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MED•GEM
MEDITERRANEAN GREEN ELECTRONS AND MOLECULES
NETWORK

JORDAN
SKILLS GAP ANALYSIS

List of Tables & Figures

ABREVIATIONS

BESS Battery Energy Storage System
CBAM Carbon Border Adjustment Mechanism
CC Country Correspondent
CSP Concentrated Solar Power
EoI Expression of Interest
EU European Union
FA Framework Agreement
GEM Green Electrons and Molecules
GH2 Green Hydrogen
GHGs Greenhouse gases
GJU German Jordanian University
GW Gigawatt
H2 Hydrogen
IAB Industry Advisory Board
JPRC Jordan Petroleum Refinery Company
kW Kilowatt
km Kilometer
LCOH Levelized Cost of Hydrogen
LV Low voltage
LVC Local Value Creation
MCM Million cubic meters
MED-GEM Mediterranean Green Electrons and Molecules
MEMR Ministry of Energy and Mineral Resources
MMT Million metric tons
MoU Memorandum of Understanding
Mt Million tons
MW Megawatt
MOOC Massive Online Open Courses
NFP National Focal Point
NH3 Ammonia
OAAB Online Academia Advisory Board
O&M Operation and Maintenance
PEM Proton Exchange Membrane or Polymer-electrolyte membrane
PtX Power-to-X
PV Photovoltaic
R&D Research and Development
RE Renewable Energy
RWGSM Regional Working Group on Standardization and Metrology
ToR Terms of Refernce
ToT Training of Trainers
TVET Technical and Vocational Education and Training
WG Working Groups

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EXECUTIVE SUMMARY

The Green Hydrogen **(GH2) Skills Needs Assessment and Gap Analysis** report for Jordan highlights the **urgent and long-term workforce needs** critical for developing Jordan's **GH2 sector**. By addressing **skill gaps** and building competency within the Power-to-X (PtX) value chain, this report offers a **roadmap** to identify the needed **hydrogen-related upskilling and reskilling** of the country's workforce to support the development of a skilled workforce in the PtX economy and at a later stage for designing and developing an **effective and dedicated skills strategy**.

Short-term actions recommended to equip Jordan's workforce with GH2-related skills

- **Engage key stakeholders:**
  - Conduct **structured interviews** with **project developers**, **local manufacturers**, **government ministries**, **and national agencies** to identify specific training needs.
  - Validate Jordan's **current skills landscape** and define **occupational profiles** to be created.
  - Identify specific **GH2 project requirements** to gather essential data for **upskilling and reskilling** initiatives.

  The MED-GEM Network will support this activity by guiding interview processes between the government and industry, paving the way for partnerships with PtX project developers and training providers.

- **Develop tailored short-term courses:**
  - Implement identified **pre-requisite technical assistance needed** such as **feasibility studies** and **assessment reports** to identify needed skills and overcome barriers to develop training programs.
  - Design training programs that prioritize **essential skills**, **safety standards**, **and practical experience**.
  - Target audiences include **decision-makers**, **technical advisors**, **engineers**, **technicians**, and **specialists**.
  - Offer **theoretical and hands-on training** in both **face-to-face and online formats**, complemented by **on-the-job opportunities**.

- **Define and establish training standards and certifications:**
  - Address gaps in **GH2 training standards** and **safety protocols** to ensure uniformity in qualifications and proficiency.
  - Provide **standardized guidance** for training providers, enabling them to define expected competencies for safe hydrogen work.

  Jordan can benefit from the MED-GEM Network's support in this activity by collaborating along with the remaining partner countries with the "Regional Working Group on Standardization and Metrology (RWGSM) for GH2 Development" proposed by the network.

- **Build financial literacy to attract investments:**
  - Conduct **capacity-building programs** on **financial literacy and resource mobilization** for ministries, government agencies, financial institutions, project developers, and private-sector stakeholders.
  - Address **financial challenges** and **investment barriers** by establishing a framework for funding **green energy projects**.

  Jordan can benefit from the MED-GEM Network's support in this activity by collaborating along with the remaining partner countries and participating in regional consultation workshops to help the network design and implement training seminars to be delivered to different stakeholders.

- **Build capacities related to EU regulations and standards:**
    - Provide training on the **GH2 certification process** and the **Carbon Border Adjustment Mechanism (CBAM)** for stakeholders involved in the production and export of PtX products, such as **H2, ammonia, and green steel**.

The MED-GEM Network is already supporting these activities and will continue to do so by implementing certification pilots and sharing lessons learnt on the EU's voluntary certification schemes and conducting trainings on CBAM.

- **Develop specialized training centers:**
    - Partner with **project developers, industries, and training providers** to create a **Hydrogen Training Center** and a **Centre of Excellence**.
    - Equip these facilities with **cutting-edge training equipment** to provide **hands-on experience** and drive **research, development, and innovation** in the GH2 sector.
    - Foster **strategic partnerships** with **international organizations, experts, and training providers** to bring **global best practices** to Jordan, enhancing local capacities and aligning with **industry standards**.
    - Compile and launch **modular training programs** covering critical skills, enabling educational institutions to integrate these programs into their curricula.
    - Prioritize **Train-the-Trainer programs** to build **local capacity**, reducing reliance on external providers.

- **Develop a digital training platform:**
    - Develop a **centralized platform** to host hydrogen-related training resources, similar to Massive Online Open Courses (**MOOCs**).
    - Include **multilingual content** (e.g., English, French) to increase accessibility and collaboration among **Southern Mediterranean countries**.
    - Offer online courses from **renowned global partners** to support Jordan's workforce in meeting the demands of an expanding GH2 market.

This activity would receive the support of the MED-GEM Network as it plans to create a MOOC platform which would host hydrogen-related content compiled by partners and develop training programmes on the platform. Jordan's participation as well as the involvement of the remaining partner countries would contribute to the platform's content richness and impact.

- **Implement awareness programs:**
    - Develop **interest of younger generations** for the hydrogen sector by **teaching schoolteachers** some ground **knowledge** about **hydrogen** encouraging them to integrate **awareness raising** activities **in class**.
    - Organize **GH2 Hackathons** among **university students** within Jordan, allowing them to address a local challenge related to the PtX value chain in the country, serving as a great entry point to **raise awareness** on the GEM industry amongst university students and professors.

The MED-GEM Network can support in this last activity as it has already organized so far two successful GH2 Hackathons in Morocco and Lebanon.

Mid to long term actions recommended to institutionalize and sustain skill-building efforts

- **Strengthen collaboration with educational institutions:**
  - Establish formal recognition of **GH2 training certificates and diplomas** to ensure consistent quality in key areas, such as **hydrogen safety**.
  - Build partnerships with **local universities, vocational training centers, and industry associations** to expand training programs and integrate **practical experience** into curricula.
  - Align **academic offerings** with the needs of the growing GH2 market.
- **Conduct capacity assessments:**
  - Perform a detailed evaluation of **higher education and TVET institutes** to identify key qualifications and unique capabilities required for the GH2 value chain.
  - Analyze existing courses to identify **gaps** and opportunities for **curriculum updates** that meet **industry demand**.
- **Develop advanced educational offerings:**
  - Facilitate the creation of specialized **GH2-related degree programs, postgraduate courses**, and **enhanced TVET programs** to stay aligned with advancements in **hydrogen technologies**.
- **Foster a culture of ongoing learning:**
  - Introduce **hydrogen modules** within **continuous education frameworks** to keep professionals updated on evolving technologies and industry requirements.
  - Strengthen partnerships between **educational institutions and industry stakeholders** to facilitate ongoing learning and ensure the workforce remains **adaptable** and **knowledgeable** about the latest GH2 trends and requirements.
- **Promote research, development, and innovation:**
  - Focus on **entrepreneurship and innovation support** through dedicated funding opportunities and incubation programs.
  - Drive significant progress in **PtX technology** to create a vibrant GH2 economy in Jordan.

In conclusion, the **GH2 Skills Needs Assessment and Gap Analysis report** sets forth a **comprehensive, strategic approach** to building a **skilled workforce** for Jordan's emerging GH2 industry. Through **targeted short-term actions** and **sustainable, long-term capacity-building measures**, Jordan can foster a robust talent pipeline, **address skill gaps**, and enhance collaboration among government, academia, and industry.

INTRODUCTION

Background and Context

The MED-GEM Project, supporting Green Electrons and Molecules' (GEM) development in the Southern Mediterranean Neighbourhood, is an initiative funded by the European Union (DG NEAR) that aims to create and operate a sustainable Network in the Southern Neighbourhood region. By convening dialogue and collaborative activities between key energy stakeholders, MED-GEM activities facilitate and promote the growth of the GEM industry, in particular Renewable Energy (RE) and Green Hydrogen (GH2), at national and regional levels. The Network also aims at increasing public awareness on the imperative need for an accelerated clean energy transition. The MED-GEM network is structured around four thematic components: (1) Policy and Regulations, (2) Industry, (3) Infrastructure, and (4) Finance.

Among the activities that MED-GEM has been mandated to initiate is the creation of an Industry Advisory Board (IAB). The MED-GEM's IAB is a selected group of leading industrial stakeholders from the GEM sectors that voluntarily provides professional advice to the policy makers according to industry requirements and interests, policies, and market developments. The recommendation of the IAB members from the partner countries was ensured through the National Focal Points (NFPs) after consultation with the existing local Industry Associations, Alliances, Clusters, or Industry organizations active in their respective countries. These members will contribute to gathering specific insights on industrial, market, regulatory, financial and innovation trends and provide recommendations for activities along the GEM value chain, aiming for large-scale and speedy deployment of GEM technologies within the EU Southern Neighborhood area. In the aim of enhancing knowledge exchange and sharing of best practices, the IAB also includes members from the EU Industry associations and alliances such as WindEurope, SolarPower Europe, and Hydrogen Europe to interact and cooperate with IAB members from partner countries where appropriate.

Accordingly, the first IAB workshop was organized by the European Commission/DG NEAR through the MED-GEM Network on 20 December 2023 in Brussels. The workshop gathered EC officials, EU stakeholders, designated NFPs from the Southern Mediterranean Countries, and industry/infrastructure key players members of the IAB. The aim of the meeting was to explore what needs to be done to realize both GH2 and RE's potential, identify the challenges and recommend policy measures to governments to address them. In addition to fostering cooperation between the EU and the Southern Mediterranean Countries on green electricity and renewable hydrogen, the IAB's purpose is to inspire action through the exchange of relevant best practices and lessons learned as well as opportunities for win-win partnerships.

MED-GEM's inaugural IAB meeting provided crucial insights into priority areas and collaborative actions for the sustainable growth of the GEM industry across partner countries. The workshop participants identified the following key themes demanding attention: Infrastructure, Financing, GH2 Certification, Human capital (Jobs, skills, and capacity building), Local value creation, Policies, Hydrogen zones/valleys, Business models, Export potential, and Local use potential. Furthermore, the IAB workshop participants selected the following four topics as high priority topics that need to be addressed: (1) Local value creation, (2) Certification, (3) Jobs, skills, and capacity building, (4) Infrastructure. A tour de table was conducted for each of the four selected topics where participants from all partner countries and EU stakeholders shared and discussed the existing local capabilities in partner countries, challenges faced, opportunities to build on, clarifications needed, and actions to be taken, as well as suggestions and recommendations.

In summary, the 1st IAB meeting laid a foundation for collaborative efforts, addressing key challenges and leveraging opportunities for sustainable growth of the GEM industry across partner countries where it was agreed that the IAB will reconvene every 6 months, supplemented by Working Groups (WGs). The MED-GEM team supported the creation of three WGs: (1) Infrastructure, (2) Local value creation, (3) Jobs, skills, and capacity building, and drafted a ToR for each WG based on the outcomes collected from the tour de table conducted. These ToRs were shared with IAB participants who were asked if they were interested in joining these WGs. These WGs constituted smaller groups compared to the IAB having their own rhythm where they met and will continue to meet several times in between the IAB meetings and share interim results.

The main objectives and deliverables of these WGs is to:

1. Gather specific data in the partner countries on the current status, gaps, needs, challenges, opportunities, and future perspectives related to infrastructure, local value creation, jobs, skills, and capacity building across the whole RE and GH2 value chain. This was facilitated by preparing three **baseline surveys**, one for each WG topic, that were shared with the partner countries who collected the required information by **April 2024**.

2. Consolidate the information collected from the baseline surveys and prepare an **interim report (compilation of country fiches)** with a first layer of analysis of the situation country by country with first key findings along with a SWOT analysis and preliminary recommendations that were presented during the 2nd IAB meeting held in Brussels on 11 June 2024 organized by the MED-GEM Network.

3. Conduct an **in-depth needs assessment and gap analysis** on a country level based on the baseline assessment done, the ongoing and upcoming planned activities, and international best practices from literature review, to put forward a thorough analysis of the situation on a local and regional level and come up with actionable recommendations compiled in a **final report**. Outcomes of this report are to be presented during the next IAB meeting to be held in Istanbul on **17 December 2024** where the potential collaboration and technical assistance to partner countries will be determined. This is in addition to potential complementing collaborations between partner countries and potential partnerships between members from partner countries and EU stakeholders.

Acknowledgements and Contributions

We would like to express our deepest gratitude to MED-GEM National Focal Points (NFPs), Country Correspondents (CCs), and IAB Working Group (WG) members from WG co-chairs and leaders to survey contributors who supervised, followed-up, and filled in all the information required for the baseline surveys. This enabled the MED-GEM team to prepare the interim report (compilation of country fiches) in June of 2024, providing an overview of the GEM Sector at the level of skills, infrastructure, and local value creation in the Southern Mediterranean Countries. Thanks to this first layer of analysis led with great collective efforts in each country, the MED-GEM team was able to conduct an in-depth needs assessment and gap analysis on a country level based on the baseline assessment done to come up with actionable recommendations compiled in this final report.

Our gratitude is also extended to all our international partners (IRENA, UfM, RCREEE, UNIDO, Dii, GIZ PtX Hub) who actively participated in presenting relevant information by (1) sharing tips and insights with all WG participants that could help them fill in the surveys and (2) organizing brainstorming sessions and workshops with the MED-GEM team to share assessment methodologies and recommendations related to the thematic topics.

This is in addition to the diverse stakeholders interviewed in the different partner countries such as developers, local manufacturers, ministries and national agencies, etc.

METHODOLOGICAL APPROACH FOR THE SKILLS NEEDS ASSESSEMENT AND GAP ANALYSIS

This methodology is designed to evaluate skill requirements, identify gaps, and provide actionable recommendations for partner countries in the upcoming two years. The focus is primarily on short-term capacity-building and technical support activities that the MED-GEM Network can potentially implement by the end of 2026, complemented by broader recommendations for the mid to long term. The emphasis on short-term solutions allows for the delivery of immediate, actionable recommendations tailored to each partner country. These recommendations aim to meet the current demand for hydrogen-related upskilling and reskilling, rather than suggesting long-term measures that may become outdated as market conditions and needs rapidly evolve. This approach also considers the assignment's limited timeframe and resources.

A key aspect of this methodology is the collaboration between the MED-GEM Network and international partners, particularly UNIDO. Coordination ensures synergy and avoids duplication of efforts in skills needs assessments. UNIDO's methodology includes preparing a detailed report with strategic recommendations and a roadmap that outlines the training programs and policy initiatives required to build a future-ready workforce for the hydrogen sector. This roadmap serves as a guide for stakeholders to implement changes, ensuring the long-term sustainability and growth of the hydrogen industry.

Methodology

1. **Literature review and workshop participation**: Conduct a comprehensive review of existing literature, including the European Hydrogen Skills Strategy, Identification of Skills Needed for the Hydrogen Economy, Skills Needs and Gap Analysis in Namibia's PtX Sector, Green Skills for Hydrogen as well as participate in workshops such as UNIDO's H2 skills development expert group meeting to discuss their skills assessment methodology.

2. **Data collection from baseline surveys and country fiches**: Utilize data gathered from the baseline surveys and compiled in the country fiches.

3. **Country baseline and readiness assessment**: Evaluate countries based on their energy status and GH2 readiness, considering factors like the existence of a GH2 strategy or roadmap, GH2 projects that have reached financial closure, and significant memoranda of understanding (MoUs) and expressions of interest (EoIs). This in addition to the country's current Hydrogen consumption and it's potential for local use and export, it's current landscape for the local manufacturing of RE and GH2 components, as well as an overview of the existing jobs and skills in the RE and GH2 sectors.

4. **Needs assessment and gap analysis**: Adopt a targeted and practical approach to assess needs and analyze gaps, tailored differently for each country based on its energy status / hydrogen readiness and future perspective / planned activities. This targeted approach includes prioritizing areas of immediate need after a general overview of the needs has been created.

5. **Stakeholder mapping**: Identify key stakeholders, including ministries, national agencies, project developers, and local manufacturers, with a focus on those involved in H2-related activities.

6. **Formulation of actionable recommendations**: Develop actionable short-term recommendations for each country, along with more general mid to long term suggestions. This targeted approach includes prioritizing areas after creating a general overview of the needs.

7. **Stakeholder interviews**: This first output on occupational profiles and skills needs for the hydrogen sector will be **complemented by interviews at a later stage**, targeting stakeholders, with a more detailed analysis to enable the development of a dedicated Skills Strategy.

For partner countries in the early stages of hydrogen development, which lack a GH2 strategy or active projects, the focus is on foundational development of a GH2 economy, including infrastructure. This involves mapping the relevant stakeholders such as ministries and national agencies for them to identify the knowledge and expertise they require. In addition to identifying the pre-requisite technical support essential to help decision-makers and advisors better understand the skills they need to be trained in and overcome the barriers to facilitate the development of training programs and certifications.

In the more advanced partner countries, which have established GH2 strategies and projects that have reached financial maturity, the focus shifts more towards project development (design and planning), implementation, and operation and maintenance (O&M), alongside fostering local value creation (LVC) and local manufacturing. These countries, while further along in their hydrogen journeys, still require significant skills development across the GH2 value chain. For the foundational development phase, the approach mirrors that of earlier-stage countries, i.e., identifying the relevant stakeholders, pre-requisite technical assistance needed, and essential skills. While for the project development, implementation, and O&M phases, the focus will be on mapping project developers, GH2 projects, and the scope of these projects (activities across the GH2 value chain and end use applications) to identify the hydrogen-related occupational profiles that need to be created, as well as the required skills, knowledge, and expertise. This also involves interviews with the project developers to further understand the industry's current and near future needs in terms of workforce profiles and skill sets.

Local value creation is another priority for these countries. By specifying the components for renewable energy and hydrogen technologies that are manufactured locally or are planned to be manufactured (either new or increased production capacity), occupational profiles in manufacturing will be identified along with their skills that contribute to local manufacturing capabilities. For local manufacturing, the approach adopts findings from the LVC gap analysis report conducted by the MED-GEM Network, interviews with local factories and manufacturing facilities mapped in the baseline surveys and country fiches, in addition to interviews with developers at a later stage to identify locally produced components they would be interested in purchasing.

This methodology provides a structured, action-oriented approach to addressing skills gaps in the hydrogen sector, prioritizing immediate needs while laying the groundwork for long-term development across partner countries.

BASELINE ASSESSMENT

Country Readiness for GH2 Economy

Current Infrastructure Landscape

Current Landscape for the Local Manufacturing of RE and GH2 Components

Overview of th Existing Jobs and Skills in the RE and GH2 Sectors

This section will give us a **brief overview of the country's baseline** when it comes to RE and GH2 at different levels **based on the information collected from the baseline surveys and compiled in the country fiche**, allowing us to establish a baseline for the country's overall readiness, specify and target the focus areas in the in-depth skills needs assessment, identify the gaps, and provide actionable recommendations to meet the current demand for RE and hydrogen-related upskilling and reskilling. In the case **where more information than what is found in the below section is needed** on the country's baseline assessment related to readiness, infrastructure, local manufacturing, as well as jobs, skills, and capacity building, **refer to the country fiche attached in annex 2**.

Country Readiness for a GH2 Economy

National Hydrogen strategy, regulatory framework, infrastructure investments, and fiscal incentives

The country's national hydrogen strategy has been developed by the Jordanian Ministry of Energy and Mineral Resources (MEMR) in cooperation with the ESSA as part of the USAID support to Jordan. The strategy has not been published officially yet. However, it includes specific supply and demand targets up to the year 2050 that can be seen in the table below:

Year	2030	2040	2050
GH2 Production (MMT)	0,59	1,5	3,4
Electrolysers Capacity (GW)	5	13	29
RE Capacity (GW)	8	22	47
Avoided Emissions (MMT CO2 eq)	4,2	6,1	8,2
LCOH ($/kg)	3,2		

Table 1. National H2 strategy targets up to 2050

In coordination with MEMR, a GH2 steering committee consisting of public institutions, private sector companies, and academia is being established, to be stakeholders in the GH2 market and related industries.

Furthermore, a study by the World Bank under the name of "Jordan: Options for Legal and Regulatory Frameworks for GH2 Production, Use and Exports" has analyzed the current regulatory framework across the GH2 value chain and developed possible models for the market in Jordan for both local consumption and export. Study results are expected to be out soon.

Under the new Investment Environment Law [Law No. (21) of 2022] that has been approved in Jordan, all investment projects, including energy projects, benefit from custom and tax exemptions on equipment used, production requirements, and production inputs. The law stipulates in Chapter Three, Article 10, incentives granted to investment projects, which are an exemption or reduction on income tax of no less than 30% for a period of 5 years. The Council of Ministers may also decide, based on the recommendation of the Exemptions and Incentives Committee formed under the Investment Environment Law, to approve any incentives, benefits, or exemptions for economic projects. GH2 projects are among the important projects in the Hashemite Kingdom of Jordan that will benefit from these incentives that were approved under the Investment Environment Law. And under the 2014 RE law, RE and EE systems, equipment and production inputs are exempt from VAT and customs.

Moreover, MEMR has signed 12 MOUs as well as 1 framework agreement (FA) for the development of GH2 projects in Jordan, all focusing on ammonia production except one focusing on methanol. All signed MOUs are in the pre-feasibility study stage where a detailed feasibility study will follow as a FA and if projects show feasibility for the government and the investors the FA will be turned into an investment agreement.

Current Hydrogen consumption and potential for local use and export

As this could be a **good indicator and driver for the country's development plans on infrastructure** (ports, pipelines, trucks, etc.) **and end-use applications** such as heating, power generation, transport, and industrial processing (oil refineries, steel and iron production, chemical production, etc.), the sectors that presently use H2 and its derivatives were looked at their current consumption and potential use of GH2 in the future when produced. **The sectors identified were petroleum refining operations, sterilization and medical devices calibration, power plants, fertilizers, steel, food, and chemical industries**. In addition to that, the country's potential for GH2 export in terms of target markets and quantities that can be exported based on local supply and market demand were looked into. Refer to the below tables for more details related to the potential sectors for local use of GH2, the potential markets, and the estimated figures.

Current H2 usage situation and the potential for local GH2 use in different sectors		
Sector	**Current consumption of H2 and its derivatives**	**Potential for local use of GH2 and its derivative**
Petroleum refining operations	5,800 tons per annum of grey H2 (96% of total H2 consumed in the country) - Produced and consumed inside the Jordan Petroleum Refinery Company (JPRC)	5,800 tons per annum of GH2
Food industry, sterilization and medical devices calibration	200 tons per annum of H2 (4% of total H2 consumed in the country)	200 tons per annum of GH2
Fertilizers, steel, and power plants industries	271,275.22 tons per annum of imported grey ammonia (93% consumed by the fertilizers industry)	271,275.22 tons per annum of green ammonia
Chemical Industry	Approximately 216 tons per annum of nitric acid	Approximately 216 tons per annum of nitric acid
	Approximately 482.5 tons per annum of methanol	Approximately 482.5 tons per annum of methanol
	Approximately 116 tons per annum of butanol	Approximately 116 tons per annum of butanol
	Approximately 105 tons per annum of sodium hydroxide	Approximately 105 tons per annum of sodium hydroxide
Pharmaceuticals, detergents, plastics, and paints industries	Figures not available	Figures not available

Table 2. Current hydrogen usage situation and potential for local GH2 use in different sectors

Country's potential for GH2 export	
Target markets	**GH2 export potential**
• European Union. • Neighboring Arab Countries through existing free trade agreements.	An approximate amount of 5 million tons per annum of ammonia (Initially).

Table 3. Country's potential for GH2 export

Current Infrastructure Landscape

Status of existing infrastructure that the entire GH2 value chain can build on

The current and existing infrastructure that the country can build on and expand to integrate the GH2 value chain into were identified. The mentioned infrastructure comprises: (1) Transportation - roads and highways, ports and harbors, land transportation, (2) Water - water supply systems, desalination plants, water treatment plants, and (3) Energy - Power generation plants, transmission and distribution lines, gas pipelines, H2 pipelines, electricity interconnections.

<table>
<tr><th colspan="6">Transportation</th></tr>
<tr><th colspan="2">Roads and highways</th><th colspan="2">Ports and harbors</th><th colspan="2">Land transportation</th></tr>
<tr><td colspan="2">• Desert highway 15
• King's Highway</td><td colspan="2">Aqaba port which has existing infrastructure such as storage tanks for grey ammonia imports.</td><td colspan="2">Trucks for H2 transportation</td></tr>
<tr><th colspan="6">Water</th></tr>
<tr><th colspan="2">Water supply systems</th><th colspan="2">Desalination plants</th><th colspan="2">Water treatment plants</th></tr>
<tr><td colspan="2">• Desalinated sea water in Aqaba
• Groundwater
• Surface water
• Unconventional resources</td><td colspan="2">• The brackish groundwater and surface water
• The seawater desalination quantities in Aqaba</td><td colspan="2">There are 32 wastewater treatment plants across the country</td></tr>
<tr><th colspan="6">Energy</th></tr>
<tr><th>Power generation plants</th><th>Transmission and distribution lines</th><th>Gas pipelines</th><th>H2 pipelines</th><th colspan="2">Electricity interconnections</th></tr>
<tr><td>The existing power generation plants (steam, Gas turbines, combined cycles, diesel, hydro, solar, and wind)</td><td>Existing transmission lines (both overhead and underground)</td><td>The Arab Gas Pipeline 1,200km connecting Egypt with Syria and Lebanon through Jordan</td><td>No existing H2 pipelines</td><td colspan="2">Existing electrical interconnections with Egypt, Syria, Palestine, and Iraq</td></tr>
</table>

Table 4. Status of existing infrastructure (transportation, water, and energy)

Current Landscape for the Local Manufacturing of RE and GH2 Components

Major local industries and priority manufacturing activities

The current and existing major local industries and priority manufacturing activities that the country can build on and expand to integrate into the RE and GH2 value chains were identified and an overview was given by highlighting the sectors covered by these manufacturing activities, the products being manufactured by sector, the number of factories in each sector, as well as their market focus, be it local use or export. **The sectors identified were the renewable energy sector, chemicals / fertilizers industry, steel industry, and cement industry**.

Manufacturing of components for RE technologies

The existing factories in the country that are involved in manufacturing components for RE technologies were looked at the products they manufacture by technology (wind energy, solar PV, solar CSP, etc.), the production capacity, the number of companies out there, as well as the quality assurance measures and quality control processes they have in place. This is in addition to the extent to which these RE manufacturing facilities cover the demand of the local market.

Existing factories involved in manufacturing RE components			
Technology	Products	Production capacity	Numbers of companies
Solar PV	• Solar PV modules (7 different types) • Mounting structures (3 different types)	580 MWp (so far) both local use and export	1 Factory: Philadelphia Solar (Solar PV modules manufacturer)
Solar PV / Wind energy	Power cables	Not available	9
Solar PV	Metal structures, inverter, batteries	Not available	Not available
Solar thermal	Solar thermal collectors (Different types available: vacuum tube collector, heat pipe system, copper flat plat collector, and traditional flat plat system)	Not available Both local use and export	1 Factory: Hanania Investments Group | Energy (Solar Solar Thermal collectors' manufacturer)

Table 5. Existing factories involved in manufacturing RE components

These RE manufacturing factories cover a good extent of the demand of the local market. In addition, the RE components industry in Jordan has an excellent reputation where its products are exported to many markets, including Arab and Western ones.

Manufacturing of components for GH2 systems

The existing factories in the country that are involved in manufacturing components for GH2 systems were looked at the products they manufacture by technology, the production capacity, the number of companies out there, as well as the quality assurance measures and quality control processes they have in place. Some of the systems for the GH2 components that were looked into are: electrolysers, water supply systems, water treatment systems, H2 compression system, H2 storage systems, gas purification systems, control and automation systems, cooling systems, safety systems, monitoring systems, infrastructure for distribution and utilization, etc. This is in addition to the extent to which these GH2 manufacturing facilities cover the demand of the local market. In the case of Jordan, the country has a few existing factories that manufacture components for GH2 production systems such as pipes, cables, and storage tanks.

Overview of the Existing Jobs and Skills in the RE and GH2 Sectors

This section gives an overview of the existing jobs and skills covering the entire value chain of RE and GH2 within the country **with special focus on expertise, skill sets, and competences** that the country's workforce has as this report's main objective is to identify the skills needs and gaps once a skills baseline has been established. However, if information related to capacity building is needed, refer to the country fiche attached in annex 2 where the data collected from the baseline surveys and compiled in the country fiche looked into the existing capacity building activities related to the RE and GH2 sectors in the country at the level of Technical and Vocational Education and Training (TVET), university level, and in the form of modular trainings and short courses.

Jobs in the clean/green technologies sector

The below table gives an overview of the country's workforce working in the clean/green technologies sector - number of people employed in the sector, percentage of the total workforce, and the existing jobs and occupations in major local manufacturing industries related to the sector.

Green/clean technologies sector (RE and GH2)	
Number of people employed	6,436*
Percentage of country's total workforce	Data not available
Existing type of jobs in major local manufacturing industries related to the sector	
• Engineers and managers in the solar PV and wind industries (construction, procurement, operation, and maintenance) • Engineers in the water desalination industry • Technicians in solar PV manufacturing industries (framing, testing, etc.) • Technicians in installing thermal solar water heaters • Technicians in assembling, testing, and installing control panels (such as low voltage control panels used in the automation industry for PLCs, VFDs, etc.) • Instrumentation technicians (gauges, sensors, transducers, etc.) • Low voltage electricians (house and factory wiring) • Welders (piping welding) • Plumbers (water and gas piping) • Solar PV installers (concrete and steel structure) • Technicians in fertilizer companies	

Table 6. Existing jobs in the clean/green technologies sector

** These figures cover cover the energy and energy efficiency sectors based on the study "Green Jobs Assessment in selected Economic Sectors in Jordan" published by GIZ*

Skill sets of the country's workforce in the RE sector by technology

A baseline on the existing expertise, skill sets, and competences in the RE sector that the country's workforce has was established along with a **rating of these skills based on self-perception**. This input is valuable in the sense that it provides a baseline to compare to and hence guide future initiatives on workforce development, skills enhancement, and capacity building to meet the demands of the evolving GEM industry.

RE sector by technology				
Technology	Wind energy	Solar PV	Solar CSP	Hydroelectricity
Skills rating*	2.5	5	1	1
Remarks	Wind projects and sites are limited	Solar PV projects and companies are abundant	Good technical theoretical background without any large projects installed	Good technical theoretical background without any large projects installed
Existing skills	• Design and site selection of wind power plants • Operation and maintenance of wind turbines and the related electrical system	• Design and site selection of solar PV power plants • Assembly of solar PV modules and manufacturing of some components (not wafers) • Installation, operation, and maintenance of solar PV panels, mounting structure, electrical systems (inverters, transformers, statcom and power factor control, etc.), and tracking systems	Available on a small scale (no specific skills can be determined)	Skills are limited and are available on a small scale (e.g., 5MW plant at King Talal Dam). A new project will be constructed in the coming 5-10 years with a capacity of 470MW.

Table 7. Status of skills in the RE sector

** Rating of existing skills was based on self-perception and is to be interpreted accordingly. A scale of 1 to 5 was used, 1 being the lowest and 5 being the highest*

Skill sets of the country's workforce in the GH2 sector

A baseline on the existing expertise, skill sets, and competences in the GH2 sector that the country's workforce has was established along with a **rating of these skills based on self-perception**. This input is valuable in the sense that it provides a baseline to compare to and hence guide future initiatives on workforce development, skills enhancement, and capacity building to meet the demands of the evolving GEM industry.

GH2 sector					
Value Chain Segments	Strategy / Policy / Regulatory framework	Financing and funding	Implementation of regulations	Relevant technologies	GH2 production
Skills rating*	4	1	2	2.5	2.5
Remarks	The ministry of energy has developed a national strategy with a vision and clear targets where it also worked on different options for legal and regulatory frameworks	Additional support needs to be channeled into the direction of mobilizing funds towards GH2 projects	Options for regulations are already there, however the sector is new and there is not past experience in enforcing regulations in the GH2 sector	There are existing skills in the RE value chain whereas there are skill gaps in the installation of electrolysers and their operation and maintenance, etc.	There are existing skills in the RE value chain whereas there are skill gaps in the installation of electrolysers and their operation and maintenance, etc.
Existing skills	• Skills related to H2 production from electricity exists in three chemical companies: National Chlorine Industries Co. (NCI), Al-Baha Company, and Jordan Bromine Co. • Skills related to H2 production from steam methane reforming (SMR) exist in Jordan Petroleum Refinery Company (JPRC) • Skills related to the fertilizer industry based on imported grey ammonia (NH3) • Skills related to the operation and maintenance of the above mentioned industries. The installation and maintenance of electrolyzers would be needed in the future. Moreover, the skills are needed in the field of sea water desalination				
Value Chain Segments	GH2 storage	GH2 transportation	GH2 local use	GH2 export	Safety / Hazard / Risk
Skills rating	3	0	0	0	2
Remarks	The private sector has experience with industrial gases as well as in the storage of ammonia	H2 is currently being used and transferred (in vessels) in Jordan in limited quantities	The H2 currently being used in Jordan is not green. There is no GH2 use in Jordan yet	There is no GH2 export in Jordan	There are regulations governing industrial gases, but not for H2 in particular
Existing skills	• Skills related to H2 production from electricity exists in three chemical companies: National Chlorine Industries Co. (NCI), Al-Baha Company, and Jordan Bromine Co. • Skills related to H2 production from steam methane reforming (SMR) exist in Jordan Petroleum Refinery Company (JPRC) • Skills related to the fertilizer industry based on imported grey ammonia (NH3) • Skills related to the operation and maintenance of the above mentioned industries. The installation and maintenance of electrolyzers would be needed in the future. Moreover, the skills are needed in the field of sea water desalination				

Table 8. Status of skills in the GH2 sector

** Rating of existing skills was based on self-perception and is to be interpreted accordingly. A scale of 1 to 5 was used, 1 being the lowest and 5 being the highest*

FUTURE PERSPECTIVES AND PLANNED ACTIVITIES

In recent years, the Jordanian government has recognized the urgent need to transform its energy sector. The country has embarked on an ambitious journey to increase energy independence, enhance security of supply, and transition towards a more sustainable energy mix. This has led to the exploration of various alternative energy sources and technologies, including RE and, more recently, the potential of GH2, where the national hydrogen strategy stipulates provisional targets aiming at 3.4 MMT of GH2 production and 29 GW of electrolyzer capacity to be powered by 47 GW of RE capacity by the year 2050. Accordingly, and in terms of future perspectives and planned activities:

- MOUs have already been signed for the **production and export of hydrogen and its derivatives** where the below table maps and identifies the major developers and projects that are under discussion and/or are planned to be implemented in the country once financial closure is reached.

- As for **local usage** this can fall into either **industrial chemical feedstock** which has already been analyzed and as an **industrial thermal fuel** where the MED-GEM Network is supporting in that regard. MED-GEM has contracted a Senior Short-term Expert (SSTE) to delve into the potential of GH2 in Jordan as thermal fuel for industrial heat, examining its feasibility, benefits, and challenges within the context of the country's unique energy landscape and industrial needs. This study will help identify the end-use applications for GH2 and its derivatives (i.e., downstream activities of the PtX value chain) at a local level within the country.

- When it comes to the **local manufacturing** of RE and GH2 components, the findings of the needs assessment and gap analysis report related to local value creation, will help identify any new product development.

Identifying the major RE and GH2 production projects to be implemented in the country along with potential end-use applications and local manufacturing activities will help identify the needed jobs along with upskilling and reskilling required for the country's workforce in the upstream, midstream, and downstream activities across the PtX value chain.

Mapping of developers and projects in the RE and GH2 sectors		
Company	Description	Contact Person
Enertrag	500,000 tons of green amonia every year.	• Ms. Lana Almasri • Mr. Maher Matalka
Jordan Green Ammonia (JGA)	100,000-300,000 tons of green ammonia every year. Link	• Mr. Tomoho Umeda/ CEO Hynfra • Dr. Wael Suleiman/ CEO Fidelity Group • Sharhabeel Madi
Philadelphia Solar	200,000 tons of green ammonia every year.	• M. Jon Miller, Engagement Lead, Strategy & Consulting • M. Chuni Fann, Director - Strategy & Consulting
Mass Group Holding	180,000 tons of green ammonia every year.	• Mr. Ahmed Ismail Saleh
Kawar Energy	100,000 tons of green ammonia every year.	• Mr. Hanna Zaghloul
Amarenco and H2 Global	1,000,000 tons of green ammonia every year. Link	• Mr.Waleed Hallaj • Mr.Yazan Faouri
Masdar	50,000 tons of green hydrogen every year. Link	• Eng. Zaid Tahboub
Kepco & Xenel	500,000 tons of green ammonia every year.	• Mr. Karim Salamoun
Ocior Energy	900,000 tons of green ammonia every year.	• Mr. Sanjay Nagrare
Catalyst	150,000 tons of green ammonia every year.	• Mr. Firas Rimawi

Table 9. Mapping of developers and projects in the RE and GH2 sectors

Mapping of developers and projects in the RE and GH2 sectors		
Company	**Description**	**Contact Person**
FFI	832,000 tons of green ammonia every year.	• Mr. Zaid Al Edwan
CTGI	200,000 tons of green ammonia every year.	• Dr. Mohammed Atteih
HD Solar	400,000 tons of green ammonia every year.	• Dr. Faysal Alserhan

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SKILLS NEEDS ASSESSMENT AND GAP ANALYSIS FOR JORDAN

As the GH2 economy develops in the country, the need for a skilled workforce to service the sector and sustainable economic growth emerges. As outlined in the previous section of this report "Future Perspective and Planned Activities", catalytic projects identified have the potential to create a significant number of jobs annually across the GH2 value chain in the near future for both export and domestic use. To realize these job opportunities, the current workforce will require reskilling and/or upskilling to be able to participate in the GH2 economy.

In order to conduct the skills needs assessment of the GH2 economy in the country, this report relied primarily on the overall jobs and skills across the PtX value chain needed for a market transformation that were identified in the two studies below – **both attached in annex 2**:

(1) "Skills Needs and Gap Analysis in Namibia's PtX Sector" Study implemented by GIZ, and

(2) "Identification of Skills Needed for the Hydrogen Economy" Research Report published by the Department of Higher Education and Training of the Republic of South Africa.

The findings of these studies were compiled in **annex 1 as a practical guideline to be used to identify the overall jobs and skills across the PtX value chain** which will serve as a crucial starting point for identifying the needed hydrogen-related upskilling and reskilling of the country's workforce to support the development of a skilled workforce in the PtX economy and at a later stage for designing and developing an effective and dedicated skills strategy.

Since the Hydrogen economy is still emerging in the country, an initial assumption can therefore be made that there is currently no surplus of hydrogen-related skills in Jordan except for some existing skills and expertise required for numerous occupations in some activities across the PtX value chain such as RE production (solar PV), sea water desalination, and ammonia storage; in addition to some end-use applications (mainly fertilizers industry and petroleum refining operations) along with policies, legal aspects, regulations, and fiscal incentives.

The petroleum, gas, chemicals, and fertilizer industries have skills that can be transferrable to the hydrogen value chain. However, upskilling or reskilling will be required for these occupations to ensure that they incorporate green hydrogen–related capabilities.

As the GH2 economy becomes established, there is a risk that the skills demanded by the industry will exceed the supply of individuals in the labour market who possess the required skills. It is therefore essential to ensure that workers in the current labour force are appropriately upskilled or reskilled to include hydrogen-specific capabilities.

This section of the report outlines the skills required (skills demand) for the Hydrogen economy after having reviewed the existing skills (skills supply) in the "Baseline Assessment" Section and assesses the skills imbalances envisaged for the development of the Hydrogen economy based on the identified project developers and their GH2 projects mapped in the "Future Perspectives and Planned Activities" Section. This analysis is undertaken using a qualitative approach, however, to confirm this, a deeper analysis of both qualitative and quantitative data would be required by conducting interviews with stakeholders at a later stage.

Here below are the skills gaps and needs as identified by the baseline survey contributors (NFPs, IAB WG members, and experts in the field) for the RE sector by technology which the study will rely on for RE-related skills required due to the country's relatively broad experience in the sector. However, these skills will be narrowed down and prioritized based on the identified RE activities in the projects mapped in the "Future Perspectives and Planned Activities" Section.

Wind energy	
Skills gaps	• Advanced site selection, potential measurements, knowledge of wind turbines classes, etc. • Installation of wind turbines
Skills needs*	• Site assessment and advanced selection according to different factors including wind speeds, environmental protection, bird flyways, archaeological sites, etc. • Identification of the wind potential (wind data measurements, wind data analysis, topographical studies, etc.)
Solar PV	
Skills gaps	Energy storage for solar PV systems
Skills needs	Increase the capacity factor of solar PV systems through storage solutions
Solar CSP	
Skills gaps	The entire system from design all the way to operation as there is a lack of awareness and trainings
Skills needs	Awareness about the technology
Hydroelectricity	
Skills gaps	The entire system from design all the way to operation as there is a lack of awareness and trainings
Skills needs	Awareness about the technology

Table 10. Skills needs and gaps in the RE sector by technology as collected from baseline survey

Moreover, here below are the skills gaps and needs as identified by the baseline survey contributors (NFPs, IAB WG members, and experts in the field) for the GH2 sector.

GH2 value chain	
Strategy / Policy / Regulatory frameworks, Financing and funding, Implementation of regulations, Relevant technologies, GH2 production, GH2 storage, GH2 transportation, GH2 local use, GH2 export, Safety / Hazard / Risk	
Skills gaps	• Gaps can be found in the design, modeling, sizing, installation, operation, and maintenance of (1) GH2 production plants using electrolysis, (2) green ammonia production plants using the Haber-Bosch process, and (3) green methanol production plants using the Fischer-Tropsch process. • There are also gaps in the development of suitable health and safety regulations for the storage and transportation of gases.

Table 11. Skills needs and gaps in the GH2 sector as collected from the baseline survey

* *Skills needs in terms of upskilling and reskilling*

GH2 VALUE CHAIN	
Strategy / Policy / Regulatory frameworks, Financing and funding, Implementation of regulations, Relevant technologies, GH2 production, GH2 storage, GH2 transportation, GH2 local use, GH2 export, Safety / Hazard / Risk	
SKILLS NEEDS*	• Basic principles of H2 • The role of H2 in the energy transition • H2 production methods • H2 electrolyser principle of operation and maintenance • Electrolyser sizing and selection • H2 storage • H2 industrial applications • Cost issues and feasibility calculations • Fuel cell principle of operation and maintenance • Water desalination and demineralisation plants • Health and safety principles: procedures, risk assessment, handling storage and transportation of H2 and its derivatives. • Design and sizing of equipment • Basics of project management and planning

However, since the Hydrogen economy is still relatively new to the country, a more thorough analysis was conducted related to the skills needed for the GH2 sector based on the project activities identified from the planned projects compiled in Table 9. These skills are to be further disaggregated by occupational group across the PtX value chain segments and mapped against the respective project phases by relying primarily on the overall jobs and skills identified in the two studies mentioned above. These findings will serve as a crucial starting point for identifying the needed hydrogen-related upskilling and reskilling of the country's workforce which will be further analyzed based on the data collected from interviews to be done at a later stage with related stakeholders. Refer to the below table for the skills needs assessment and gap analysis across the PtX value chain in Jordan.

** Skills needs in terms of upskilling and reskilling*

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<table>
<tr><th colspan="3">Skills needs assessments and gap analysis across the PtX value chain in Jordan</th></tr>
<tr><th colspan="2">PtX value chain segments</th><th>Skills needed for hydrogen-related occupationnal profiles</th></tr>
<tr><td colspan="2">Foundational development of a GH2 economy</td><td>Based on the country's energy status and its GH2 readiness (i.e., Jordan has a GH2 strategy/roadmap, legal and regulatory framework, fiscal incentives, and GH2 projects planned and/or being discussed), below are **a list of skills that decision makers and their technical advisors would need to develop a GH2 economy**:
• Technical feasibility, economic viability, what it takes to make project bankable (including modeling), social and environmental impact
• How to negotiate with developers and financing (How? Who? etc.)
• Access to land, best practices for permitting of H2 projects, and assessing risks and rewards
• How to speak to the public and civil society actors for community engagement.
• Health, safety, and hazards of working with H2 (Cross-cutting skill mentioned below)
• Policies, legal aspects, regulations, and fiscal incentives (Cross-cutting skill mentioned below). **Not needed for Jordan as already developed**.
The **exact skills** needed are to be identified and prioritized **based on interviews** to be done at a later stage **with representatives of ministries and national agencies** (refer to "Skills interview guide for ministries and national agencies" in annex 2) while the **skills** needed **related to financing** are to be identified **based on findings** from: (1) the **finance assessment report** on the current state of green energy finance in the country, (2) the stakeholder mapping report, (3) the consultation workshop report, and (4) the customized strategies and action plans for enhancing finance frameworks report being **conducted by** the **MED-GEM Network**.</td></tr>
<tr><td rowspan="4">Upstream activities</td><td>Local manufacturing of RE and GH2 components</td><td>• **Upskilling** could be required for the manufacturing / assembly of already existing RE and GH2 components produced locally identified in the baseline survey such as **solar PV modules**, **mounting structures**, **power cables**, **inverters**, **batteries**, **solar thermal collectors, pipes, and storage tanks** to meet certain standards and/or increase production capacity.
• **Reskilling** could be required for manufacturing **new RE and GH2 components** based on the findings from the Local Value Creation (LVC) Gap Analysis (GA) Report regarding the products identified to be made locally.
• The **exact skills** needed are to be identified **based on**: (1) findings from the **LVC GA Report**, (2) **interviews with local manufacturers** for data validation and further information (refer to "Skills interview guide for local manufacturers" in annex 2), and (3) **interviews with project developer** regarding components they would be willing to buy locally and following which standards (refer to "Skills interview guide for developers" in annex 2). Note that interviews with stakeholders are to happen at a later stage.</td></tr>
<tr><td>Infrastructure</td><td rowspan="6">• The **upskilling and reskilling** required would be related to the project activities identified from the **planned projects** compiled in Table 9 and mapped against the respective project phases: (1) Planning and Design, (2) Transportation of Components, Equipment, and Materials, (3) Construction and installation, and (4) Operation and Maintenance (O&M).
• The **activities** identified in the planned projects focus on: **RE production (Solar PV), GH2 production, Green ammonia production, Electrolysis powered by RE, Electrolysis (Proton exchange membrane / PEM), Seawater desalination, Advanced energy storage systems, Battery energy storage system (BESS), Transportation for export and domestic consumption**.
• The **overall jobs and skills** needed for the above-mentioned activities can be identified by occupational group across the PtX value chain segments to the left and mapped against the above mentioned project phases **based on the two studies** compiled in annex 1 as a practical guide.
• The **exact skills** needed will be identified starting with the **overall skills mapping** done in the previous step and narrowed down and prioritized based on the data collected from **interviews** to be done at a later stage **with project developers**. The data collected will be such as the following:
which projects have reached financial closure, what occupational profiles will be created in each project phase, which ones are for locals, what are the numbers needed for each occupation, what skills are needed for each occupational profile, what trainings do they provide as an organization, etc. (refer to "Skills interview guide for developers" in annex 2). Note that Jordan has existing skills and expertise in some of the mentioned activities such as RE production (solar PV), sea water desalination in Aqaba, and ammonia storage in Aqaba port.</td></tr>
<tr><td>Production</td></tr>
<tr><td>Transformation</td></tr>
<tr><td rowspan="2">Midstream activities</td><td>Storage</td></tr>
<tr><td>Transportation</td></tr>
</table>

Table 12. Skills needs assessment and gap analysis across the PtX value chain in Jordan

Skills needs assessments and gap analysis across the PtX value chain in Jordan		
PtX value chain segments		**Skills needed for hydrogen-related occupationnal profiles**
Downstream activities	End-use applications	• Some **upskilling** might be required in the sectors where Hydrogen and Ammonia are already being used as **industrial chemical feedstock**, mainly in the **fertilizers industry** and **petroleum refining operations** and to a lesser extent in the sterilization and medical devices calibration, power plants, steel, food, and chemical industries. • As for local usage of **Hydrogen as an industrial thermal fuel**, the findings of the study being conducted by MED-GEM "Assessment of GH2 for Industrial Heat in Jordan" will help identify the industrial sectors where Hydrogen can be used as a thermal fuel and in turn the **needed skills (upskilling and reskilling)** in that regard.
	Export	Since Jordan plans to export GH2 and green ammonia to the EU and neighbouring Araba Countries, the following skills are a must: • Understanding of the **EU's voluntary certification schemes** for GH2 and its derivatives and comprehension of the **certification process**. • Understanding of the **EU's** Carbon Border Adjustment Mechanism (**CBAM**) and its **implications for trading PtX products** like hydrogen, ammonia, and green steel and the comprehension of the **CBAM process.** • In addition to the existing skills that the country's workforce has in storage of grey ammonia imports in Aqaba port, some upskilling and reskilling will be required. The **exact skills** needed are to be identified **based on**: (1) findings from the **Infrastructure GA Report,** (2) **interviews** to be done at a later stage **with project developers**.
Overarching areas		• The **core skills** and **cross-cutting competencies most required** by industry stakeholders **across various occupational profiles throughout all the PtX value chain segments** are as follows: • Knowledge of **Hydrogen properties** and **behaviour** • **Health, safety**, and **hazards** when working with or around Hydrogen • Knowledge of **legal aspects**, **regulations**, **permitting** of H2 projects • Knowledge of hydrogen-related **standards**, **codes**, and **guidelines** for production, storage, distribution, and utilization • Understanding **electrochemical reactions** and **Hydrogen production processes** • Understanding of **Hydrogen system components** and **integration with RE**

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CONCLUSIONS AND RECOMMANDATIONS

Short-term Recommendations (1-2 years)

- Engage stakeholders and develop upskilling and reskilling programmes:

  - Conduct a literature review of the Local Value Creation and Infrastructure Gap Analysis Reports developed by the MED-Gem Network and collect data related to potential skills needed.

  - Validate the stakeholder mapping in this report which identified the key stakeholders (project developer, local manufacturers, ministries, and national agencies) and planned projects.

  - Interview the project developers to collect data such as which projects have reached advanced stages of development such final investment decision (FID), what occupational profiles will be created in each project phase, what are the numbers needed for each occupation, what skills are needed for each occupational profile, what trainings do they provide as an organization, etc. (Refer to the developed "Skills interview guide for developers" in annex 2).

  - Interview local manufacturers to collect data such as the will to expand your operations, what occupational profiles would be needed, what are the numbers needed for each occupation, what skills are needed for each occupation, what trainings do they provide as a company, etc. (Refer to the developed "Skills interview guide for local manufacturers" in annex 2).

  - Interview ministries and national agencies to collect data such as the list of skills (by priority) that the decision makers and their technical advisors would need to develop a GH2 economy, the technical support needed as a pre-requisite to overcome barriers to develop training programs, assessments, and certifications, etc. (Refer to the developed "Skills interview guide for ministries and national agencies" in annex 2).

  - Compile the data collected from the interviews with the stakeholders to design, prioritize, and implement the upskilling and reskilling required for the country's workforce across the whole PtX value chain, building on the above Section "Skills Needs Assessment and Gap Analysis for Jordan", the assessment done in Table 12, and the "Practical Guideline to Identify Jobs and Skills Across the PtX Value Chain" in annex 1.

  This activity will be implemented in the upcoming semester with support of MED-GEM's Industry Advisory Board (IAB) and the Online Academia Advisory Board (OAAB) for green GH2 development in the Southern Mediterranean Countries" that is planned to be established (refer to "Draft Concept Note - Establishment of the Online Academia Advisory Board" in annex 2).

- Establish partnerships with PtX project developers and training providers to deliver short courses (theoretical and practical hands-on trainings) to professionals (decision makers in ministries, technical advisors, engineers, technicians, specialists, managers, elementary-level occupations, etc.) on the identified skills needed (in face-to-face and online formats) complemented with on-the-job training opportunities conducted locally or abroad.

- Implement identified pre-requisite technical assistance needed to overcome barriers to develop training programs, assessments, and certifications, etc:

  - Define training standards for Hydrogen and establish safety training standards (based on existing standards), enabling employers to quickly assess the qualifications and competencies of individuals seeking employment within the Hydrogen sector. Furthermore, the lack of training standards in the field of hydrogen poses a challenge for training providers who lack common recognised guidelines to define the expected proficiency level to safely work with hydrogen (European Hydrogen Skills Strategy, page 30).

This activity can be implemented by Jordan and the remaining partner countries participating in the "Regional Working Group on Standardization and Metrology (RWGSM) for GH2 Development" proposed by the MED-GEM Network (refer to "Draft Concept Note - Establishment of a Regional Working Group on Standardization and Metrology" in annex 2) whose primary objective is to promote harmonized standards, ensure safety, and enhance the quality and interoperability of technologies and infrastructure related to GH2 and derivatives across Southern Mediterranean Countries.

- Understand Jordan's potential for local usage of Hydrogen as an industrial thermal fuel and in what industrial sectors to identify the needed skills (upskilling and reskilling) for such end-use applications.

- Provide capacity-building support on financing green energy (RE and GH2) to relevant ministries, government agencies, financial institutions, venture capital and private equity firms, project developers, EPCs and other stakeholders on specific topics to be identified as relevant during the planned regional consultation workshop.

This activity is being implemented by the MED-GEM Network where Jordan and the remaining partner countries can play a decisive role in its success by actively supporting the finance expert contracted by MED-GEM in his activities such as validating the stakeholders mapping and the current state of financing green energy as well as participating in discussions and regional consultation workshops to identify the most important gaps and challenges that may hinder the development of financing green energies in the Southern Mediterranean Countries. All this would help him design the training seminar to be delivered to the different stakeholders in all partner countries, addressing the challenges and coming up with recommendations and a specific road map / action plan to develop a dedicated framework for financing green energy.

- Provide trainings to relevant stakeholders such as ministries and industry associations related to:

  - the understanding of the EU's voluntary certification schemes for GH2 and its derivatives and comprehension of the certification process.

The MED-GEM Network is already supporting in this activity by implementing a certification pilot by selecting two GH2 pilot projects from the partner countries to undergo pre-certification and two certifying agencies accredited and approved by the EU, where these two certifying agencies will carry out the certification process for the selected pilot projects based on EU regulations/directives on renewable hydrogen. This pilot certification process will determine the feasibility and operationality of the certification process along the production, transportation and consumption / export of renewable hydrogen in the Southern Mediterranean countries. In addition, it will help fill any identified gaps and address any obstacles that might hinder its implementation in these countries and share information, findings, and recommendations with all partner countries in the MED-GEM Network.

  - the understanding of the EU's Carbon Border Adjustment Mechanism (CBAM) and its implications for trading PtX products like hydrogen, ammonia, and green steel and the comprehension of the CBAM process.

The MED-GEM Network is already supporting these activities and will continue to do so. The network previously conducted a CBAM training to MED-GEM's NFPs, CCs, and IAB members in Brussels on the 10th of June 2024 and plans to do more in that regard.

- Develop a digital library / centralized online platform, in collaboration with other Southern Mediterranean Counties and the EU, serving as a hub for a wide range of hydrogen-related training and resources made available in an open-access format, similar to Massive Online Open Courses (MOOCs) enhancing their visibility and expanding their reach and accessibility to interested individuals overcoming geographical limitations that in-person training may impose. Moreover, having these online training courses in different languages (English and French at least) would help overcome language barriers and increase the collaboration between the countries.

  This activity would receive the support of the MED-GEM Network as it plans to create a MOOC platform which would: (1) host the content (hydrogen-related training courses and resources) compiled by partners such as Hydrogen Europe Research and Hydrogen Europe, Green Skills for Hydrogen (ERASMUS+), H2Excellence, GIZ PtX Hub Academy, The European Hydrogen Academy, European Hydrogen Observatory Educational, and JUST GREEN AFRH2ICA; and (2) develop as well as provide tools to develop training programmes on the platform. These online training courses would be available to users free of charge who would be issued a MED-GEM Network Certificate upon completion. Jordan's participation as well as the involvement of the remaining partner countries would contribute to the platform's content richness and impact, increasing public awareness on the imperative need for GH2 for an accelerated clean energy transition.

- Implement a Green Hydrogen Hackathon among university students within Jordan, allowing them to address a local challenge related to the PtX value chain in the country and pitch their idea after providing the selected applicants with the needed training and mentoring. This would be a great entry point to raise awareness on the GEM industry amongst university students and professors.

  This is an activity that the MED-GEM Network can support in as it has already implemented two successful GH2 Hackathons in Morocco and Lebanon so far and plans to continue doing so in the remaining partner countries.

- Raise awareness of pupils about technology and societal matters and develop interest of younger generations for sectors such as hydrogen. Actions in this area could be teaching schoolteachers some ground knowledge about hydrogen so that they feel comfortable integrating certain awareness raising activities in class.

- Define what type of training equipment is needed for training hydrogen specialists to prioritise investment for training infrastructure. Hydrogen Europe could support and provide more information on this as this is something that they are trying to explore in the International Partnership for a Hydrogen Economy.

- Team up with project developers, industries, and training providers to establish a Hydrogen Training Center equipped with modern equipment for hands-on training in GH2 along with a Hydrogen Centre of Excellence to promote research and development activities and drive innovation in the sector.

- Develop partnerships with international organisations, experts, and training providers to leverage global expertise and best practices.

- Train and certify local trainers through Training of Trainers (ToT) programmes provided by project developers or training providers and capacitate them with the relevant knowledge and skills required to effectively train (upskill or reskill) Jordan's workforce and reduce the reliance on external providers for short practical trainings.

- Compile, develop, and launch modular training programmes to provide skills in different areas across the PtX value chain (identified needed skills, cross-cutting, fundamentals, most required) once partnerships have been established with project developers and training providers and local trainers have been trained and certified. Modular trainings allow for customization and offer flexibility of learning tailored to individual needs and later on allow educational institutions to select relevant modules and integrate them in their curricula.

Broader Mid to Long Term Recommendations

- Recognise certificates/diploma in continuous education: Implement recognised training standards to guarantee a certain quality of training on essential topics linked to Hydrogen, such as safety which would be a much welcome development by industry stakeholders.

- Establish and strengthen partnerships with educational institutions, industry associations, and PtX project developers to further expand the range of training programmes and facilitate on-the-job training opportunities for students and professionals.

- Conduct an in-depth analysis of the capacity building needed for the Hydrogen economy in Jordan at the level of Universities and TVET Institutes:

    - Identify qualifications required for the H2 value chain and the unique GH2 capabilities (refer to the and the "Practical Guideline to Identify Jobs and Skills Across the PtX Value Chain" in annex 1 and use tables 4 to 10 in Section "6.2.1 The skills required for the green hydrogen economy" in the "Identification of Skills Needed for the Hydrogen Economy" Report in annex 2).

    - Conduct an in-depth analysis of all the courses offered by analysing the websites of the universities and technical institutes and using the data collected from the "Jobs, Skills, and Capacity Building" Survey conducted by the MED-GEM Network and compiled in the country fiche in annex 2.

    - Compare the qualifications and the unique GH2 capabilities offered by Jordan's Universities and TVET Institutes with those required for the hydrogen economy and identify the gaps.

- Propose external support to academic entities which could take the form of agreements for common courses and degrees with participation of external experts fostering the transfer of knowledge and expertise in the country.

- Develop and scale up the TVET programmes and on-the-job trainings to incorporate the newest GH2-related curricula and increase hands-on experience.

- Collaborate with universities and academic institutions to incorporate GH2-related courses, curricula, and research initiatives to bridge the existing skill gaps.

- Develop advanced degree programmes and postgraduate courses focused on newest PtX technologies.

- Strengthen collaboration between educational institutions and industry partners to align curriculum with industry requirements and emerging technologies.

- Train the teachers in Universities and TVET Institutes and capacitate them with the relevant knowledge and skills required to effectively train Jordan's GH2 students and workforce:

    - Increase collaboration between industry and education institutions

    - Foster relationships between Jordan's universities and TVET institutes and their international counterparts and/or to international companies

- Focus on Hydrogen in continuing education to facilitate the upskilling of workers:

    - Open initial education modules to continuous education, and/or

    - Integrate Hydrogen-related content into the regular skills update of professionals

- Strengthen the research and development capabilities within Jordan to support the growth of PtX technologies and applications.
- Foster entrepreneurship and innovation in the PtX sector through incubation and acceleration programmes, funding opportunities, and business support services.

Conclusions

Implementing these recommendations will establish a robust foundation for Jordan's hydrogen economy, empowering the workforce through targeted training and skill-building initiatives. By engaging stakeholders and creating partnerships across industry, government, and academia, Jordan can foster a sustainable hydrogen ecosystem that enhances local capabilities and meets the growing demands of the global green energy market. Short-term actions, like stakeholder engagement and the development of targeted training programs, will support an immediate response to skill gaps, while mid to long term strategies aim to create a lasting impact through advanced training facilities, research collaborations, and curriculum integration. Through these concerted efforts, Jordan is well-positioned to drive innovation, strengthen industry-academia relations, and contribute to a sustainable green hydrogen transition across the Southern Mediterranean region.

ANNEX 1
PRACTICAL GUIDELINE TO IDENTIFY JOBS AND SKILLS ACROSS THE PTX VALUE CHAIN

In order to conduct the skills needs assessment of the GH2 economy in the country, this report relied primarily on the overall jobs and skills across the PtX value chain needed for a market transformation that were identified in the two studies below – both attached in annex 2:

1. "**Skills Needs and Gap Analysis in Namibia's PtX Sector**" Study implemented by GIZ, and

2. "**Identification of Skills Needed for the Hydrogen Economy**" Research Report published by the Department of Higher Education and Training of the Republic of South Africa.

The findings of these studies were compiled in this annex as a practical guideline to be used to identify the overall jobs and skills across the PtX value chain which will serve as a crucial starting point for identifying the needed hydrogen-related upskilling and reskilling of the country's workforce to support the development of a skilled workforce in the PtX economy and at a later stage for designing and developing an effective and dedicated skills strategy.

Overall jobs and skills identified from the "**Skills Needs and Gap Analysis in Namibia's PtX Sector**" Study

The "Skills Needs Assessment" Chapter of the study starts by describing the sequence of processes of the PtX value chain involved in the production and distribution of both H2 and its derivatives up to their end use in a range of PtX applications where the upstream activities are those relating to GH2 production and storage, while downstream activities are those relating to the end-use. The PtX value chain was divided into the following six stages:

1. **Infrastructure** which includes new desalination plants, new water pipelines, extensions to the electricity grid, new hydrogen pipelines, new roads, deep seaport terminals to receive large ammonia transportation ships.

2. **Production** which focuses on GH2 production via electrolysis using electricity supplied by RES and water via new water pipelines.

3. **Transformation** which considers the conversion of H2 into ammonia, the production of synthetic fuels, etc.

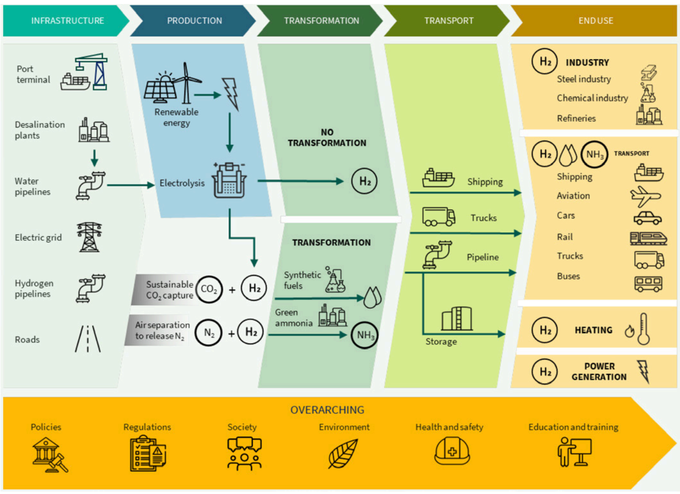

Figure 1. PtX value chain stages
(Skills Needs and Gap Analysis in Namibia's PtX Sector, 2023, page 9)

4. **Storage and Transportation** which looks at the storage of H2 and its transportation via pipelines and/or tanker trucks. It also looks at the storage and transportation of H2 derivatives, such as the export of ammonia via ammonia tanker ships.

5. **End use** which includes applications such as industrial processing, transport, heating, and power generation

6. **Overarching** which encompasses aspects which impact on the other groups such as the policy and regulatory landscape, social and environmental considerations, health and safety considerations, and education and training.

For a more detailed description on each of the six PtX value chain stages, refer to Section "2.1 PtX Value Chain" in the "Skills Needs and Gap Analysis in Namibia's PtX Sector" Study in annex 2.

In the next section, the study considers that as the H2 and PtX markets in Namibia begin to evolve, the next few years will be dominated by large construction projects where significant numbers of jobs will be created which is a similar case to many of the partner countries being assessed including Jordan. The phases of these projects can all be broadly seen as:

1. Planning and Design
2. Manufacturing
3. Transportation
4. Construction and installation
5. Operation and Maintenance (O&M)

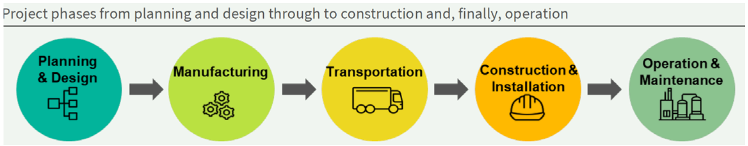

Figure 2. Construction Project Phases
(Skills Needs and Gap Analysis in Namibia's PtX Sector, 2023, page 10)

Accordingly, this section takes a detailed look at **key jobs and skills required for the following PtX value chain stages mapped against the respective project phase**:

- GH2 production (PV, wind, battery storage, electrolysis)
- GH2 compression, storage, and transportation
- Green ammonia production
- H2 refueling stations and fuel cell heavy duty vehicles

For the sake of clarity, refer to the below table for one example of the jobs and skills identified for the "GH2 compression, storage, and transportation" stage of the PtX value chain mapped along the project phases.

Planning & Design	Transportation	Construction & Installation	Operation & Maintenance
Perform planning, approvals and compliance processes **Project developers, planners, regulators**	*Receive, process, hold, release incoming goods at ports* **Port authority personnel, shipping agents**	*Perform detailed engineering design and procurement of hydrogen compression and storage facilities, and hydrogen pipelines* **Mechanical, civil, industrial, process and other engineers**	*Monitor and operate PV and battery plant* **Electrical engineers**
Ensure compliance with safety and environmental regulations, permitting and other standards **Regulators, inspectors**	*Organise transport of components, equipment and materials to construction site* **Logistics personnel**	*Install and commission all hydrogen compression and storage units and associated pipework and instrumentation* **Mechanical engineers, pipe fitters, pipe fitter's assistants, metal workers, instrumentation technicians, labourers**	*Monitor and operate hydrogen compression and storage facilities, and hydrogen pipelines* **Mechanical, industrial, instrumentation or other engineers**
Perform preliminary design of hydrogen compression and storage facilities, and hydrogen pipelines **Mechanical, civil, industrial, process and other engineers**	*Transport components, equipment and materials to construction site* **Truck drivers**	*Install and commission hydrogen pipeline and associated pipework, instrumentation, etc.* **Mechanical engineers, pipe fitters, pipe fitter's assistants, metal workers, instrumentation technicians, labourers, earthmoving plant operators, crane and hoist operators**	*Perform engineering maintenance on facility and hydrogen pipelines* **Mechanical engineers, pipe fitters, pipe fitter's assistants, metal workers, instrumentation technicians**
Perform preliminary design of hydrogen compression and storage system **Industrial, process, mechanical engineers**		*Approve all installations with regard to quality, performance, safety* **Inspectors, health & safety officers**	*Monitor and operate electrolyser plant* **Mechanical, industrial, process, instrumentation or another engineer**
			Perform facility and pipeline inspection at intervals **Instrumentation technicians, engineering inspectors**
			Perform plant inspections at intervals **Engineering inspectors**

Table 13. Jobs and skills for GH2 compression, storage, and transportation mapped along the project phases
(Skills Needs and Gap Analysis in Namibia's PtX Sector, 2023, page 16)
Note that jobs and skills in manufacturing industries were not considered at that stage of the study

This section also looks more broadly at indirect jobs and skills in sectors on which the PtX sector depends, namely in infrastructure and in the overarching areas such as regulatory, policy, societal, environmental, education and training.

For the exact jobs and skills required across the PtX value chain stages mapped against the respective project phases or any further details in that regard, refer to Section "2.2 Jobs and Skills Demands along the PtX Value Chain" in the "Skills Needs and Gap Analysis in Namibia's PtX Sector" Study in annex 2.

Moreover, the key jobs identified in the skills needs assessment have been categorized into eight occupational groups according to skills, areas of use, and approximate qualification levels, as follows:

1. Engineers
2. Non-Engineering Professionals
3. Managers
4. Administrators, Logistics, and Other Support Staff
5. Regulatory, Safety and Quality Assurance Personnel
6. Technicians and Artisans
7. Construction Workers
8. Truck Drivers

Figure 3. Occupational Groups
(Skills Needs and Gap Analysis in Namibia's PtX Sector, 2023, page 36)

For a more detailed description on each of the eight occupational groups related to their skills, across the PtX value chain stages, and along the project phases, refer to Section "4.2 Description of Occupational Groups" in the "Skills Needs and Gap Analysis in Namibia's PtX Sector" Study in annex 2.

Furthermore, this last section in the study mentions that almost all jobs identified as being in demand for the GH2 and PtX sectors already exist in industry where in many cases, the base skills from these jobs need to be supplemented with a new PtX-specific skillset. Accordingly, and just for guidance purposes, refer to Table 11 in Section "4.3 Existing Qualifications and Gap Identification for All PtX-Related Jobs" in the "Skills Needs and Gap Analysis in Namibia's PtX Sector" Study in annex 2. This table lists the jobs in each occupational group, provides a brief description of the base skillset, the current qualification available in Namibia, the PtX-required qualification (as far as one already exists), and the supplementary PtX-specific skills required (defined as the "gap" to be filled). This only gives an indication of the types of skills they should already possess, and the types of skills they would still need to acquire in a labour market where the jobs identified as being in demand for the GH2 and PtX sectors already exist in industry.

Occupational groupings	Current qualification (NQF level)	Total no. of graduates 2018-2022	Desired qualification	Gap (required GH or PtX skills)
Engineers				
Electrical/electronics engineer (Base skills: Design electrical/electronic systems, oversee installation and operation, monitor and optimise performance)	BTech in Electrical Engineering (NQF 7) BEng (NQF 8)	156	Same qualification with supplementary PtX modules	Elective modules in: All modules to incorporate design, installation, commissioning, operation & maintenance, standards, quality and safety aspects. • Electrics of PV systems • Electrics of wind systems • Electrics of battery energy storage systems • Electrical grids with high shares of renewables • Electrics of electrolyser systems • Fuel cells

Table 14. Table cut-out - Identification of PtX skills gaps for key jobs relevant to the green hydrogen and PtX sectors
(Skills Needs and Gap Analysis in Namibia's PtX Sector, 2023, page 37)
Note that skills gaps have been defined in term of possible training offers

Overall jobs and skills identified from the "Identification of Skills Needed for the Hydrogen Economy" Report

The "Skills Supply, Demand, and Imbalances in the Hydrogen Economy" chapter of the research report outlines the skills required (skills demand) for the H2 economy, reviews the existing skills (skills supply), and assesses the skills imbalances envisaged for the development of the H2 economy. It identifies both **occupations** and **associated capabilities** (**skills and knowledge**) that will be required to carry out hydrogen-related activities safely and effectively across the H2 value chain segments. In the first section of this chapter, **the H2 value chain was divided into the following four segments**:

1. Production
2. Storage
3. Distribution and Transportation
4. End-use applications such as heating, power generation, transport, and industrial processing (oil refineries, steel production, iron production, and chemical production)

Accordingly, the core skills (including capabilities) required along with their applicability across the H2 value chain were identified and divided into three levels: high (H), medium (M), and low (L). Moreover, a total of 138 occupations were identified in addition to the qualification required for each occupation, and these were categorized into **five occupational clusters / categories** adopted from international best practices, as follows:

1. Engineers (35 Occupations)
2. Technicians and tradespeople including associated professionals and skilled craftsmen (39 Occupations)
3. Specialists (38 Occupations)
4. Managerial occupations (14 Occupations)
5. Elementary-level occupations (12 Occupations)

It is worth mentioning that an extensive review of literature was conducted to inform the identification of occupations required for the H2 economy, mainly focusing on Australia, Canada, France, and the EU, where skills needs assessments have been concluded for the H2 economy. The qualifications required for these occupations and their categorization across the H2 value chain segments were also informed primarily by the literature review. Where literature was not available, authors' analyses were used. Additionally, online recruitment platforms such as LinkedIn and PNet were used to map the existing skills. Furthermore, a general online search in addition to online recruitment platforms was used to confirm other hydrogen-related skills whose existence could not be confirmed.

Accordingly, and just for guidance purposes, refer to tables 4 and 5 in Section "6.2.1 The skills required for the green hydrogen economy" in the "Identification of Skills Needed for the Hydrogen Economy" Report in annex 2. These tables list the occupations in each occupational category along with the associated qualification and skill level that will be required to carry out hydrogen-related activities safely and effectively across the H2 value chain segments as divided above.

For the sake of clarity, refer to the below table for one example of the occupation, qualification, and skill level identified for the "Engineers" occupational category mapped along the H2 value chain segments.

LEGEND
Existing skills
Unsure of existence
Non-existing skills

No.	OFO	Core occupation	Skill level	Qualification	Value chain segments						
								End-uses			
					Production	Storage	Distribution and transportation	Heating	Power generation	Transport	Industrial processing (oil refineries, steel, and iron productiown and chemical production)
		ENGINEERS									
1	214501	Chemical engineer	H	Bachelor's degree: Chemical or *electrochemistry engineering*	×	×	×	×		×	×
2	214201	Civil engineer	H	Bachelor's degree: Civil engineering	×	×	×				
3	215101	Electrical engineer	H	Bachelor's degree: Electrical engineering	×	×	×		×	×	
4	215201	Instrumentation engineer	H	*Bachelor's degree: Instrumentation engineering*	×		×		×		
5	214301	Environmental engineer	H	Bachelor's degree: Civil engineering, with environmental engineering	×						
6	214103	Robotics and automation engineer	H	Bachelor's degree: Mechatronics engineering	×	×	×	×	×	×	×
7	214607	Gas engineer	H	Bachelor's degree: *Petroleum*, mechanical, civil, or chemical engineering	×	×	×	×	×	×	×
8	214101	Industrial engineer	H	Bachelor's degree: Industrial engineering	×	×	×	×	×	×	×

Table 15. Table cut-out - Requirements for GH2 Skills
(i.e., Occupations and Corresponding Qualifications)Disaggregated by value chain segments (Identification of Skills Needed for the Hydrogen Economy, 2024, page 37)

For the exact occupation, qualification, and skill level required across the occupational categories mapped against the respective H2 value chain segments or any further details in that regard, refer to Section "6.2.1 The skills required for the green hydrogen economy" in the "Identification of Skills Needed for the Hydrogen Economy" Report in annex 2.

The identified occupations required across the H2 value chain segments categorized into five occupational clusters / categories adopted from international best practices are outlined in the table below for guidance purposes.

Identified occupations required across the H2 value chain segments				
Engineers (35 occupations)	Technicians & trades people (39 occupations)	Specialists (38 occupations)	Managers (14 occupations)	Elementary level workers (12 occupations)
Chemical engineer*	Commissioning technician	Renewable interconnect specialist	Plant manager	Cleaner
Civil engineer*	Chemical process technician	Automation & control specialist	Drilling & completions supervisor	Helper
Commissioning engineer	Chemical laboratory technician	Geoscience professional: **Geologist***, geophysicist, geotechnical specialist	Pipeline scheduler	Caretaker
Electrical engineer*	Mechanical technician	Compression specialist	Asset performance manager	Guard
Instrumentation engineer	Maintenance technician	Corrosion specialist	Utility services planner	Garbage collector
Environmental engineer*	Test technician	Measurement specialist	Maintenance planner	Sweeper
Robotics & automation engineer	Cylinder technician	Pipeline integrity specialist	Power scheduler	Labourer
Facility engineer	Fuel cell electric vehicle (FCEV) technician	Tank tester or inspector	**Project manager***	Land clearer
Gas engineer	Fuel cell technician	Transportation solutions advisor	Business & technology manager development manager	Handyperson
Grid connection engineer	HVAC technician	Hydrogen integration specialist	**Supply chain manager***	Assembling labourer
Industrial engineer*	Electrolyser technician	Utility inspector	**Sales & marketing manager***	Manufacturing labourer
Mechatronics engineer*	Refueling technician	Economic modelling specialist	Administrative manager	Freight handler
Mechanical engineer*	Utility service technician	**Economist***	Investment manager	
Process engineer*	Instrumentation technician	Finance specialist	Communications manager	
Process control engineer	Mechatronics technician	Communications & marketing specialist		
Safety engineer*	Materials technician	Lawyer		
Production engineer	Marine technician	Safety & hazards specialist		
Cavern engineer	Electrochemical technician	Business developer		
Drilling engineer	Safety technician	Supply chain specialist		

Table 16. Identified occupations required across the H2 value chain segments

** Occupations in high demand that would require reskilling or upskilling for the hydrogen economy*

Identified occupations required across the H2 value chain segments				
Pipeline engineer	System integration technician	Power-to-X technology specialist		
R&D engineer	Operation technician	Hydrogen value chain expert		
Software engineer*	Renewable energy technologist	Public relations specialist		
Locomotive (train) engineer	Welder	Administration specialist		
Welding engineer*	Assembly technician	IT specialist		
Materials engineer	Manufacturing production technician	Sustainability specialist		
Systems engineer	Pipeline technician: Electrical & instrumentation, mechanical	Innovation specialist		
RE engineer*	Locomotive electrician	Energy storage specialist		
Refueling station engineer	**Electrician***	Energy transition specialist		
Electrolysis engineer	Drilling crew	Operation optimisation specialist		
Electrochemical engineer	Reservoir technologist	Technology commercialisation specialist		
Fuel cell engineer*	Compression station operator	Grid operation specialist		
Marine engineer	Control room operator	BOP specialist		
Hydraulic engineer*	Well completions operator	Land acquisition specialist		
Design engineer	Plant operator	Nanotechnology specialist		
Quality engineer	Utility operator	Marine engines expert		
	Heavy-duty mechanic (dual fuel)	Artificial intelligence specialist		
	Truck driver	Cybersecurity specialist		
	Gas fitter	Political scientist		
	Fitter & turner*			

In the next section, the study details the capabilities (skills and knowledge) for each occupation identified in the above table. These capabilities were adapted from Hufnagel-Smith (2022b) and Hydrogen Europe Research et al. (2023b). However, not all the occupations identified were extracted from these sources; therefore, the Council for Scientific and Industrial Research (CSIR) conducted an analysis for the remaining occupations identified. Tables 6–10 in Section "6.2.2 Capabilities required for the green hydrogen economy" in the "Identification of Skills Needed for the Hydrogen Economy" Report in annex 2 provide a matrix that identifies the skills and knowledge around which upskilling or reskilling can be focused on to ensure individuals currently employed in these occupations, in non-hydrogen-related sectors, are able to participate in the H2 economy.

Accordingly, this section takes a detailed look at **key occupations and capabilities (skills and knowledge) required for the occupational categories mapped against the respective H2 value chain segments**. For the sake of clarity, refer to the below table for one example of the occupations and capabilities identified for the "Engineers" occupational category mapped along the H2 value chain segments. The core capabilities required and their applicability across the value chain are denoted by 'x'.

HYDROGEN CAPABILITIES	Plant manager	Drilling and completions supervisor	Pipeline scheduler	Asset performance manager	Utility services planner	Maintenance planner	Power scheduler	Project manager	Business and technology manager development manager	Supply chain manager	Sales and marketing manager	Administrative manager	Investment manager	Communications manager
HYDROGEN PRODUCTION														
Knowledge of automated process systems and control systems associated with electrolysers														
Understanding electrochemical reactions, processes, and hydrogen production process	×				×			×	×	×				×
Maintenance of equipment and systems involved in hydrogen production	×							×						
Appropriate selection, design, and maintenance of electrolysers, vessels, compressors, piping systems and fitting, valves, and seals to withstand hydrogen pressure and temperatures	×													
Appropriate selection, design, and maintenance of combustion, compression, pumping and turbine systems, and equipment to withstand hydrogen pressure and temperatures														
Knowledge of hydrogen gas value chains	×							×		×				
Knowledge of key high power electrical equipment and interconnection applications associated with renewable electricity–powered electrolyser produced hydrogen								×						
HYDROGEN STORAGE														
Understanding appropriate well completion solutions for hydrogen		×						×						
Understanding properties and characteristics of hydrogen in a gaseous state		×												
Appropriate selection, design, and maintenance of hydrogen compression, turbine systems, and equipment														
Understanding measurement equipment and instrumentation associated with hydrogen transmission														
Understanding hydrogen compression processes	×							×						

Table 17. Table cut-out - H2 capabilities for manager
(Identifications of Skills Needed for the Hydrogen Economy, 2024, page 78)

For the exact occupations and capabilities required across the occupational categories H2 value chain segments against the respective occupational groups or any further details in that regard, refer to Section "6.2.2 Capabilities required for the green hydrogen economy" in the "Identification of Skills Needed for the Hydrogen Economy" Report in annex 2.

The below table identifies the **most required hydrogen capabilities across the five occupational categories**.

Most required capabilities for the GH2 economy	
Occupational category	**Hydrogen capabilities**
All 5 Occupational Categories: 1. Engineers 2. Technicians and tradespeople 3. Specialists 4. Managerial occupations 5. Elementary-level occupations	**Most Required / Core and cross-cutting:** 1. Knowledge of hydrogen properties, behaviour, and potential hazards created 2. Safety when working with or around hydrogen 3. Knowledge of hydrogen-related regulations, standards, and codes 4. Understanding electrochemical reactions, processes, and hydrogen production processes
Engineers Technicians and tradespeople	**Most Required:** 1. Understanding the properties and characteristics of hydrogen in a liquid and gaseous state 2. Understanding hydrogen compression processes 3. Evaluating performance and production quality, as well as diagnosing and addressing production and process issues relating to hydrogen
Specialists	**Highly Required:** 1. Knowledge of hydrogen gas value chains 2. Insights into hydrogen production, economies, risks, technology, renewables, and scaling 3. Knowledge of hydrogen production, distribution, and dispensing technology to meet the needs of different fleets **Fundamentals:** 1. Knowledge of hydrogen fuel cell technology, how it works, and value proposition relating to emissions targets and cost-effectiveness 2. Knowledge of hydrogen production, distribution, and dispensing technology to meet the needs of different fleets
Manageial occupations	**Required:** 1. Knowledge of hydrogen gas value chains

Table 18. Most required capabilities for the GH2 economy

ANNEX 2 STUDIES, QUESTIONNAIRES, AND CONCEPT NOTES

- Country fiche Jordan (Hyperlink)
- European hydrogen skills strategy (Hyperlink)
- Green skills for Hydrogen (Hyperlink)
- Identification of Skills Needed for the Hydrogen Economy-Report-April-2024 (Hyperlink)
- International-PtX-Hub_202308_Namibia-PtX-skills-needs-assessment (Hyperlink)
- Skills interview guide for developers (Hyperlink)
- Skills interview guide for local manufacturers (Hyperlink)
- Skills interview guide for ministries and national agencies (Hyperlink)
- Local Value Creation Gap Analysis Report Jordan (Hyperlink)
- Infrastructure Gap Analysis Report Jordan (Hyperlink)
- Draft Concept Note - Establishment of the Online Academia Advisory Board (Hyperlink)
- Draft Concept Note - Establishment of a Regional Working Group on Standardization and Metrology (Hyperlink)
- Draft Concept Note - Establishment of the MED-GEM's Centralized Online Platform (Hyperlink)

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