



UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION



GLOBAL PROGRAMME  
GREEN HYDROGEN IN INDUSTRY  
Innovative | Decarbonized | Inclusive



# GLOBAL PROGRAMME FOR GREEN HYDROGEN IN INDUSTRY

ANNUAL REPORT 2022



## INTRODUCTION

The current report reflects UNIDO’s work undertaken within the Global Programme for Green Hydrogen in Industry in January–December 2022. The Global Programme also counts on the cooperation with the “International Hydrogen Energy Centre (IHEC)” in Beijing, launched by UNIDO and the Government of China in July 2021.

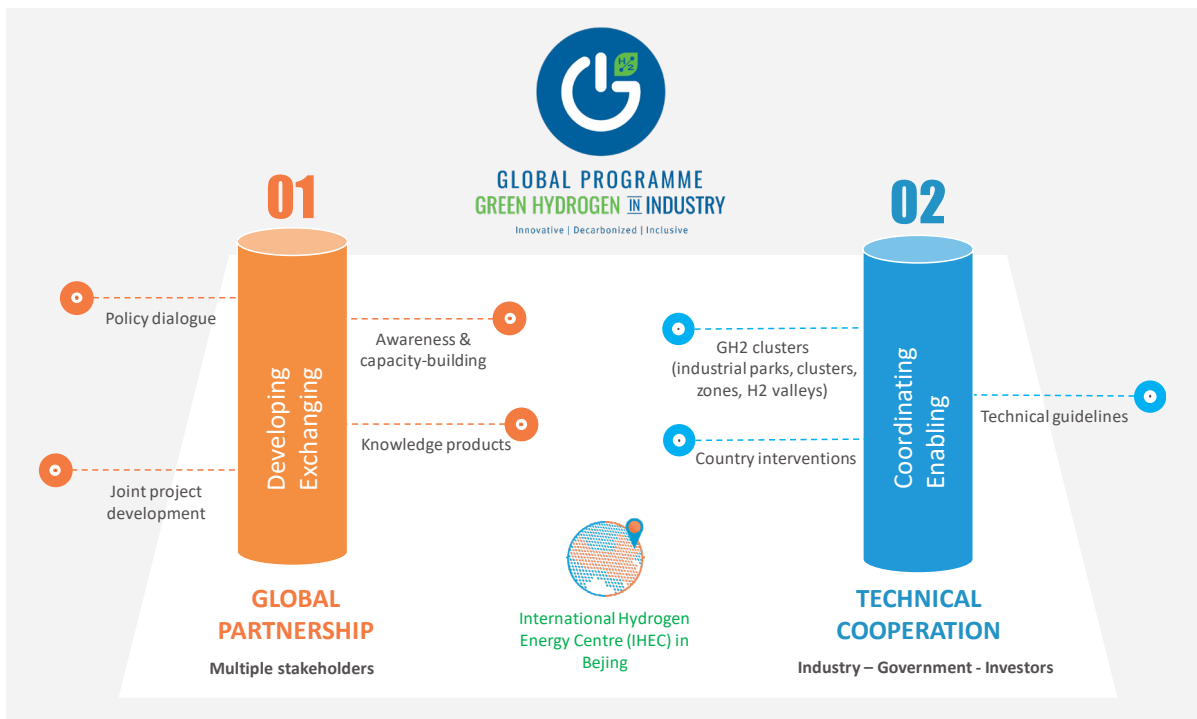
## BACKGROUND

The Global Programme for Green Hydrogen in Industry is in line with UNIDO’s mandate on Inclusive and Sustainable Industrial Development, reflected in SDG-9. The Programme aims to promote a Just Transition of industry in developing countries and transition economies by fostering local production and application of green hydrogen. The programme has two key pillars of work: The Global Partnership for Hydrogen in Industry (Phase I) and the Technical Cooperation Programme.

The first pillar aims to raise awareness and increase capacity building of green hydrogen application in industry for national policy makers and industry representatives. The partnership acts as a platform for Member States, industries, private sector, investors, research and academic institutions. It provides opportunities for policy dialogue, awareness-raising, knowledge sharing and joint project development.

Through the second pillar, UNIDO cooperates with industry and government in developing countries and transition economies to design and implement green hydrogen projects in industry. These projects focus on the decarbonization of hard-to-abate sectors and aim to stimulate innovation and the application of locally produced green hydrogen, thereby, creating additional job opportunities and economic gains for the respective region/country. These projects also have as essential elements the work on national policy frameworks and incentives to provide an enabling environment for applying green hydrogen.

Figure 1. UNIDO Global Programme for Green Hydrogen in Industry structure.



Both pillars are supported by the International Hydrogen Energy Centre in Beijing that UNIDO has launched together with the Chinese government. The centre operates as a knowledge partner, supporting technology research, development and application as well as by building-up green hydrogen economies and promoting international cooperation.

## PROGRAMME ACTIVITIES

The Climate and Technology Partnerships division was created under the Directorate on SDG Innovation and Economic Transformation (IET) in August 2022. The Division coordinates UNIDO's Global Programme for Green Hydrogen in Industry and represent UNIDO in relevant high-level policy discussions and fora. Furthermore, the Division facilitates knowledge management and exchange, supports UNIDO's global forum activities associated to climate and technology innovation; and coordinates high-level events such as the green hydrogen events at the United Nations Climate Change Conference 2022 (COP 27).

The following section includes an overview of the activities carried out for both outcomes of the project in 2022.

### I. GLOBAL PARTNERSHIP COMPONENT

#### Identification and negotiation with partners and key stakeholders

During the reporting period, UNIDO has held and continues to proceed negotiations and discussions with a variety of institutions and organizations. Three project concepts were presented, one respectively to the German Federal Ministry of Economic Cooperation and Development (BMZ), the German Federal Ministry of Education and Research (BMBF), and the European Union for green hydrogen projects and their industrial application in different countries.

#### Project Development

- To continue with operationalization of the Global Partnership. UNIDO developed a separate project titled "Global Partnership for Hydrogen in Industry Phase II". This phase will address the needs identified in Phase I (ongoing project) and operationalize partnership activities to accelerate the uptake of green hydrogen for industrial application in developing countries.

The BMZ has made a contribution of 750,000 EUR to the "Global Partnership for Hydrogen in industry Phase II" with the aim to ensure active coordination between UNIDO and GIZ (German Corporation for International Cooperation) to create synergies and complement ongoing initiatives. It will design a framework where UNIDO and members can jointly formulate projects

Additional contributions to the Global Partnership Phase II from the Government of Austria, Italy, Spain, Denmark and United Arab Emirates are currently under development and negotiation.

- UNIDO, World Bank, and IRENA are finalizing a global green hydrogen programme to be funded under the GEF-8 programme circle. UNIDO will lead the global programme component and invite other institutions to present national (child) projects. The programme seeks to provide assistance in enhancing technological readiness and institutional capacity, along with analysis of industrial clusters that have potential to become green hydrogen clusters.



### Partnership Agreements

- From 15 to 18 May 2022, UNIDO's Director General had a mission to Morocco where he met with representatives of the highest government level. At the occasion of this visit, the Director General signed a joint declaration on the establishment of a partnership to support UNIDO's Global Programme for Green Hydrogen in Industry with the Minister of Industry and Trade and the Minister of Energy Transition and Sustainable Development (fig. 1.1).
- On 8 November, the Director General of UNIDO and the Director General of the International Renewable Energy Agency (IRENA), signed a Joint Declaration on advancing sustainable energy through the fundamental role of green hydrogen. Both organizations declared efforts to advance a sustainable energy transition through green hydrogen in pursuit of access to energy, energy security and economic development of developing countries (fig. 1.2).
- Further Partnership agreements are being finalized with ISO, Hydrogen Council, Hydrogen Europe, and the Spanish Hydrogen Association.



### Engagement with Member States on green hydrogen

- UNIDO actively engaged with Member States and key partners to define and shape the Global Partnership for Hydrogen in Industry (Phase I). The CTP division identified the priorities and needs of developing countries (UNIDO Member States) through extensive consultations and dialogues. The outcomes of the Development Dialogues addressed the need for policy dialogue amongst Member States to exchange best practices and knowledge on green hydrogen application for industry, followed by the importance of developing projects through fund mobilisation.
- On 26 January, 2022, the CTP division organized an Information Session to present the objective and activities of the Global Partnership for Hydrogen in Industry to potential partners from private sector, research and innovation. The session aimed to engage and align with existing initiatives and to produce synergetic approaches in green hydrogen.
- Two sessions of Development Dialogues were organized for UNIDO Member States to engage on matters related to the Global Partnership and shape the partnership development in line with Member States needs and priorities. Both sessions welcomed the participation of 170 participants each.

The first session of the Development Dialogue took place on 1 April, 2022. During the session, UNIDO and partners shared best practices and informed about national and global green hydrogen initiatives in industry (fig. 1.3). Participants included, the Department of Science Innovation of South Africa, Research Institute for Solar Energy and New Energies (IRESEN) of Morocco, ENI of Italy, the International Hydrogen of China, and the World Energy Council.

The second session of the Development Dialogue followed on April, 2022. UNIDO presented key organizational initiatives on GH2 in cooperation with UNIDO Field Offices and the Investment and Technology Promotion Office (ITPO) in Bonn. The session also addressed the outcomes of the on-line survey distributed after the first dialogue. Member states stated the following services as key for the Global Partnership: Policy dialogue, joint project development, country-specific workshops for green hydrogen development and investment and funds mobilization.

- On 6 July 2022, an informative webinar with Member States on “Hydrogen in Industry: do colors or CO2 content matter?”, was organized. The webinar provided an introduction to the types of hydrogen based on colors, along with its classification made upon quantifying the CO2 content or carbon footprint of the hydrogen produced. The webinar presented insights through a panel discussion on hydrogen initiatives from government and industry representatives and respond to further questions during interactive discussions.
- Between August and October 2022, a series of regional dialogues were conducted to exchange best practices and experiences amongst Member States (fig. 1.4). Participants presented and discussed countries’ experiences in the development of national strategies and roadmaps, along with project developments in green hydrogen for industrial applications.

Figure 1. Photos of selected meetings / events



1.1 UNIDO and Morocco reinforce partnership to drive green industrial development



1.2 UNIDO and IRENA support a global energy transition through green hydrogen



1.3 The first session of the Member States Dialogue in April 2022



1.4 The GRULAC regional session in September 2022

## Engagement with partners and global forum activities

- On 18 May 2022, UNIDO participated in the European Hydrogen Energy Conference (EHEC) in Madrid and presented the Global Programme for Green Hydrogen in Industry. This is an event that serves as a platform for updates on hydrogen energy technologies. It aims to showcase advances in R&D projects and products.
- On 20 May 2022, UNIDO participated on GreenLab Summit 2022 which was organized in Skive, Denmark (fig. 2.1). The event aimed to address how to create green growth, rural development and a just green transition through industrial symbioses and energy innovation, including green hydrogen application and PTX. GreenLab is currently contributing to the drafting of the Technical Guidelines for UNIDO's model on Green Hydrogen Industrial Clusters.
- UNIDO organized a panel discussion at the ARC Cleantech Innovation Festival on 22 June, 2022 with partners; Future Cleantech Architects, UNFCCC and InnoEnergy. The discussion focused on 'Green Hydrogen Industrial Clusters – paving an inclusive industrial pathway' and aimed to define the role of hydrogen in an industrial environment by addressing key challenges in developing green hydrogen industrial clusters and identifying its enablers in policy, financing and technology. The panel invited the Department of Science and Innovation of South Africa, Suez Canal Economic Zone of Egypt, SAP and the German Hydrogen and Fuel Cell Association (DWV).
- Within the framework of the WTO Eight Global Review of Aid for Trade, UNIDO held a session on 'Advancing the Green Hydrogen Economy' with the German Federal Ministry for Economic Cooperation and Development (BMZ), on 29 July 2022. The first session included experts from BMZ, the Organization for Economic Cooperation and Development (OECD), the Namibia Investment Promotion and Development Board (NIPDB), and the Office Chérifien des Phosphates (OCP Group), whom discussed cost constraints brought by the procurement of green hydrogen and highlighting the need for cost scalability.
- UNIDO participated at the GCF Global Programming Conference and Private Investment Conference on 13-16 September and organized a side-event on 'Financial incentive schemes for accelerating the development of green hydrogen in developing countries and transition economies'. The event proceeded a roundtable discussion with the Development Bank of Southern Africa, Orascom Construction Group, Institute Research Energy Solar and Energy Nouvelles (IRESEN) and GIZ to address the financial challenges encountered in green hydrogen for developing countries.
- UNIDO participated at the 12th Arab-German Energy Forum was organized by the Arab-German Chamber of Commerce and Industry and took place on 11 and 12 October 2022 in Berlin. The forum aimed to promote and further advance the promising cooperation between German and Arab business partners in the energy sector, including green hydrogen. During the event, UNIDO presented the Global Programme, its perspectives on the development of green hydrogen in industry in the arab world and the COP 27 planned activities.
- UNIDO participated at the World Hydrogen Congress in Rotterdam on 13 October to deliver a panel discussion within the side event organized by the Women in Green Hydrogen on 'Green hydrogen globally- how can international collaboration shape the transition to hydrogen?'. The panel addressed how international partnerships and collaboration increase opportunities for the hydrogen sector and the development of woman talent.

- At 24 October, UNIDO participated at the European Hydrogen Week in Brussels, organized by the European Union and Hydrogen Europe. A panel discussion on ‘Hydrogen and new geopolitics of energy’ was made with UNIDO’s active participation as a panelist along side DG INTPA of the European Commission, United Nations ECE Group of Experts on Gas, African Hydrogen Partnership and Motor Oil (fig. 2.2).
- Between September and December 2022, a joint webinar series was conducted with the Women in Green Hydrogen (WiGH) addressing topics on “Green ammonia fueling industrial development” at 13 September, “Decarbonizing the Global Steel Industry with Green Hydrogen” at 9 October and “Financing for Industry” on 8 December. The series of events discussed adequate approaches in green hydrogen applications in industry and its enablers within policy, financing and technology. The sessions highlight representing female leaders in industries and bring greater visibility to best practices and experiences from developing countries and transition economies.
- Within the African Union Summit on Industrialization and Economic Diversification, UNIDO organized a virtual roundtable side-event, titled “Green hydrogen value chains: driving innovative and low-carbon industrial development and financing in Africa” on 24 November. The event welcomed panelists represented from the African Development Bank, Suez Canal Economic Zone of Egypt, Dii Desert Energy and OCP Group of Morocco.
- On 24 November, UNIDO presented the Global Programme for Green Hydrogen in Industry at an internal event organized by the Asian Development Bank as part of “Insight Thursday series: Accelerating green hydrogen in developing countries and transitioning economies”. The session provided an overview of green hydrogen in developing countries with a focus on challenges, enablers and initiatives that were presented at the COP27.
- Further overview of events is provided in **Annex 3**.

Figure 2. Photos of selected meetings / events



2.1 UNIDO presents its Global Programme at the GreenLab Summit 2022



2.2 UNIDO participates at the European Hydrogen Week in Brussels in October 2022

### National workshops on green hydrogen

- Following the Director General's mission, a Workshop on 'Green Hydrogen application in Moroccan Industry and Clusters' took place in Rabat, Morocco on 6 July 2022 (fig. 3.1). It was organized by UNIDO in cooperation with the Ministry of Industry of Morocco, and provided strategic recommendations on the mapping of green hydrogen industrial clusters in line with UNIDO's approach. Such clusters aim to achieve sustainable economic and environmental gains and positive social impact for the local communities. As a concrete example, the GreenLab green hydrogen industrial park was introduced.
- UNIDO in collaboration with Spanish Hydrogen Association (AeH2) and Costa Rican Hydrogen Association, and INA (Instituto Nacional de Aprendizaje) delivered a symposium on hydrogen economy and a workshop on green hydrogen from 12-15 December 2022 in San Jose, Costa Rica (fig. 3.2). The symposium welcomed 70 participants represented from public and private sectors and financing institutions to build capacities for a sustainable green hydrogen economy. A workshop on green hydrogen economy and fuel cells was held by bringing together more than 50 teachers and trainers from the country to build capacity on the use of hydrogen fuel cells, primarily for transportation purposes. UNIDO will cooperate with the Government of Costa Rica to support the implementation of the national strategy for green hydrogen.

### Publication of policy papers

- Four articles on Green Hydrogen were published on the Industrial Analytics Platform (IAP):
  - » [Green Hydrogen: Fuelling industrial development for a clean and sustainable future](#)
  - » [Industrial and innovation policy can speed up the Green Hydrogen transition](#) (written in collaboration with IRENA)
  - » [Achieving a green hydrogen transition built on equity and consensus](#) addressed strategies and challenges for a just green hydrogen transition with implications for energy, water and food supply security, and potential impacts on land use, ecosystems and biodiversity.
  - » [Green Hydrogen – The energy opportunity for decarbonization and developing countries](#) by the Director General of UNIDO, addressing UNIDO's vision and role for shaping the green hydrogen transition.

Figure 3. Photos of selected meetings / events



3.1 UNIDO co-organizes a workshop on GH2 application in Moroccan industry & clusters in July 2022



3.2 UNIDO co-organizes a Costa-Rican symposium on hydrogen economy in December 2022



## COP27 UNIDO engagement on green hydrogen

### High-level events with the COP27 Presidency

The Sharm el-Sheikh Climate Change Conference (COP27) took place from 6 to 18 November, 2022. Through prolonged and active negotiations with the COP27 Presidency, UNIDO participated in a number of high-level panels, roundtables and events on green hydrogen:

- Director General of UNIDO was present with Heads of State, Government and International Organizations to address on the topic, “Investment in the Future of Energy: Green Hydrogen” (8 November). The high-level roundtable was co-chaired by Abdel Fattah El-Sisi, President of Arab Republic of Egypt, and Olaf Scholz, Chancellor of Germany.
- During Roundtable discussions, President El-Sisi, and Alexander De Croo, Prime Minister of Belgium launched the ‘Global Renewable Hydrogen Forum’. The Forum will be a multi-stakeholder public-private platform to facilitate the use of renewable hydrogen to foster the decarbonization of industries and accelerate a Just transition by bridging developing countries and developed countries (fig. 4.1).
- In line with its mandate, UNIDO aims to support the implementation of the multi-stakeholder platform to facilitate large-scale deployments of renewable hydrogen. Members of the Forum will include partners such as IRENA, Hydrogen Council and the Green Climate Fund, potential renewable hydrogen producing and/or consuming countries, private sector investors and global industry associations, international financial institutions and other international agencies.
- UNIDO and the COP27 Presidency hosted a special evening event ‘Future Energy – Green Hydrogen’ on 9 November to highlight the potential of green hydrogen (fig. 4.2). The evening event brought together key partners from ORASCOM Construction group, OCI, OCP, the Sovereign Fund of Egypt and the Spanish Hydrogen Association; to bring together representatives and experts from developing and industrialized countries to discuss future energy concepts.
- In support of the Ministry of Electricity and Renewable Energy of Egypt, UNIDO has participated in the Presidency Event on Energy Day ‘Toward a Green Hydrogen Economy- Scaling next-generation energy systems in the developing world’ on 15 November (fig. 5.1). The session addressed the potential of developing countries, particularly within Africa, to become green hydrogen producers and explore opportunities for application of green hydrogen within local industries.

Figure 4. Photos of selected meetings / events



4.1 UNIDO participates at the European Hydrogen Week in Brussels in October 2022



4.2 UNIDO hosts a special evening event “Future Energy - Green Hydrogen” at COP27

The panel discussion welcomed the Minister of Energy and Mineral Resources from the Kingdom of Jordan the Minister for Climate Action, Environment, Energy, Mobility, Innovation and Technology of Austria and high-level panelists from the European Bank of Reconstruction and Development, European Investment Bank, KfW and OCI Methanol.

**Cooperation with partners on green hydrogen**

- UNIDO organized a side event with UNICEF on “Green Hydrogen for People and Planet: Amplifying voice of youth to drive inclusive energy transition in the African Continent”. The event convened stakeholders from UNIDO, UNICEF, Department of Science and Innovation of South Africa, ACWA power and GreenLab to discuss the importance of integrating environmental and social issues in the development of green hydrogen projects. The session addressed the importance of job creation and facilitating education to develop the skills and competences needed for children and young people to contribute to a sustainable energy future.
- UNIDO participated in events organized by Climate Action; IRESEN and the Ministry of Energy Transition and Sustainable Development of Morocco; Breakthrough Agenda; World Climate Foundation, SASOL and Future Cleantech Architects. (For more information and overview of events see Annex 4)

**Figure 5. Photos of selected meetings / events**



5.1 UNIDO participates in the Presidency Event “Toward a Green Hydrogen Economy”



5.2 UNIDO organizes a side event with UNICEF on how to drive an inclusive energy transition

## II. GLOBAL TECHNICAL COOPERATION COMPONENT

### Organization structure of the Technical Cooperation Programme

- The Technical Cooperation Programme designs and implements projects, focusing on the decarbonization of hard-to-abate sectors through increased deployment of renewable energy and infrastructures for green hydrogen production, storage and transport. This will be achieved through the following approach:
  - » Implementing country-specific demonstration projects in line with industrial development policies of the respective countries. UNIDO's green hydrogen cluster model will serve as a basis for the application of green hydrogen in industry clusters to accelerate hydrogen production and demand.
  - » Developing green hydrogen industrial roadmaps and strategies to be replicated amongst developing countries and transition economies for the application of green hydrogen and decarbonization of industrial clusters, zones, parks and hydrogen valleys.

### Development of Technical Cooperation Portfolio

- Within the framework of the Technical Cooperation, the team supports specific country project interventions, with a special focus on Green Hydrogen clusters. A number of countries requested UNIDO to provide assistance such as Algeria, Colombia, Egypt, Morocco, Madagascar, Nigeria, Nicaragua, Peru, Serbia, South Africa, Uruguay, Costa Rica, Vietnam, Azerbaijan and the Philippines.
- In September 2022, a new technical cooperation was initiated in Egypt funded by the Ministry of Foreign Affairs and International Cooperation of Italy. The intervention aims to assess the potential for a low carbon hydrogen market in Egypt. The activities will strengthen the country's readiness for the development of a low carbon hydrogen market and promote its usage for industry decarbonisation. The intervention will contribute to strengthen public and private institutions with knowledge acquired on Egypt's low carbon hydrogen production potential, current and future demand scenarios, development of business models and creation of value chains.
- The team submitted GCF Readiness proposals on green hydrogen for Morocco and South Africa:
  - » Enhancing enabling environment to support the decarbonisation of Moroccan steel production through the application of green hydrogen.
  - » Enhancing the institutional capacity of South Africa to coordinate green hydrogen activities of the Hydrogen Society Roadmap.



- As a key element, UNIDO developed a three-phase model for “green hydrogen industrial clusters”. This model aims to accelerate the application of locally produced green hydrogen in industrial zones, clusters, and parks. Its aim is to serve as a replicable model through which countries can pilot green hydrogen technologies to achieve their climate and industrial goals as well as to generate economic and social opportunities. This requires significant amounts of green hydrogen and coordination among the stakeholders within the clusters.

The model provides guidance for governments and industries in the preparation, implementation, and up-scaling of green hydrogen industrial clusters. UNIDO will assist in early-stage development and deployment of green hydrogen industrial clusters.

### **Technical guidelines for UNIDO’s Green Hydrogen Industrial Cluster Model**

- Technical guidelines on Green Hydrogen Industrial Clusters. The guidelines will present the characteristics of the green hydrogen industrial clusters as well as the steps necessary to develop one. The guidelines are under development with partners represented from the German Energy Agency (DENA), HEAVENN, FC Architects and GreenLab. A peer review workshop with experts will be conducted to revise and modify the approach.

## **III. FOCUS FOR 2023**

### **Technical Cooperation**

#### Country specific interventions

- UNIDO will initiate country specific interventions in a minimum of 5 countries.
- In cooperation with the World Bank and IRENA, the GEF Global Programme for Green Hydrogen in Industry will be launched in support of developing countries and transition economies.

### **Global Partnership for Green Hydrogen in Industry**

#### Establishing partnerships and Partner engagement

- UNIDO will proceed its first global partnership meeting with Member States to develop a work-plan on the partnership activities.
- Building on the launching made at the COP27, UNIDO will support the Government of Egypt and Belgium on the Global Renewable Hydrogen Forum with Partners represented from IRENA, Hydrogen Council, and GCF.
- Innovative finance models will be developed in partnership with DFIs, the Green Climate Fund and private sectors actors, and UNIDO will further collaborate with the Breakthrough Agenda to develop workshops for financing green hydrogen.
- UNIDO aims to cooperate with UNICEF in support of training, skills development by focusing on youth capacity building for green hydrogen.

### Developing knowledge products

- Study on green hydrogen infrastructure for developing countries and the development of tool-kit for green hydrogen infrastructure development: This study will include an analysis of the minimum infrastructure needed for the production and application of green hydrogen in industry. It will also propose guidelines to assess the availability of this infrastructure in developing countries and present the opportunities for its development.
- Guidelines for developing and monitoring green hydrogen industrial policies: In collaboration with international agencies UNIDO will design the guidelines with best practices for the monitoring and development of hydrogen industrial policies. The guidelines will be built on IRENA's and UNIDO's work on industrial policy development.
- Workshops for developing green hydrogen industrial cluster models: In collaboration with international partners, UNIDO will present and promote the guidelines with the different elements to be taken into account for the application of green hydrogen in an industrial cluster. UNIDO will design training and promotional materials through a series of workshops on the guidelines.

### Supporting green hydrogen standards

- UNIDO will collaborate with the International Organization for Standardization (ISO) technical Committee 197 "Hydrogen technologies" to increase knowledge and insight in public-private sectors of developing countries and transition economies. The standard development process will inform developing countries on how to better participate in standard setting and address challenges on quality infrastructure needed to assess conformity to hydrogen standards.



## ANNEX 1. CRITERIA FOR COUNTRY PRIORITIZATION

Criteria 1	<p>Presence of industrial energy projects in industries/sectors:</p> <ul style="list-style-type: none"> <li>• Steel</li> <li>• Refineries</li> <li>• Chemical (Ammonia/Methanol)</li> <li>• Cement</li> </ul>
Criteria 2	<p>Green Hydrogen production:</p> <ul style="list-style-type: none"> <li>• Presence of at least MW size renewables power plants</li> <li>• Availability of renewable energy surplus</li> </ul>
Criteria 3	<p>Presence of projects on natural gas, biogas, and biofuels; countries with availability of gas infrastructure</p>
Criteria 4	<p>Off-grid energy needs:</p> <ul style="list-style-type: none"> <li>• Mini grids in rural areas and islands where long-term/seasonal storage is needed</li> <li>• Local grid stability/balancing</li> </ul>
Criteria 5	<p>Presence of electric mobility projects where FCEVs can be a complement/alternative to EVs (heavy duty and/or material handling vehicles connected to industrial areas/ports)</p>
Criteria 6	<p>Presence of projects located in port areas and/or involving maritime applications</p>
Criteria 7	<p>Presence of industrial country roadmaps, projects or programmes, policies on green hydrogen (ongoing or to be developed)</p>

## ANNEX 2. UNIDO GH2 INDUSTRIAL CLUSTER MODEL

UNIDO is currently developing an industrial cluster model that can be replicated amongst developing countries to decarbonize industrial clusters and parks. Its aim is to serve as a model through which countries can achieve their climate and industrial goals, generate economic and social opportunities, and pilot innovative low-carbon technologies.

This work will have emphasis on industrial clusters in developing countries and transition economies. Industrial clusters with a presence of hard to abate industries (e.g. refining, chemicals, iron and steel, and cement) and with potential for value-chain (i.e. ecosystem-wide) decarbonization would be prioritized. This approach seeks to use existing synergies and shared green hydrogen resources to deliver improved environmental, economic, and social performance in the decarbonization of industry.

UNIDO envisions a tiered model based on extensive international experience, and on case studies of emerging hydrogen cluster models. This model will be divided into **three phases**:

<b>Phase 1:</b> Preparation of green hydrogen clusters	Awareness raising and capacity building Stakeholder engagement Feasibility studies, including sector coupling potential Finance and investment planning Addressing technical and policy gaps
<b>Phase 2:</b> Green hydrogen application	Production of green hydrogen Adaptation of industrial process for the application of GH2 Utilization of green hydrogen in industrial processes Sector coupling Innovation hubs Monitoring and continuous improvement
<b>Phase 3:</b> Green hydrogen upscaling	Green hydrogen project/programme upscaling Global green hydrogen network development

Through subsequent capacity building and coordinated technical assistance activities, industrial clusters will be brought to a level of readiness wherein pilot green hydrogen projects can be developed. Throughout the intervention period, monitoring and evaluation exercises will be carried out both to track progress and update the model based on technology and cost developments. The final model can then be used to scale green hydrogen industrial cluster development, both locally and abroad by leveraging UNIDO's networks.



## ANNEX 3. CTP WEBINARS AND TRAINING EVENTS OVERVIEW

The number of events organized and participants that have participated in respective sessions are provided within the table below.

In total participants in webinars and training events.

<b>Events organized</b>	<b>14</b>
<b>Participants</b>	
Development Dialogue	
First Session	170
Development Dialogue	
Second Session	170
Informative webinars	120
Regional Dialogues	
Asia-Pacific	50
African Group	40
GRULAC	60
Eastern European Group	30
Western European Group	20
WTO	30
GCF	30
Women in Green Hydrogen joint webinars	
Ammonia	70
Steel	130
Financing	70
AU Industrialization Summit	30
ADB	101
Forum for Globalization and Industrialization	50
<b>Overall participants</b>	<b>1171</b>
<b>Events attended</b>	<b>7</b>
<b>Papers published</b>	<b>4</b>
<b>Workshops organized (capacity building)</b>	<b>2</b>



## ANNEX 4. UNIDO COP27 ENGAGEMENTS

An overview of the COP27 events which featured CTP participation or were initiated by CTP are provided, along with bilateral meetings that took place.

COP27 Sharm El-Sheikh Implementation Summit	07 Nov.	(DG participation) Opening of the World Leaders Summit	(Bilateral Meeting) Hydrogen Council	(Bilateral Meeting) European Investment Bank		
	08 Nov.	(DG participation) High-Level Roundtable Investment in future of Energy: Green Hydrogen  Launch of the Global Renewable Hydrogen Council Organiser: COP27 Presidency	(Bilateral Meeting) World Climate Foundation	(Signing of Joint Declaration)  International Renewable Energy Agency (IRENA)		
Finance	09 Nov.	(Event hosting) Special Evening Event Future Energy – Green Hydrogen	(Bilateral Meeting) International Organization for Standardization (ISO)	(Bilateral Meeting) UAE/COP28		
Resilience Science & Youth	10 Nov.	(Invited panelist) Sustainable Innovation Forum Organiser: Climate Action	(Meeting) Prof. Jeffrey Sachs, Center for Sustainable Development, Colombia University	(Bilateral Meeting) Singapore	(Bilateral Meeting) German Federal Ministry for Economic Cooperation and Development (BMZ)	(Closed door meeting) Breakthrough Agenda Organisers: UNFCCC, Breakthrough Agenda
Decarbonization	11 Nov.	(Invited panelist) Scaling up Power-to-x technologies Organiser: IRESEN	(Invited panelist) Global Renewable Hydrogen Forum: From MoUs to Investing in Projects Organiser: COP27 Presidency	(Bilateral Meeting) Danish Climate Ambassador and Envoy	(Invited panelist) Delivering the Hydrogen Breakthrough – Creating and mobilizing finance Organiser: Breakthrough Agenda	
Adaptation & Agriculture	12 Nov.	(Bilateral Meeting) Global Environmental Facility	(Bilateral Meeting) World Bank ESMAF	(Interview) Anne – Media correspondent	(Bilateral Meeting) Copenhagen Infrastructure Partners	
Gender	14 Nov.	(Invited panelist) World Climate Summit – Heavy industry and decarbonization Organiser: World Climate Foundation	(Invited panelist) Technical Innovation to drive green hydrogen and the derivatives roadmap Organiser: SASOL			
Energy	15 Nov.	(Invited moderator) Presidency session: Toward a green hydrogen economy: scaling next-generation energy systems in the developing world Organiser: COP27 Presidency	(Side event) Green Hydrogen for People and Planet: Amplifying the voice of youth to drive inclusive energy transition in the African Continent Organisers: UNIDO, UNICEF	(Invited panelist & Interview) Accelerating Innovation in Green Hydrogen - The Movement Organiser: Future Cleantech Architects		
Solutions	17 Nov.	(Invited panelist) Challenges and opportunity in the energy transition and direction of global cooperation				





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