORMANCE IMPROVEMENT

Total oil production 1.8 bn barrels

Additional routes for transporting oil for export

PETROCHEMISTRY

Polypropylene 500 thousand tons (1% world production)

Polyethylene 1250 thousand tons (1,5% world production)

Polyethylene terephthalate 430 thousand tons

Terephthalic acid 600 thousand tons

ENERGY TRANSITION

Reduction of CO2 emissions by 15% against the level of 2019

Renewable Power Development >2 GW *

* >500 MW to KMG share

Target indicators of the KMG Low-Carbon Development Program for 2022-2031

Main Target

- **Reduction of carbon footprint by 15% by 2031**
- 2019 is a base year
- Scope 1 and Scope 2

Focus Areas

- Improvement of energy and operational efficiency by **at least 10%**
- Development of renewable energy sources of **at least 300 MW**
- Implementation of **Carbon Offset Projects**

Potential Areas

- CCUS/CCS
- Low-carbon hydrogen energy
- Nature-based solutions
- Biofuel
- Methane management

The first national company in Kazakhstan that developed LCDP

LCDP Action Plan has been approved

A number of projects are already underway

Partnership

ҚазМұнайГаз, eni, Chevron, Shell, TotalEnergies, European Bank for Reconstruction and Development

We are open for cooperation and joint projects

DEPARTMENT OF ALTERNATIVE ENERGY

Department for Alternative Energy

Comprehensive analysis of hydrogen technologies

- Review and analysis of international experience in transferring the economy to environmentally friendly fuels (programs, strategies, roadmaps, hydrogen energy standards);
- Detailed analysis of data, research and development, domestic and foreign experience in the production of "blue and green" hydrogen;
- Energy, environmental, economic modeling of production and use of hydrogen.

Support and advice on pilot projects of KMG on hydrogen energy

- Expert analysis on the designation of production problems and preparation of conclusions and recommendations for pilot projects;
- Consultations in the development of standards, programs and strategies for hydrogen energy (National Roadmap);

Laboratory of Hydrogen Technologies

Research cooperation on hydrogen energy projects

- Search and comprehensive analysis of research projects on hydrogen energy (on the production, storage and transportation, use of hydrogen) for the purpose of partnership and implementation;
- Scientific and technical support of selected research projects and preparation of documentation, reports;
- Preparation of conclusions and recommendations for improving the quality and efficiency of research projects;

Research work in the Atyrau branch

- Equipment and launch of the laboratory, organization and planning, development of a quality manual, commissioning;
- Determination of the prospects for the development of a research topic, preparation of experiments on the manufacture of alloys and structural analyzes for the efficient and safe storage and transportation of hydrogen.

Research work in the laboratory block

Cooperation with local and foreign institutions and universities in the framework of R&D projects:

- Kazakh-German University
- Nazarbayev University
- Reiner Lemoine Institute (Germany)
- Tokai University (Japan)
- Green Spark KNT (Italy)

- Development of research projects for the production, storage and use of hydrogen, including metal hydrides as a material for storing and transporting hydrogen
- Green hydrogen production
- Development of fuel cell systems
- Projects for the transportation of hydrogen through the pipeline in the form of gas
- Study of hydrogen embrittlement
- Project scaling up to TRL 7-9

Scientific backlog of the Laboratory for the study of hydrogen technologies.

SALD-2300 Shimadzu

METTLER TOLEDO HP DSC 2+

GASPRO Setaram

SEM QUANTA 650

XRD RIGAKU ULTIMA

PM 400 Retsch

Purchased equipment for 2022:

- Particle size analyzer
- Differential Scanning Calorimeter
- Gas analyzer

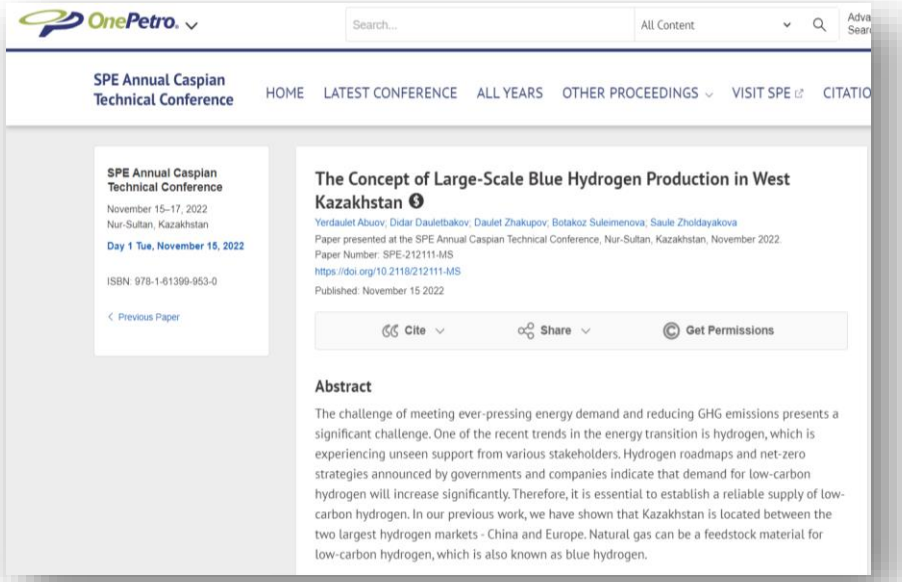
Equipment in KMGE branches:

- Scanning electron microscope (Aktau branch)
- X-ray diffraction analyzer (Atyrau branch)

Application for 2023:

- Ball mill
- Electrochemical sensor
- Heating plate
- Distiller
- Ultrasonic bath
- Scales
- Laboratory furniture

Published research papers



- Toward a Hydrogen Economy in Kazakhstan, October 2022, Asian Development Bank Institute

- The Concept of Large-Scale Blue Hydrogen Production in West Kazakhstan, November 2022, Society of Petroleum Engineering

- Realizing the benefits of a hydrogen industry in Kazakhstan, July 2023, International Journal of Hydrogen Energy

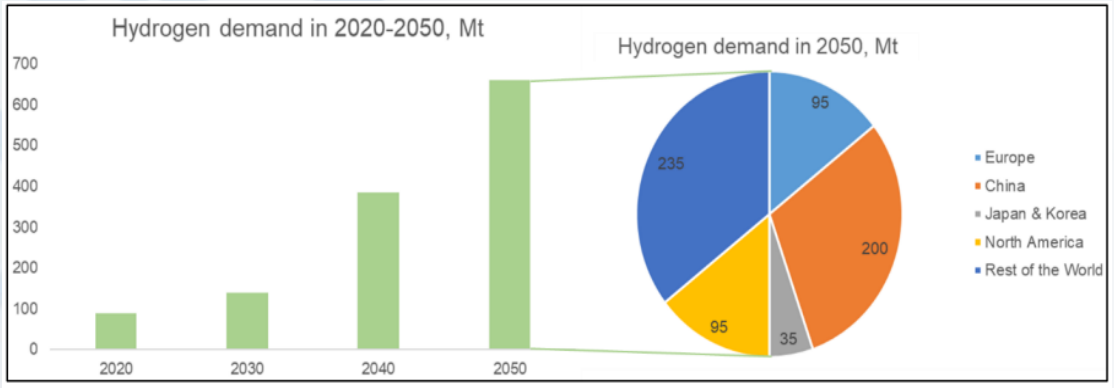
HYDROGEN IN KAZAKHSTAN

External market

Blue and **green** hydrogen have great potential in Kazakhstan

- Natural gas reserves and existing gas injection facilities for blue hydrogen
- Renewable Energy Resources (RES) for Green Hydrogen

Kazakhstan is closely located between the two largest hydrogen markets. China and Europe will become the largest markets for hydrogen in 2050 with a combined demand of 330 million tons (or 50% of global demand).



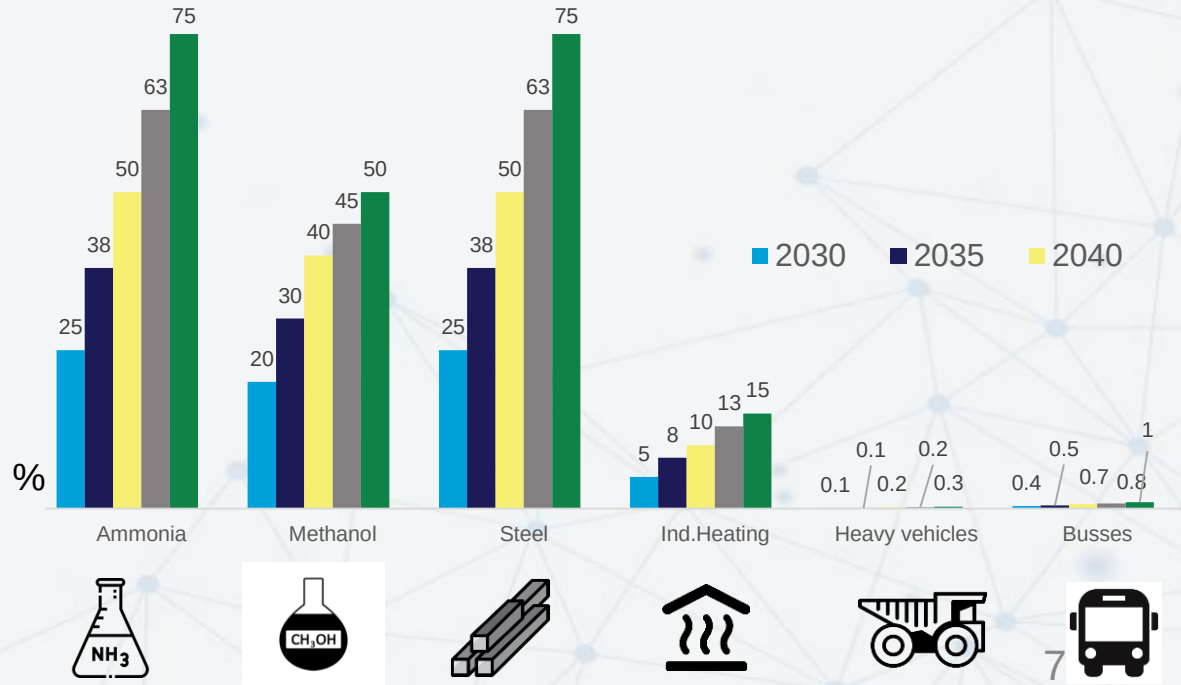
Ref.: «Towards hydrogen economy in Kazakhstan» ADBI 2022

Internal market

According to the World Bank report:
Hydrogen will be mainly used in the domestic market in the production of

- **Ammonia**
- **Methanol**
- **Steel production**

The total volume of the hydrogen market in the Republic of Kazakhstan will amount to 160 billion US dollars. Decarbonization and the Carbon Tax are also major drivers for the development of hydrogen technologies.

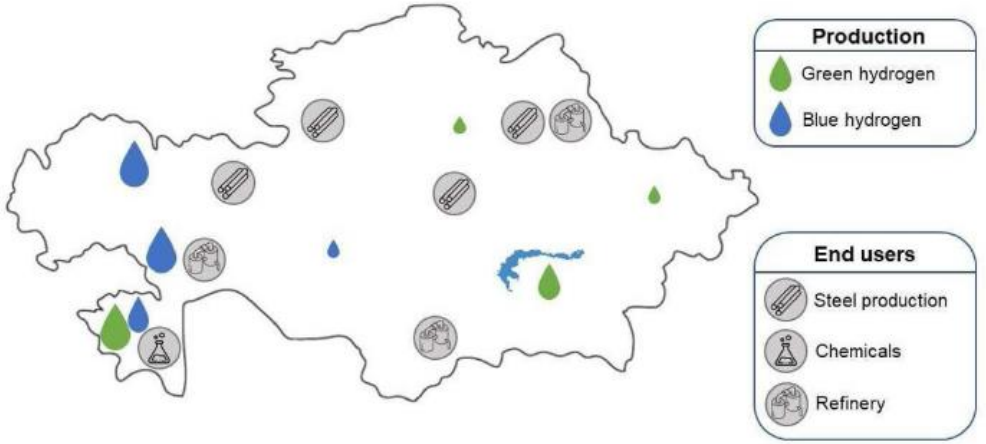


Why does Kazakhstan need hydrogen?

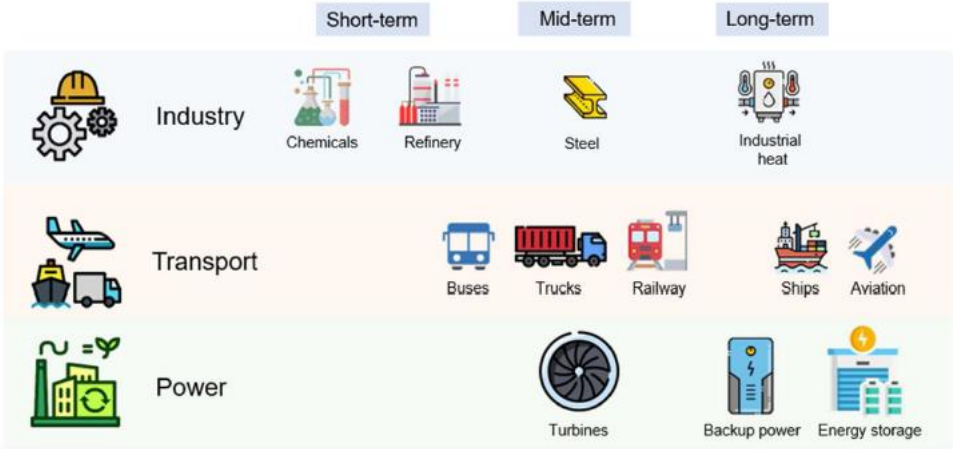
Driver 1: Export potential
Two main markets - China and Europe

Driver 2: Carbon tax
CBAM, ETS

Driver 3: Decarbonization
Exising decarbonization actions are insufficient



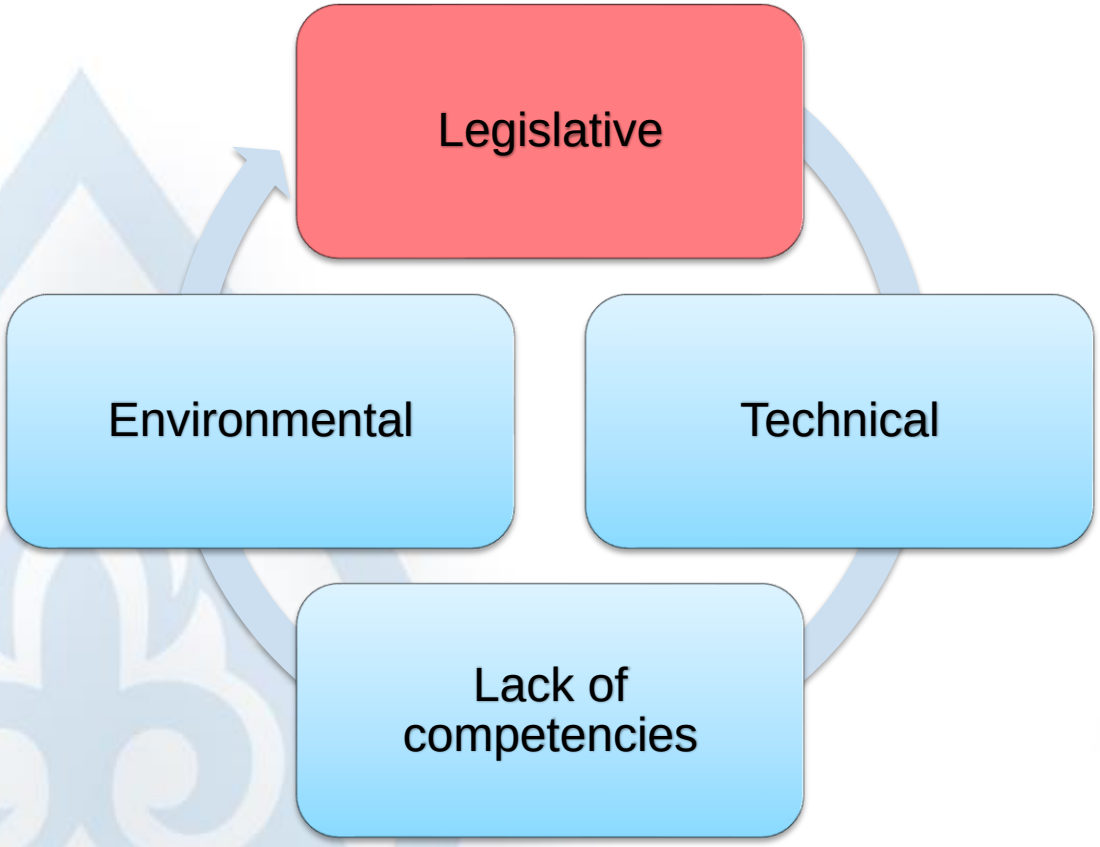
Potential hydrogen supply and end-users in Kazakhstan



The timeframe for hydrogen end-use in Kazakhstan

Toward a Hydrogen Economy in Kazakhstan, Asian Development Bank Institute/
Realizing the benefits of a hydrogen industry in Kazakhstan, International Journal of Hydrogen Energy

Challenges



- Safe use of hydrogen
- No clear vision for the future of the hydrogen industry: stakeholders are not pushing forward the development of the industry.

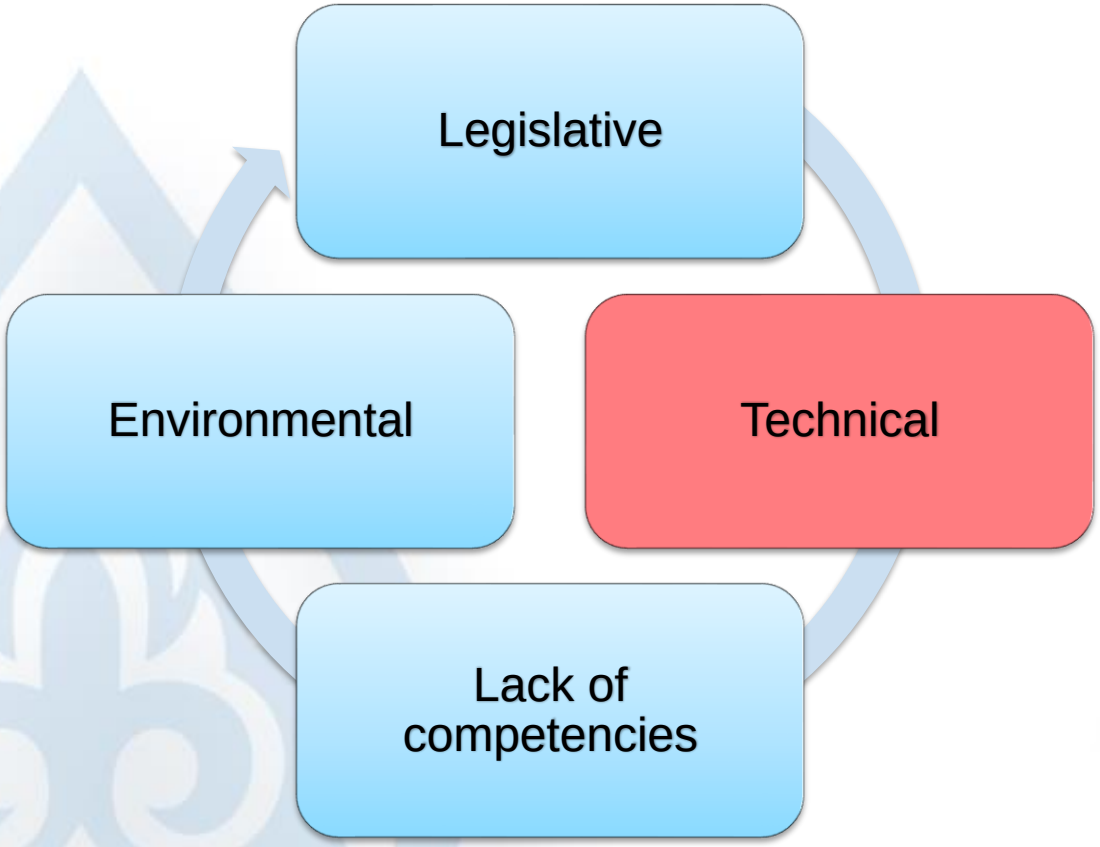
- Preference, and recommendation according to the standards of the Kazakhstan Regional Association Ecological initiative “ECOJER” / In the frame of TC №117 “New energy and alternative energy”/ “Hydrogen technologies”.

Year	Consider	Approval	
2023	7	3	1. "Quality of Hydrogen Fuel. Product Specification“ 2. "Fuel Cell Technologies. Safety Requirements for Installing Stationary Fuel Cell Power Systems“ 3. "Basic Safety Requirements for Hydrogen Systems"
2024	17		

- Proposals, and recommendations within the framework of the working group on the Concept for the development of hydrogen energy in the Republic of Kazakhstan until 2040 (Ministry of Energy of the Republic of Kazakhstan).

24.04.2024
First Draft of Hydrogen Energy Development Concept until 2040 in Kazakhstan by Ministry of Energy

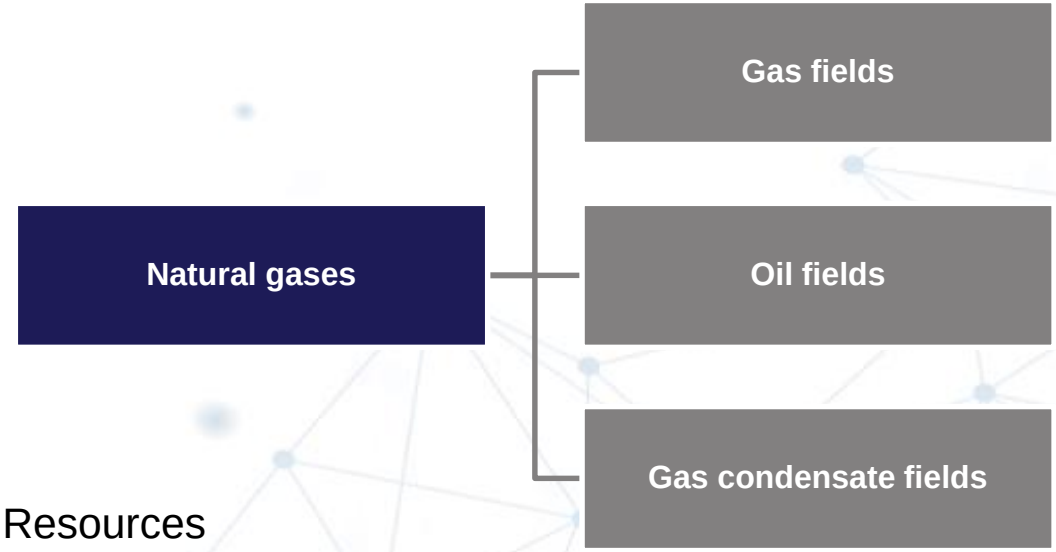
Challenges



- Creating a value chain
- Infrustructure

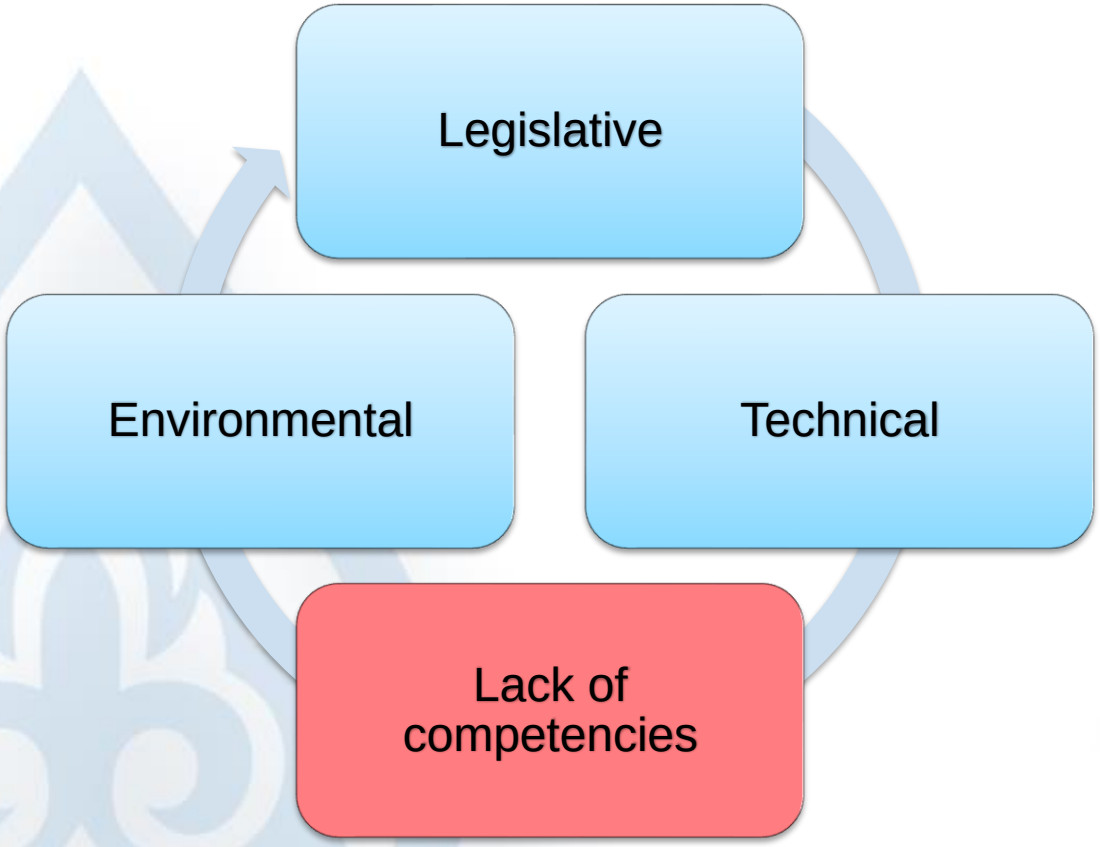
Development of a technical and economic calculation for the production of blue hydrogen

- Limited demand for hydrogen in Kazakhstan (currently only two refineries use “gray” hydrogen).
- The existing industrial infrastructure does not allow for the use of hydrogen without extensive modernization (energy sector).
- There is no demand for low-carbon hydrogen.



- Resources
- Limiting factors
- Subsidiaries and affiliates companies of KMG
- Fields and their plans for gas utilization

Challenges



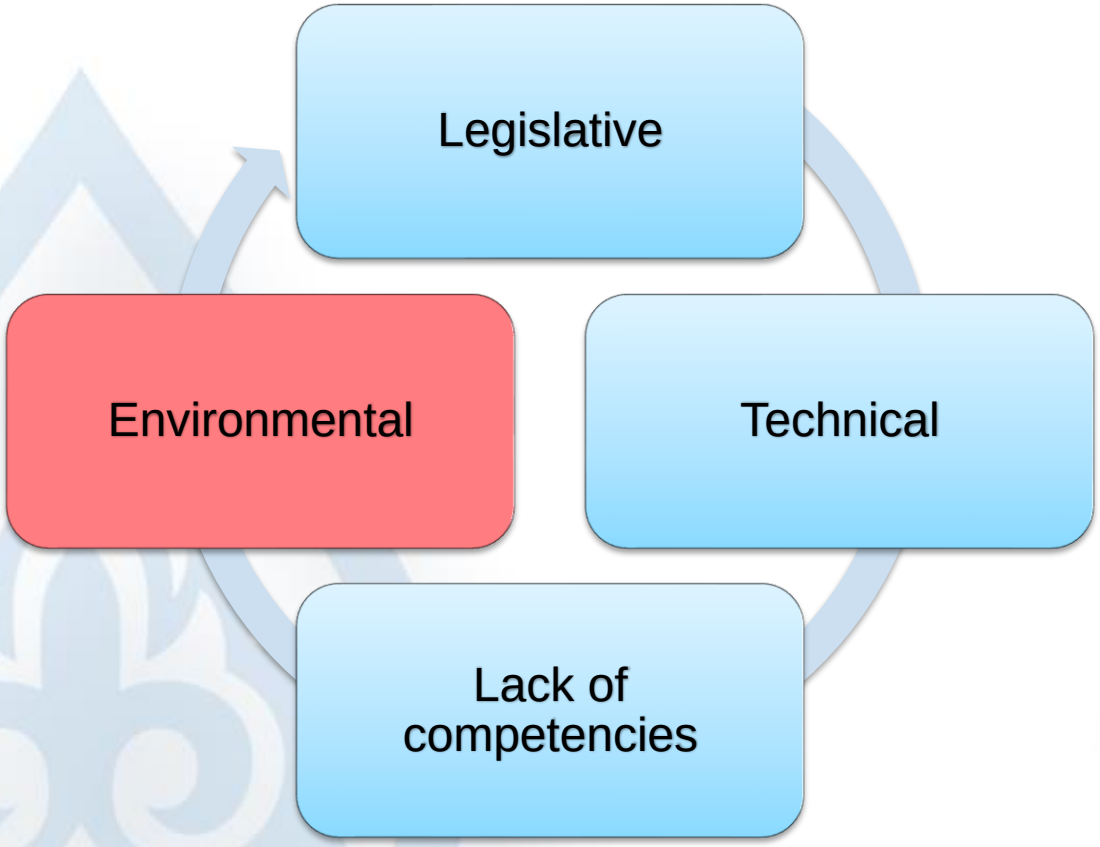
- Introduction, educational training, seminars (Retraining of current specialists)

Year	Amount	MoU
2022	2	Green Spark, ERG Research and Engineering Center
2023	1	Mitsubishi Heavy Industries

- Training, visiting ongoing projects

Year	Organization	Training
2022	TOO Green Spark, Aksai city, Kazakhstan	First pilot project for green hydrogen production
2023	INPEX, Japan	CCS technologies
2023	JCCP, Japan	Hydrogen utilization technologies
2023	GIZ, Germany	Hydrogen diplomacy
2024	Reiner Lemoine Institute, Germany	Assessment of water resources for hydrogen production

Challenges

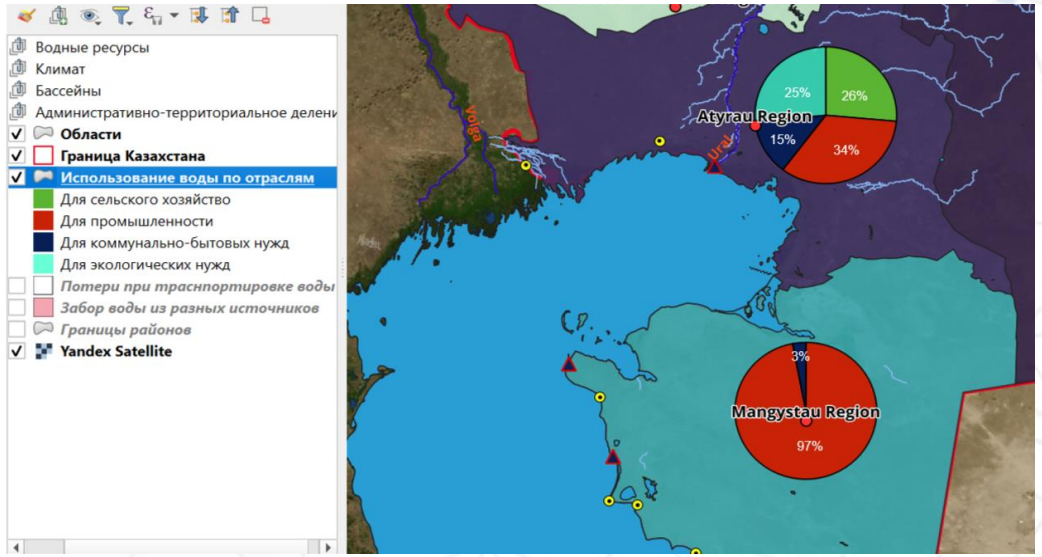


Hydrogen production poses a risk to Kazakhstan's water resources

- Blue hydrogen water consumption (13-17 kg water/H_2kg)
- Green hydrogen water consumption (9-18 kg water/H_2 kg)
- Blue hydrogen from coal consumes almost four to five times more water (41-86 kg of water /H_2 kg)

Assessment of water resources for hydrogen production based:

- Qualitatively analyzed data on the water resources of the RoK, as well as the existing potential of renewable energy sources.
- Visualization of estimated data on the availability of water resources in a certain region.
- Analyze various hydrogen production scenarios



Water resources map for hydrogen production in West Kazakhstan

- Analysis of hydrogen production opportunities in Kazakhstan
  - Green hydrogen
  - Blue hydrogen
- Hydrogen storage experiments
  - Synthesis of metal hydrides
  - Study scaling
- Formation of the hydrogen energy market
- Standards and regulations
- CCUS
- R&D
- Pilot projects

RAH$_2$MET!
TH$_2$ANK YOU!

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