Sustainable Hydrogen Production in Central Asia

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A multi-stakeholder platform that promotes economic integration, cooperation among member States, sustainable development and economic prosperity based on:

- public policy dialogue
- discussion of international legal instruments
- development of regulations and standards
- exchange and application of best practices and knowledge
- technical cooperation for countries with economies in transition
Building Resilient Energy Systems


What is a resilient energy system?

- **A resilient energy system** ensures that energy makes an optimal contribution to a country’s social, economic, and environmental development.
- **Energy security** strengthens energy independence through interconnectivity and trade.
- **Affordability** reduces costs of electricity, heating, cooling, and transport.
- **Environmental sustainability** lowers the carbon footprint and enhances efficiency across the energy supply chain.
Priority Activities for Sustainable Energy in 2023

• Access to critical raw materials and United Nations Framework Classification for Resources (UNFC) → adoption of UNRMS, necessity for scaling renewable energy and energy transition

• Work on hydrogen production and decarbonization in Central Asia (project on low-carbon hydrogen production in the CIS countries and its role in the development of the hydrogen ecosystem and export potential)

• Work on energy connectivity – project on enhancing regional energy connectivity for more resilient and carbon neutral energy systems in Central Asia

• Almaty Energy Forum – a platform for continuous inclusive multistakeholder dialogue to facilitate regional cooperation, provide technical capacity support and build cross-regional technical and institutional capacity in Central Asia
Assessment of Readiness Level across UNECE Region

Levels of actions taken towards the integration of hydrogen into energy systems

**Western Europe**
Western European nations including Austria, France, Germany, the Netherlands and the UK are among the global leaders in implementing large-scale hydrogen projects. Commercial scale projects are being announced alongside specific targets in hard-to-decarbonise industries.

**Central Europe**
The integration of hydrogen into national strategies is directly supporting the creation of regulatory frameworks. EU support for projects such as Slovenia’s renewable hydrogen project is a welcome addition to the region.

**North America**
There is high potential for scaling up hydrogen across the North American region. However, there is a need for a more comprehensive regional approach towards hydrogen project implementation to complement existing research and development.

**Southern Europe**
Universal agreement that hydrogen is a viable future technology with complementary national strategies is supporting the introduction of public and private partnerships. Nations including Italy and Spain have the potential to become a leading source of clean hydrogen generated from renewable energy.

**Western Balkans**
Wider inter-regional EU projects can support clean hydrogen production and usage. Increased support from international partners can make bold action a reality in the region.

**Scandinavia**
Extensive investments alongside varied pilot projects make Scandinavia a strong act to follow. Sweden’s recent production of emission-free steel could be the start of transformative change across international industry.

**Baltic**
The region shares long-term EU commitments and is expected to develop further national hydrogen strategies to support widespread use of hydrogen in transport and other key sectors with high potential.

**Russia**
Hydrogen inclusion in the national long-term, alongside strong political statements in a standalone national hydrogen roadmap can support the nation to ramp up hydrogen production.

**Central Asia**
Existing knowledge in natural gas and renewable energy provides a strong case for Central Asia to expand clean hydrogen production. Support from the wider international community could support decarbonisation through financing and regulatory frameworks.

**Caucasus**
The blending of hydrogen into natural gas pipelines in Azerbaijan could facilitate further nations to follow suit. Georgia has also recently sought funds from international partners to make the first steps in producing green hydrogen.

**Eastern Europe**
Hydrogen roadmaps and interest in pilot projects are at the top of the political agenda in the region. However, more support is needed to build on existing momentum and facilitate comprehensive financing and legislative proposals.
HYDROGEN VALUE CHAIN
Hydrogen, an innovative solution for achieving carbon neutrality

PRODUCTION

FUEL-BASED PRODUCTION
- Natural gas
  - Steam methane reforming
  - Autothermal reforming
- Coal
  - Gasification of coal with or without CCS
- Biomass
  - Gasification of biomass with or without CCS

ELECTRICITY SYSTEM
- Renewable energy
  - Electricity from wind, solar, hydro or geothermal power
- Nuclear
  - Electricity and heat from nuclear power

CONVERSION, PROCESSING & TRANSPORTATION

PURE H₂
- Liquification and regasification of H₂
- H₂ gas compressed

PROCESSING
- Haber-Bosch process
  - H₂ and N₂ to ammonia; standard shipping modes
- Methanization
  - H₂ + CO₂ → CH₄ + H₂O or H₂ + CO → CH₃OH (methanol)
  - (synthetic or substitute natural gas)

CONVERSION

USE

TRANSPORT
- Hydrogen into fuel cells for trucks, passenger vehicles
- Synthetic fuels for shipping and aviation

INDUSTRY
- Hydrogen as feedstock in refining, steel production, chemicals production
- Hydrogen for heat generation for industrial processes

BUILDINGS
- Hydrogen for heating
- Hydrogen for onsite power through fuel cells

POWER
- Fuel cell electricity, H₂ turbines and H₂ CHP
- Energy storage and system buffer

STORAGE
- Liquified H₂ in storage tanks
- Geological storage in underground salt caverns

AWARENESS
- Recognise hydrogen as a viable climate mitigation option

ACCEPTANCE
- Develop and integrate policies to jumpstart hydrogen economy

FINANCE
- Direct public and private investment into clean hydrogen projects
# Project on Sustainable Hydrogen Production Pathways

| Analysis of national potentials to contribute to development of a hydrogen ecosystem and global energy transitions, including the supply of energy to energy-deficient regions of the world |
| Analysis of priority areas for the development of national hydrogen potential |
| Analysis of hydrogen production potential across CIS countries |
| Analysis of the opportunities for hydrogen export and possible applications in the domestic market |
| Peer-to-peer dialogue on best practices and lessons learned in developing national hydrogen strategies |

| Subregional assessment of cost and technical performance of hydrogen production from fossil fuels, low-carbon energy, and renewable energy across beneficiary countries |
| Refining of existing data and assumptions related to sustainable hydrogen production for the energy model. |
| Directions for the implementation of pilot projects for the supply of sustainable hydrogen for export |

| Recommendations for pilot projects in international cooperation in sustainable hydrogen technologies |
| Policy dialogue to identify and overcome existing barriers to development of a hydrogen ecosystem |
| Final seminar for representatives of governments, industry, and academia to present and discuss recommendations and discuss how they can be incorporated into draft National Action Plans to meet SDG 7 |
Towards the Hydrogen Economy Development

**Azerbaijan and Turkmenistan** - major energy exporters towards the EU and China. The climate policy in these countries does not yet create significant incentives for decarbonization and low-carbon technologies deployment. The key consumers of gas from Azerbaijan and Turkmenistan - the EU and China - are actively developing the hydrogen economy, which can create additional incentives for the countries.

**Kyrgyzstan and Tajikistan** are united by energy shortage problem and a significant hydropower plants share in the energy mix, which provide low-carbon, but intermittent energy. Hydropower plants create problems associated with energy deficit during winter and energy surplus during summer. This creates potential for hydrogen production using surplus curtailed electricity from hydropower plants and use of this hydrogen, for example, to replace imported oil products.

**Kazakhstan and Uzbekistan** are showing impressive momentum in launching the low-carbon energy transition— despite being rich in and exporting their own fossil energy resources. Both countries are drafting national hydrogen strategies with the support of international organizations and are actively deploying renewable energy.
Kazakhstan

Resource potential of hydrogen production in Kazakhstan by 2040, thousand tons per year

- Minimum Scenario
- Maximum Scenario

- Hydrogen by water electrolysis using renewable electricity, thousand tons per annum
- Hydrogen by SMR + CCUS, thousand tons per annum
- Hydrogen by water electrolysis using nuclear electricity, thousand tons per annum
Kyrgyzstan

Resource potential of hydrogen production in Kyrgyzstan by 2040, thousand tons per year

- **Minimum Scenario**
- **Maximum Scenario**

- Hydrogen by water electrolysis using small hydropower electricity, thousand tons per annum
- Hydrogen by water electrolysis using large hydropower electricity, thousand tons per annum
Tajikistan

Resource potential of hydrogen production in Tajikistan by 2040, thousand tons per year

Minimum Scenario

Maximum Scenario

Hydrogen by water electrolysis using renewable electricity, thousand tons per annum
Turkmenistan

Resource potential of hydrogen production in Turkmenistan by 2040, thousand tons per year

- **Minimum Scenario**: Hydrogen by water electrolysis using renewable electricity, thousand tons per annum
- **Maximum Scenario**: Hydrogen by SMR + CCUS, thousand tons per annum
Uzbekistan

Resource potential of hydrogen production in Uzbekistan by 2040, thousand tons per year

- **Minimum Scenario**: Hydrogen by water electrolysis using renewable electricity, thousand tons per annum
- **Maximum Scenario**: Hydrogen by SMR + CCUS, thousand tons per annum
- Hydrogen by water electrolysis using nuclear electricity, thousand tons per annum
Possible typical scenario models for hydrogen economy establishment and deployment in the countries covered by the study, depending on their decarbonization policy ambition and resource potential for low-carbon hydrogen production.
Way forward

The hydrogen economy deployment pace will be determined by:

- Strategic focus on low-carbon development
- Building an appropriate regulatory framework
- Expanding markets
- Technological development
- International cooperation
- Joint projects implementation
- Common export strategy
Thank you for your attention!

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