CTF PRIVATE SECTOR PROPOSAL

Name of Project or Program	**Green Hydrogen Support Program**
CTF amount requested	Investment: USD 31.50 million Grant: USD 1.00 million MPIS: USD 0.85 million Total amount: USD 33.35 million
Country targeted	Global; CIF countries, with advanced pipeline in Morocco, as well as early indicative pipeline in India, South Africa, and Brazil
Indicate if proposal is a Project or Program	Program

1 DETAILED DESCRIPTION OF THE PROGRAM

1.1 The Program

IFC's Green Hydrogen Support Program (the "*Program*") will seek global opportunities to create green hydrogen (GH2) markets by conducting a series of coordinated activities across several CIF countries aimed at improving the bankability of GH2 solutions and business models. The *Program* will concentrate efforts on supporting and expanding a pipeline of GH2 projects across countries where investment conditions are becoming "nearly right" for these types of investments and where the governments are committed to moving the GH2 agenda forward. Target markets include Morocco, India, South Africa, and Brazil.

GH2 projects are being announced with unprecedented momentum and several projects are advancing rapidly to early planning stages across many countries. GH2 has a fundamental role in the decarbonization agenda for hard to abate sectors such as industry (e.g., chemicals, steel, aluminum) transportation (including shipping and aviation), and agriculture (e.g., fertilizers). According to the International Energy Agency, "only 5 per cent of [announcements for the production of low-emission hydrogen] have taken firm investment decisions due to uncertainties…." The significant capital investment required, along with technical and integration challenges, policy and regulatory constraints and appropriate business models essential for GH2 pilot projects are some of the key barriers to overcome without government support and/or low-cost financing. As a result, the global GH2 industry remains at a nascent stage of development, despite its immense transformational potential.

The *Program* will aim to create a crowd-in effect by increasing confidence in investors, de-risking project risks, reducing the cost of capital, and driving the competitiveness of GH2 projects. IFC's project pipeline includes production of GH2 for green ammonia for agriculture, green steel, e-methanol for green shipping and aviation fuel, and development of GH2 hubs, among others. Therefore, the *Program* has the potential to kickstart GH2 value chains in key identified economies by making a transformational impact to the development of GH2 markets in target countries, thereby stimulating long-term decarbonization objectives and making an important contribution to commitments under the Paris Agreement on Climate Change and Sustainable Development Goals.

The *Program* will initially focus on the most advanced projects in IFC's pipeline and given the rapid development of the nascent GH2 market, the *Program* will remain flexible, and seek to

identify where CTF support is needed most and likely to be most impactful. Presently, the most promising pipeline opportunities are in Morocco and India. As pipeline projects mature and meet readiness criteria, IFC may seek to submit a supplemental funding request for CTF Trust Fund Committee consideration.

In Morocco, for example, the *Program* aims to support transformative first-of-a-kind GH2 pilots that are in line with the country's sustainable energy and decarbonization objectives. If successful, IFC foresees the development of at least 3,300 Megawatts (MW) of clean power generation and 1 million (mm) metric tons (Mt) of green ammonia production starting with the first phase of deliveries in 2026. The Morocco pilots will substitute USD 2 billion of fossil-based ammonia for local green production. Other key benefits are the potential greenhouse gas (GHG) emissions savings of 1,367,269 tCO2/year, creation of over 2,500 direct and indirect jobs, and implementation of a just transition and gender action program to leverage the benefits of a balanced workforce in the country.

1.2 Fit to the CTF Futures Window

In line with the stated objectives of the CTF Futures Window, the *Program* sets its foundation on two main thematic investment areas, renewable energy plus (RE Plus) and emerging clean technology sectors. Expanding access to dedicated renewable energy resources remains a necessary pre-condition for the success of the *Program* across countries, regardless of the final GH2 applications and uses. Therefore, the *Program* underpins both large scale renewable energy generation and local production of GH2. In Morocco, the *Program* will drive large scale renewable energy deployment in the country to produce GH2 that can be used as a feedstock in the chemical sector and as fuel in electricity, heat, or transport applications.

Evolution of GH2 production requires targeted investments of concessional capital to mobilize the needed level of private investment for transformative scale, and to de-risk pilots. The *Program* builds on innovative de-risking structures that use blended concessional finance, an underlying principle of the CTF Futures Window. The *Program* will pilot first-of-a-kind GH2 projects – providing a critical demonstration effect – to accelerate scale-up of GH2 production and use in emerging markets. Concessional funding is critical for early GH2 projects to be viable and to reduce large premiums on these sustainable products relative to what is currently available from fossil fuels. In Morocco, this will facilitate large scale production of green fertilizers and with the country's geographic proximity and existing pipeline connectivity to Europe, provides an alternative source of GH2 and green ammonia for Europe for other potential uses in industry, power, heating, and transport. Sub-projects in other countries targeted by the *Program* will similarly utilize concessional resources to enable catalyzing the scale-up of GH2 production to serve markets for applications in agriculture, industry and/or transport.

1.3 Green Hydrogen and Green Ammonia International Context

GH2 and GH2-derived products are expected to be a fundamental pillar of a net zero global economy. To reach the climate goals and low emitting economy, hydrogen and hydrogen-based products are expected to account for 10% of global energy consumption.[1] However, hydrogen production must be decarbonized through clean pathways. GH2 is produced with an electrolyzer that is powered by various types of renewable energy and splits water into hydrogen and oxygen. Today, hydrogen is produced mainly by using carbon-intensive sources ("grey or brown hydrogen"). In 2021, approximately 99.6% of

[1] International Energy Agency (2022), IEA World Energy Outlook 2022, https://www.iea.org/reports/world-energy-outlook-2022

the 100 Mt of global hydrogen production used fossil fuels, having associated emissions of more than 900 Mt CO2.[2]

The urgency to achieve carbon reduction targets and recent geopolitical tensions have put extra pressure on governments to accelerate their energy transition plans. During the past five years, more than 30 countries have developed national strategies and roadmaps, and several countries have also started establishing incentive programs such as contracts for difference, tax credits and end-user incentives to accelerate the development of green hydrogen for both domestic and global consumption. As a result, in the past two years, over 400 projects have been announced globally in developing countries and approximately 70 projects are large-scale in nature with an electrolyzer installed capacity of 500 MW or more. The strongest demand for green hydrogen projects is expected to come from countries with well-established renewable energy infrastructure, conducive regulatory and fiscal environments, and those without significant appropriate domestic fossil fuel resources.

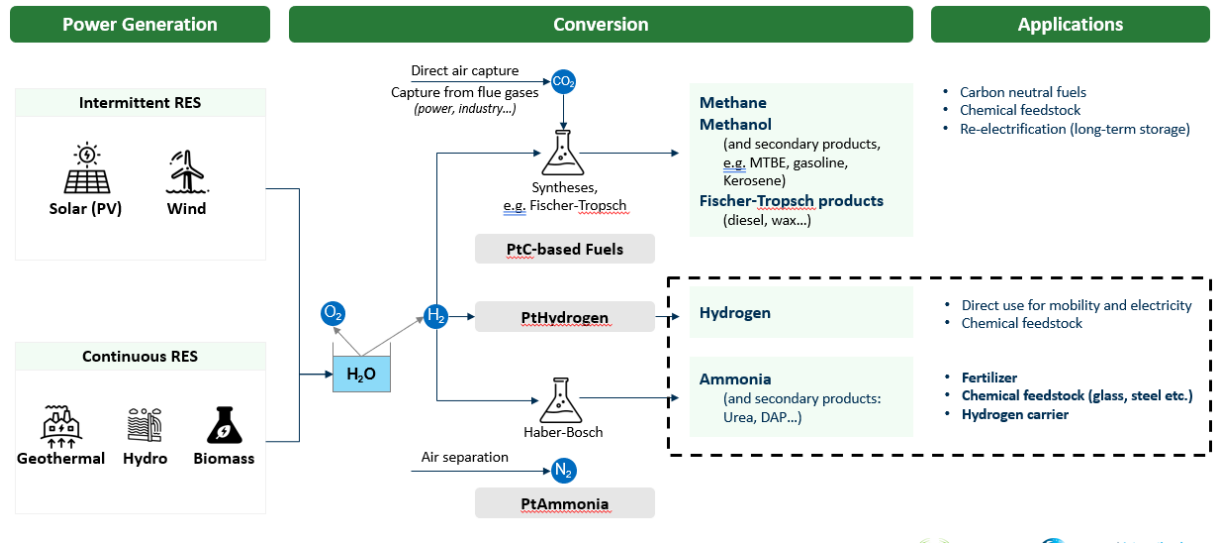
Today, demand from industry dominates end-use applications for hydrogen, and agricultural demand for ammonia production represents the second largest end-use sector globally. The demand for hydrogen reached an estimated 94 mm Mt in 2022. Over 40% of this was for oil refining (39 Mt), ammonia (34 Mt) production, methanol production (15 Mt) and direct reduced iron process for steelmaking (5 Mt). The use of hydrogen particularly for industrial applications generated 630 Mt of direct CO_2 emissions in 2021, representing 7% of global industrial CO_2 emissions. [3]

Ammonia (NH3), a hydrogen-based product, is a growing market essential for agricultural practices and global food security. About 55% of global food production is due to the proper application of fertilizers, and without their use, the planet can only produce enough food for about 3.25 billion people. Of all the nutrients needed for plants, nitrogen (essential for amino acids and proteins) is the most critical and is also most used. Ammonia is the starting point for all nitrogen fertilizers widely used in agriculture, which account for approximately 70% of global ammonia demand. The remaining 30% of ammonia demand is for a wide range of industrial applications, including pharmaceuticals, synthetic fibers, controlled explosives for mining, and specialty materials.[4] The ammonia market has been growing over the last decade and is dominated by Chinese and Russian production. In 2022, an estimated 238 mm Mt of ammonia production was available. The capacity has grown at a 1.5% compound annual growth rate since 2011 driven by population growth. In terms of demand, it reached 187 Mt at the end of 2022, 15% more than 2011.[5]

The conversion of high carbon hydrogen to green hydrogen in hard to abate industrial processes is ripe to address first. Ammonia production accounts for 1.3% of global energy demand and around 1% of energy-related CO2 emissions.[6] Considering the significant amount of grey hydrogen produced annually, and the resulting high CO_2 emissions, the priority is to start decarbonizing existing hydrogen demand by, for example, replacing ammonia produced from natural gas with green ammonia as illustrated in Figure 1 below. Medium to long-term steps would include expanding and commercializing the use of hydrogen and derivatives for heavy transport, power and heat generation and storage.

Figure 1: Green hydrogen and ammonia production and end-use sector applications

[2] International Energy Agency (2022), IEA Global Hydrogen Review, https://www.iea.org/reports/global-hydrogen-review-2022
[3] Ibid.
[4] Ibid.
[5] Bloomberg New Energy Finance (2023), Ammonia Market Primer
[6] International Energy Agency (2022), IEA Global Hydrogen Review, https://www.iea.org/reports/global-hydrogen-review-2022



Today, GH2 is not commercially deployable without addressing high upfront capital costs through concessional finance and utilizing low-cost electricity. Despite aspirational pledges to the contrary, the disparity in the cost of fossil-based and green hydrogen production remains wide. In 2021, in most regions, the cost of GH2 production was more expensive than producing hydrogen using fossil fuels (without CCUS). The average cost comparisons are: USD 1.0-2.5/kg H2 from unabated natural gas; USD 1.5-3.0/kg H2 from natural gas with CCUS ("blue hydrogen"); and USD 4.0-9.0/kg for production of green hydrogen via electrolysis with renewable electricity.[7] Particularly for production through electrolysis**,** the cost of electricity can represent about 60-70% of the hydrogen production costs; therefore cheap renewable power is one of the keys to bridging the gap with the current cost of fossil-based hydrogen.

The World Bank Group is continuously assessing investment opportunities and supporting the uptake of promising projects. IFC is currently investigating investment opportunities across 36 emerging markets and and/or providing funding to ca. 15 green hydrogen pre-investment opportunities. The engagements with the private sector include a variety of planning and feasibility studies, reviews of contractual documentation, development of pilot projects, and potential debt financing for investment projects. The International Bank for Reconstruction and Development (IBRD) is providing support to governments including drafting of low-emissions hydrogen policies, legal and regulatory framework build-up, and design of financing mechanisms to fund pilot projects. In Chile, IBRD approved a USD 150 million loan to finance projects, establish risk mitigation reserve accounts, develop technical assistance and capacity-building activities.[8] Another case is India, where the WB approved USD 1.5 billion in the form of development policy financing support to promote national and state level policies, incentives and enabling regulations for green hydrogen, reduce RE costs, improve RE integration into grids, and to launch a national carbon market. [9]

Green hydrogen and green ammonia production need a catalytic enabling environment, including local demand, national policies, subsidies, creditworthy off-takers, and strong project sponsors. Morocco is one of several emerging economies that have several appropriate ingredients to be on the forefront of developing as producers and suppliers of green hydrogen. It is among the leading countries

[7] International Energy Agency (2022), IEA Global Hydrogen Review, https://www.iea.org/reports/global-hydrogen-review-2022
[8] World Bank (2023), Chile Green Hydrogen Facility to Support a Green, Resilient and Inclusive Economic Development, https://projects.worldbank.org/en/projects-operations/project-detail/P177533
[9] World Bank (2023), First Low-Carbon Energy Programmatic Development Policy Loan (P181032), https://documents1.worldbank.org/curated/en/099062723011526290/pdf/P181032062f0960a0ab9b08dad2b10fa5f.pdf

that are creating hydrogen hubs through strong support and ambition from its government and key market players.

1.4 Barriers to Green Hydrogen Market Transformation

GH2 production uses known technologies that perform adequately on a standalone basis (i.e., alkaline electrolyzers, solar panels, wind turbines) but there are still many unknowns when these technologies are integrated and encompassed in one plant, giving rise to technology integration risk. As an example, electrolyzers need to be adapted and scaled specifically for GH2; interim energy storage and hydrogen handling systems must be scaled; and manufacturing capacity and associated costs need to be improved. All these factors and new business models are required for GH2 to be competitive with existing world-scale grey hydrogen infrastructure. Most of the projects today are at very early stages and the *Program* faces the barriers listed in Figure 2.

Figure 2: Barriers to the Program

Barrier	Description
High capital and production costs	➢ Green hydrogen costs currently range from USD 4-9/kg, which is at least 2-3x the cost of producing hydrogen from fossil fuels. The production cost for green hydrogen is particularly sensitive to project scale, power prices, plant utilization rates, and capital costs.
Access to affordable and commercially proven electrolyzers	➢ There are currently four types of electrolyzers, i.e., alkaline and polymer electrolyte membrane (PEM), which are already commercial, while anion exchange membrane (AEM) and solid oxide are at demonstration stages. There is currently no clear winner since each technology has its own limitations, from critical materials to performance, durability, and maturity, which leaves room for competition and innovation to drive down costs.[10]
Lack of off-takers	➢ Ambitious green hydrogen deployment announcements have taken place in the past three years; however, many have no firm off-takers. Offtakers will mark the pace to absorb new GH2 production and their early commitment is crucial to improve the bankability of projects. Important to note that offtakers themselves struggle to convince customers to accept the green premiums amid the uncertainty around the trajectory of future cost of production.

[10] IRENA (2020), Green Hydrogen Cost Reduction: Scaling up Electrolysers to Meet the 1.5ºC Climate Goal, International Renewable Energy Agency, Abu Dhabi.

Competitiveness against alternative technologies	➢ The use of hydrogen for chemicals is well known but cost and efficiency challenges remain around the use of green hydrogen in other applications like transport, and power generation.
Storage and transportation to end-users, and lack of infrastructure	➢ Transporting and storing hydrogen can add up to 1-2x more costs and may require significant investment in infrastructure (i.e., pipelines, shipping, storage terminals, distribution & access points, ports retrofitting) to facilitate smooth trading flows, as well as in better handling and storage systems that are energy efficient and can contain hydrogen effectively.
Poor conducive regulatory environments	➢ In most emerging markets, hydrogen-specific policies and regulations are nonexistent or not yet well defined. There is a need for cross-sectoral and global development and update of safety guidelines and technical codes.
Large Scale	➢ The large size and complexity of projects, coupled with the relatively nascent nature of green hydrogen plants operation, exposes the *Program* to execution risk such as delays and cost overruns.
Nascent or Absent Carbon Markets	➢ The implementation of GH2 projects could transform the sale of carbon credits into revenue for producers. However, carbon markets are not mature enough or lack structured credible accounting and verification methodologies in several developing countries.

In particular, the *Program's* ambitious scale may bring on challenges in terms of overall high production costs and complexity. However, the *Program's* initial successes in one or more countries can help governments further enhance the policy and regulatory environment for developers and investors, contributing to continued sector growth and a reduction in future project costs.

1.5 Investment Services Component

The global *Program* aims to develop nationally targeted GH2 initiatives starting with the most advanced potential investments in IFC's pipeline. In Morocco, for example, the *Program* will seek to finance key opportunities that have the potential to kickstart GH2 and green ammonia markets in the country. If successful, the Morocco pilots will generate positive demonstration effects for domestic

consumption, thereby displacing imported ammonia, as well as for potential nearby export markets in Europe. Morocco's experience will also be illustrative for the other GH2 investments that are being developed in other countries under the *Program*.

The GH2 pilots will support cross-sectoral decarbonization activities that underpin progress toward meeting climate mitigation objectives. Activities will seek synergies with the work being undertaken under each country's Nationally Determined Contributions under the Paris Agreement, the CIF Country Investment Plans, as well as by other development partners, including close collaboration with IBRD to support governments in the implementation of their green hydrogen strategies – all of which will help countries meet their commitments under the Paris Agreement on Climate Change.

The Morocco GH2 pilots will play a critical role in supporting food security and substituting imported ammonia with local and low-emitting feedstocks. One proposed sub-project, currently at an advanced planning stage, targets building a fully integrated 1 mm Mt per annum green ammonia production plant. The sub-project's Sponsor is a phosphate rock miner, phosphoric acid manufacturer, and fertilizer producer that is committed to reducing its carbon footprint and scaling fertilizer production to support food security. The Sponsor has access to about 70% of the global phosphate rock reserves, making it the leading producer and exporter of phosphate fertilizers globally. The plant will comprise 3,300 MW of clean power generation (including 1,000 MW of solar energy and wind 2,300 MW of wind energy), 2,700 MWh of battery storage, 1,850 MW of hydrogen electrolysis capacity and other ancillary facilities. The estimated total capital expenditure of the sub-project is USD 7 billion.

IFC is engaged with the Sponsor in the development of the sub-project under an early-stage development agreement. IFC is providing inputs and reviews to Sponsor from a lender's perspective on the preliminary feasibility and contractual documents for the project to facilitate a decision on how to move ahead with the large-scale investment.

In parallel, IFC's in-country pipeline includes several "*Early Mover*" projects identified in Morocco that will fortify a sustainable GH2 value chain that will help build and sustain the country's broader GH2 market over the long-term. These potential Early Mover GH2 pilots have sponsors with strong balance sheets that can tap into significant renewable energy potential to meet demand from local off-takers. (Similar types of opportunities are also in IFC's pipeline in India, Brazil and South Africa, among other countries. In addition, IFC is monitoring the emergence of a strong pipeline of potential sub-projects from major global players such as CWP, Masdar, Iberdrola, Proton Ventures and EDF).

The USD 31.5 million of CTF investment funds requested for this *Program* will be blended with IFC's own capital to support advanced sub-projects in Morocco and other target countries. Given that the project cost gap between conventional (high carbon intensive) types of hydrogen produced from fossil fuels and green hydrogen remains substantial, a significant amount of concessionality is needed to enable projects in developing countries and reduce the premiums on green products from impacting households, farmers, and other consumers.

The *Program* can contribute significantly to the goals of the respective country-based programs and development of GH2 roadmaps. Morocco, for example, has been one of the first countries to develop and publish a green hydrogen roadmap with ambitious targets. The Moroccan Ministry of Energy, Mines, and Environment set out a roadmap on green hydrogen in 2021 under the National Hydrogen Commission. By 2030, the roadmap outlines two pillars i) development of local hydrogen production which can fulfill national ammonia demand and ii) exportation of green hydrogen to countries with ambitious decarbonization goals. It is estimated a national green hydrogen demand of 4 TWh by 2030 powered by 2 000 MW of RE and international exports of 10 TWh generated with 6 000 MW of

RE. [11] The *Program* also targets to position Morocco as a possible exporter of green hydrogen and a hub for green industrial investment and exports.[12]

Morocco and the other countries targeted by the *Program* boast of very high-quality renewable resources, ranging from hydro, solar and wind resources, among others, which are key enablers for green hydrogen and green ammonia production. Morocco has targeted to increase the country's renewable energy installed capacity from 38% to 52% by 2030. To meet the 2030 target, the country aims to add around 10 000 MW of RE capacity between 2018 and 2030, consisting of 4 560 MW of solar, 4 200 MW of wind, and 1 330 MW of hydropower capacity[13]. Morocco's attractive RE resources, coupled with the government's strong commitment and the country's existing energy interconnection infrastructure with Europe (including gas pipelines), places it in a unique competitive position for green hydrogen and green ammonia production. In Brazil, RE already accounts for 84% of installed capacity, and while hydropower is the largest source historically, wind power and solar energy have seen the greatest growth in recent years, including for both grid-connected and distributed generation (mainly solar). Similarly, renewables account for just over 40% of installed capacity in India and 20% in South Africa.

Globally, Morocco is the world's second largest phosphate-based fertilizer producer, and it exported USD 5.8 billion in fertilizers in 2021, making it the world's 4th largest exporter. In the same year, fertilizers were Morocco's second largest export product. The main destinations of Morocco's fertilizer exports are to: Brazil (USD 1.65 billion), India (USD 700 million), Bangladesh (USD 566 million), United States (USD 295 million), and Djibouti (USD 253 million).[14] The price of ammonia globally has increased from USD 444 per ton in 2021 to USD 1 096 per ton in 2022, resulting in higher production costs for all producers. The price increase is mainly due to the conflict in Ukraine that deprived global markets of ~15% of the ammonia supply that previously came from both Russia and Ukraine. As a large phosphate fertilizer producer in Morocco, the Sponsor of the sub-project consumes ca. 1.5 million tons of ammonia every year, making it a significant consumer, and the third largest importer of the product globally.[15]

The Sponsor is strong and has an ambitious decarbonization agenda. The Sponsor's green growth program provides for a global investment of about USD 13 billion over the 2023-2027 period. By 2030, the Sponsor targets to replace its electricity consumption with green energy, avoiding about 285,000 tons of carbon dioxide equivalent (tCO2e) annually. To reduce its carbon footprint, the Sponsor plans to phase out of grey ammonia by developing own capacity for green ammonia. Hence, the sub-project presents an attractive opportunity for the Sponsor to transition from grey ammonia to green ammonia. Through the successful development of a USD 12 billion manufacturing complex over the last decade, the Sponsor has also demonstrated its technical and project execution capability for large projects and the adoption of new technology.

IFC's green hydrogen strategy aims to unlock the potential of GH2 by supporting front runners in major developing countries. IFC has adopted a strategy to support GH2 projects with robust financial and technical capacities that have the potential to scale GH2 production and applications. As a result, IFC is advancing discussions on the pilots as it seeks to develop the green hydrogen sector in Morocco,

[11] Kingdom of Morocco (2021), Green Hydrogen Roadmap, https://www.mem.gov.ma/Lists/Lst_rapports/Attachments/36/Feuille%20de%20route%20de%20hydrog%C3%A8ne%20vert.pdf

[12] World Bank's Morocco Country Climate and Development Report (CCDR)

[13] IEA (2019), Morocco Renewable Energy Target 2030

[14] Datawheel (2023), Fertilizers in Morocco, https://oec.world/en/profile/bilateral-product/fertilizers/reporter/mar

[15] Yara (2022), Fertilizer Industry Handbook

with the goal of enabling the country to become one of the first movers in the world to operationalize green ammonia production at scale. Moreover, if enough first-mover projects are successfully executed and operated in Morocco, GH2 is expected to become cost-competitive by 2030. The IBRD is also in discussions with Morocco's Ministry of Energy to support the implementation of the national hydrogen strategy. Similar identification efforts are underway in Brazil, India, and South Africa, which also have strong RE endowments, the potential to serve major domestic markets and/or the ability to export.

1.6 Program's Strategy to Achieve Market Transformation

IFC's strategy across countries follows an approach of financing GH2 projects that can help catalyze local and/or export markets, create a local value chain, and ultimately sustain a meaningful ecosystem for long-term transformation and decarbonization. In Morocco, this includes:

- **Increase of at least 30% of the power generation installed capacity in Morocco.** Currently, Morocco has 10,800 MW of power installed capacity, of which 62% corresponds to fossil fuel sources. The proposed GH2 pilots in Morocco target installing 3,300 MW of wind and solar energy, significantly increasing the clean power generation of the country for industrial uses.

- **Substitution of USD 2 billion of grey ammonia imports for locally produced green ammonia.** In Morocco, the Sponsor, consumes ca. 1.5 million tons of ammonia every year**,** making it a significant consumer of ammonia, and one of the largest importers of the product globally. In 2022, the Sponsor imported USD 2 billion of ammonia, which represented ~36% of its purchases consumed and is planned to be replaced with locally produced green ammonia.

- **An outlook of 4 million tons of fertilizer production for the African market.** The fertilizers supply of the Morocco sub-project Sponsor to the Sub-Saharan African market plays a critical role for economic development. The Sponsor plans to increase fertilizer output capacity to 15 million tons in 2023 and 20 million tons in 2027, dedicating 4 million tons for African demand.[16]

- **Contribution to Morocco's NDC conditional target of 45.5% of greenhouse gas emissions reductions by 2030, compared to business as usual.[17]**

- **Conception of project financing standards and documentation packages that can be referenced by commercial-scale green hydrogen projects under preparation in Morocco and across the world.** Projects funded under the *Program* will seek to establish a track record and demonstrate the commercial viability of financing GH2 projects by the private sector in evolving regulatory environments.

- **Creation of 2,500 direct and indirect jobs, while factoring gender inclusivity.** The Morocco GH2 pilots are expected to create over 500 direct and 2,000 indirect jobs. Also critical, especially considering the Just Transition agenda in Morocco, is to help workers develop the skills they need for the nascent GH2 industry. The gender gap in Morocco is still considerable, the country is within the lowest gender gap index scores and ranks 136 out of 146 countries.[18] Therefore, the

[16] Reuters (2023), Morocco's OCP plans USD 7 billion green ammonia plant to avert supply problems, https://www.reuters.com/sustainability/climate-energy/moroccos-ocp-plans-7-mln-green-ammonia-plant-avert-supply-problems-2023-06-20/

[17] NDC Partnership (2021), Morocco submits enhanced NDC, raising ambition to 45.5 percent by 2030. https://ndcpartnership.org/news/morocco-submits-enhanced-ndc-raising-ambition-455-percent-2030

[18] World Economic Forum (2023), Global Gender Gap Report, https://www.weforum.org/reports/global-gender-gap-report-2023/

Program aims to better recruit, retain, and promote female talents and agency, thus reducing gender gaps in Morocco, with similar efforts in other IFC GH2 selected beneficiary country sub-projects.

- **Support of first-of-a-kind GH2 projects is essential to develop policy and regulatory frameworks that incentivize private sector investments.** The *Program* promotes the acceleration of innovative projects which can spur the creation, compliance and strengthening of regulatory frameworks. The *Program* will benefit from the close coordination and collaboration between the public and private stakeholders stemming from the current activities of IBRD and IFC in Morocco. In addition, countries can learn from the experiences across selected beneficiary countries/projects.

- **Reduction of concessional funding is expected to diminish in the long term as the risk perception falls and results in greater interest of commercial investors, lowered cost of capital, and reasonable returns.** The domestic market will mature and build capacity in understanding the technology (equipment supply, engineering, advisors etc.), while global markets will continue to grow, and equipment costs will continue to fall. The *Program* will further benefit from synergies with the efforts of the respective country governments in promoting GH2 and associated technologies.

1.7 Complementarity with Other Ongoing Initiatives

At COP27, the World Bank Group announced the creation of the Hydrogen for Development Partnership (H4D), a new global initiative to boost the deployment of low-carbon hydrogen in developing countries.[19] H4D, hosted by IBRD's Energy Sector Management Assistance Program seeks to catalyse significant public and private sector financing for hydrogen investments in India, South Africa and Morocco, among other countries. The partnership will foster capacity-building and regulatory solutions, business models, and technologies toward the rollout of low-carbon hydrogen in Brazil and Morocco, among other countries. In Morocco and India, among others, H4D plans to provide technical assistance to the operationalization of national hydrogen roadmaps and the development of regulations and standards to boost hydrogen supply and demand.

Specifically in Morocco, the World Bank Group is working to accelerate GH2 projects from the pilot stage to the industrial scale by:

- Providing technical assistance to foster enabling policy, regulatory, and fiscal frameworks;
- Building innovative financing that catalyzes concessional and climate finance resources;
- Integrating risk mitigation and credit enhancement instruments to mobilize private capital; and
- Transferring knowledge to develop local green jobs to support a just transition.

IBRD is working with the Government of Morocco to strengthen the institutional capacity to implement the NDC and enhance climate resilience of targeted vulnerable groups and ecosystems. Such work expects to establish institutional mechanisms to foster an integrated approach to climate and development and enhance the resilience of vulnerable groups. It will improve policy tools and strengthen coordination among various sectoral ministries and agencies. This operation complements and reinforces other IBRD engagements on climate change at the sectoral level (water, agriculture, energy, transport, etc.)

In 2023, the IFC and the Morocco sub-project Sponsor signed a partnership agreement through a landmark green €100 million loan to build four solar plants to power the Sponsor's Morocco operations. The plants will have a combined capacity of 202 Megawatt peak (MWp) and will supply clean energy directly to fertilizers production. The Sponsor plans to source 100 percent of its electricity needs through

[19] https://www.esmap.org/Hydrogen_for_Development_Partnership_H4D

wind, solar and cogeneration by 2027. The plants will also support the resilience and diversification of Morocco's electricity sector.

2 FIT WITH INVESTMENT CRITERIA

2.1 Potential for Transformational Change

To maximize the impact of the concessional funds, Table 1 below indicates how the *Program* aligns to CTF Futures Window investment criteria.

Table 1: Alignment to CTF Futures Window investment criteria

Transformational Change Dimensions	Dimension Description[20]	*Program* Alignment
Relevance	Fundamental changes and large-scale positive impacts relevant to the project's thematic investment area	The *Program* will address the climate crisis and advance clean energy innovation by investing in green hydrogen pilot applications in key beneficiary countries in **support of their national sustainable policies.** In Morocco, for example, this translates to aiming at increasing the country's renewable energy installed capacity to 52% **and achieving NDC conditional target of 45.5% of greenhouse gas emissions reductions by 2030.**
Systemic change	Fundamental shifts in the structures and functions	By supporting multiple pioneering projects, the *Program* will help to **establish a track record and demonstrate the commercial viability** of financing green hydrogen by the private sector in complex and/or evolving regulatory environments. If the *Program* is successfully executed and operated, it can be expanded and replicated to contribute to **achieving green hydrogen cost-competitiveness by 2030**. The *Program* will **champion the development of regulations** that incentivize private sector investments through capacity building and technical assistance for governments. In Morocco, for example, IFC is providing advisory services to the *Project* Sponsor in **corporate governance,** aiming to assist in

[20] CTF Futures Window Updated Investment Criteria for MDBs

		implementing an action plan to align the governance of its subsidiaries with international best practices.
Speed	Balance the speed of change required by the urgency of addressing climate change, while considering the time required for inclusivity and addressing system complexities	The post-COVID recovery timeframe presents a significant opportunity for the *Program* to help beneficiary countries to rebuild better by **prioritizing decarbonization and low-carbon pathways**. The *Program* will **capitalize on the mounting global interest in green hydrogen from governments,** as well as the investment momentum ahead of and following COP28. The *Program* will **leverage IFC Performance standards** to establish adequate safeguards for social and environmental inclusivity.
Scale	Deliver contextually large-scale impacts, such as explicit strategies for enabling subsequent scale-up or replication of the CIF-funded intervention	Through **successful demonstration projects implemented with high standards**, the *Program* will encourage private sector participation in green hydrogen projects. The successful implementation of the *Program* will **set a precedent that can be replicated at scale** and stimulate the green hydrogen sector in target countries and other emerging markets.
Adaptive sustainability	Deliver transformational changes that are resilient and lasting over the long-term, after concessional finance support is terminated, as well as adaptive to evolving contexts.	IFC monitoring protocols for the *Program* consider **processes to assess performance and results of the *Program,*** build capacity and skills and take corrective actions when required. These are in line with the CIF Evaluation & Learning Initiative. The *Program* will also **develop local value chains** for green hydrogen production procurement, operations, and maintenance in beneficiary countries, which will lead to increased local capacity, among other benefits.

2.2 Potential GHG Emissions Reduction/Avoidance

The GHG emissions reduction estimates presented in this proposal are based on the conservative options of potential design of the *Program.* If the final design will result in different technical configurations, the updated target GHG emissions savings estimates will be reported at the IFC Board approval stage.

Calculations of potential GHG emissions savings are based on the following assumptions:

- Expected facility size: 1,850 MW electrolyzer capacity;
- Expected total installed capacity: 2,300 MW wind and 1,000 MW solar PV;
- Expected ammonia synthesis loop capacity: 1 million Mt per annum
- Expected aggregate project cost: USD 7,000 million;

- CO2 emission factor: 0.0561 tCO2/GJ
- Anticipated lifetime of each sub-project: 20 years.

The *Program* is expected to directly generate GHG emission reductions of at least 1,367,269 tCO_2e over a representative year and around 27,345,380 tCO_2e over the project lifetime.

Given that the *Program* may result in an uptake of green hydrogen projects, triggering a series of follow-up projects, IFC anticipates that these activities may result in increased stakeholders' capacity, enhanced sector knowledge, and noticeable replication effect.

2.3 Financial Effectiveness

Value for Money

Based on the above calculations for expected GHG savings over the project lifetime, i.e., 27,345,380 tCO_2e, and overall size of the investment component of this *Program* of USD 31.5 million, the implied direct GHG emission reductions per CTF USD will be 0.868 tCO_2e/USD (or USD 1.15/tCO_2e) over the life of the sub-projects.

With the total investment cost of the *Project* estimated to be USD 7 billion, the total investment per direct lifetime GHG emission reductions is expected to be around USD 256/tCO_2e.

Mobilization Potential

The CTF support of the *Program* is expected to mobilize additional co-financing of USD 6,967.5 million, leading to a CTF leverage ratio of 1:214.

(in USD millions)	**CTF (A)**	**IFC**	**Other**
Total CTF Financing	32.5	200.0	6,767.5
Total co-financing mobilized **(B)**		6,967.5	
CTF Leverage Ratio (A:B)		**1:214**	

2.4 Potential to Significantly Contribute to the Principles of Just Transition

The *Program* will foster socially inclusive processes to identify and address the distributional impacts of the transition for workers and communities. Except for Brazil, coal represents a significant share of the installed power generation capacity in India, Morocco, and South Africa and accounts for an even greater share of power generation. As the *Program* is deployed and green hydrogen facilities are built, it will generate significant local employment opportunities, enabling a just transition for communities that rely on emissions-intensive industries. In addition, the *Program* will benefit from the World Bank Group's long experience in supporting countries where coal mines and power plants are closing, while contributing to the global set of principles and practices to transition away from coal. In South Africa, for example, IBRD is currently financing and supporting implementation of the just transition elements related to the decommissioning of the remaining operating units of the Komati Power Project.

2.5 Implementation Potential

The *Program* implementation lands on an outlook with a growing demand for low-carbon hydrogen, ammonia and fertilizers as depicted in Table 2. This setting seeks to decarbonize key industrial sectors and indirectly ensure food security in developing economies.

Table 2: Implementation Potential by 2030

	2020/2021	2030	Delta (2020/2021 & 2030)	Trend
Global Hydrogen Demand	94 Mt	130 Mt	35%	↗
Global Levelized Cost of Hydrogen Production	USD 4.0-9.0/kg	USD 1.01-5.13/kg	-75%	↘
Ammonia Global Demand	187 Mt	212 Mt	13%	↗
Fertilizers Market Value in Africa	3.6 bn	3.7 bn	3%	↗

The outlook for hydrogen demand is promising, increasing from less than 100 Mt in 2021 to 130 Mt by 2030. About a quarter of the 2030 demand is projected for ammonia production, which will be converted into fertilizers.

Green hydrogen is fundamental to transition the production of fertilizers towards a low carbon pathway.

The levelized cost of green hydrogen is foreseen to reduce drastically, from up to USD 12.0/ kg to USD 1.01-5.13/kg-H2 in 2030.[21] Countries with rich renewable resources, enabling policies and regulations are potential locations for low-cost hydrogen. In Morocco, for example, the average cost of producing hydrogen in 2030 is expected to be approximately USD 3.49/kg, lower than projected production costs in Europe. Such levels set a competitive advantage for hydrogen or ammonia exports.

Ammonia global production and demand is projected to keep increasing to produce fertilizers to keep up with food demand. Ammonia installed production could grow annually by 1%, reaching 263 Mt per year by 2030. Ammonia demand for existing uses could increase in 2023 and reach 212 Mt, up 13% from 187 Mt in 2022. Around 80% of this demand corresponds to its use in the fertilizer subsector.

The market for fertilizers in Africa (excluding South Africa) is expected to have a compound annual growth rate of 1.4% by 2027. In this region, fertilizers were valued at USD 3.6 billion in 2021 and expected to reach USD 3.7 billion by 2027, representing a CAGR of 1.4% during the forecast period. Ghana, Algeria, Egypt, Morocco, Tunisia, Nigeria, and Kenya are some of the largest consumers of fertilizers. The growing government initiatives on crop health, implementation of soil testing, and rising in-house fertilizer production in African countries are some of the key factors that drive the fertilizer market in the region.[22]

2.6 Gender Equality and Social Inclusion Impact

The *Program* will seek to promote gender equality and social inclusion in all activities from design, construction, operations, and management of green hydrogen plants. Private sector investments in GH2 will create job opportunities for women, youth, and people in rural or remote areas. IFC will work on an action plan with clients to collect gender-disaggregated data to ensure that women and men can equally participate in the construction and operations of the sub-projects, as well as in the surrounding communities, creating business value and securing influence and income for themselves. In line with the

[21] Bloomberg New Energy Finance (2023), 2023 Hydrogen Levelized Cost Update
[22] Mordor Intelligence (2021), Global Fertilizers Market

Program's contribution to the just transition principles, the *Program* will pay particular attention to gender equality when it comes to the acquisition of green and sustainable related skills and experience among local workers and communities.

2.7 Development Impact Potential

The *Program* is expected to contribute to a range of Sustainable Development Goals. The associated benefits are explained in Figure 4.

Figure 4: Contribution to Sustainable Development Goals

Impact	Contribution to SDGs	Program Benefits
Social	  	Local employment and gender inclusivity will be encouraged across the lifecycle of the *Program*. The *Program* considers an action plan to better recruit, retain and promote female talents, thus reducing gender gaps in the workforce.
Economic		The *Program* will stimulate the growth of the green hydrogen and ammonia market and its value chain in target countries.
Environmental	  	The transition from hydrogen produced from fossil fuels to green hydrogen will reduce GHG emissions, and ultimately help lead to the decarbonization of key industries in target countries. It will also result in a reduction in air pollution, which will, in turn, have a positive impact on health and livelihoods.
Market or Systems		The large-scale deployment of renewable energy and the production of green ammonia, the key feedstock in the production of fertilizers, will strengthen energy and food security.

2.8 Demonstration Potential at Scale

By utilizing innovative de-risking structures that use blended concessional finance, the *Program* will pilot first-of-a-kind green hydrogen opportunities, providing a critical demonstration effect. The *Program* aims to pilot first-of-a-kind green hydrogen projects in target countries, and to create a crowding-in effect by increasing confidence in investors. Scaling up will also help reduce the levelized cost of GH2 and contribute to the creation of new green economy jobs. Based on IFC's experience, USD 1 of concessional donor funding has leveraged on average nearly USD 7 of additional finance, comprising USD 3-4 of IFC own funds and USD 3-4 of commercial third-party capital from private

sponsors and investors, reducing costs and driving project cost competitiveness of low carbon technologies.

2.9 Additional Costs & Risk Premium

The terms and amount of the CTF funding to be provided under the *Program* will reflect the reality of the relevant markets. CTF funding will seek to overcome barriers to market transformation for the *Program* with the minimum level of concessionality required.

2.10 Financial Sustainability

The first-mover green hydrogen projects are expected to require concessional funding support due to the high upfront costs, high perceived risks, uncertainty, and lack of in-country experience. Over time, however, the need for concessional funds will likely diminish. The perception of risk will decrease, attracting greater interest from domestic and private sector investors. Costs for electrolyzers and other equipment will also continue to fall, allowing for prevailing market tariffs to become sufficient to deliver desired rates of return to investors.

The development efforts, persistence, and high costs encountered by the *Program* will ease the development and implementation process and lower entry costs for future project developers. These demonstration efforts will also improve the capacity of green hydrogen technology service providers and prove the technical and economic realities of its various applications. Through these mechanisms, the *Program* expects to promote the sustainability of green hydrogen projects, thereby accelerating the development of the sector across the globe.

2.11 Effective Utilization of Concessional Finance

Concessional funding will:

- Enable selected sub-projects to obtain financing not currently available from the market, but necessary for them to move forward with phased implementation of these large multiple billion-dollar investments;
- Allow IFC and other commercial investors to provide financing to sub-projects, helping them to mitigate risks and to reach financial closure;
- Set a precedent and benchmark for successful projects with high standards;
- Directly enable the construction of the first phase of projects and indirectly stimulate the green hydrogen sector in Morocco; and
- Encourage private sector participation in green hydrogen projects that can be replicated in Morocco and other promising emerging markets seeking to decarbonize similar industrial sectors.

2.12 Mitigation of Market Distortions and Application of DFI Enhanced Principles of Blended Concessional Finance

The proposed *Program* will not distort the market, since it will not be displacing any private sector investment, but rather will support first movers in the nascent industry. The *Program* represents an important opportunity to innovate, since it will leverage and enable financing to enter the nascent green hydrogen market in target countries. In Morocco, for example, concessional finance will be directed towards reducing the cost of capital for project developers seeking to provide new and evolving GH2 solutions, given the high CAPEX investment required – an issue due to the nascent level of development, manufacturing, and deployment of electrolyzers at large scale for hydrogen production. The *Program*

will represent first-of-its-kind private sector investments. After the initial investments, and as the market matures and becomes better understood by financiers and developers, it is expected that price certainty on GH2 products will be established and as such, commercial financing will flow, reducing the need for concessional funding.

The dedicated IFC team, working on the CTF tranche in each investment sub-project, as well as members of the Blended Finance Committee will carefully ensure that the sub-project structures respond to all DFI Enhanced Principles for Blended Concessional Finance for Private Sector Projects. Specifically:

- Economic Rationale for Blended Concessional Finance: While IFC will provide financing that is not readily available in the green hydrogen sector in target countries, considering the market barriers discussed in section 1.4, CTF funds will help rebalance the risk-return profile for the private sector sponsors and lenders (including IFC) and attract the participation of investors into the *Program*.
- Crowding-in and Minimum Concessionality: The "minimum concessionality" principle requires that subsidies should not be greater than necessary to induce the intended investment. The CTF investment will provide a subsidy to the *Program* investors to the extent necessary for them to proceed. IFC will seek to offer the same subsidy provided by CTF funds is available to all market participants.
- Commercial Sustainability: Use of blended concessional finance co-investments in the GH2 sector is expected to reduce over time as a track record is established through offtake contracts, operational risks are better understood, and therefore, commercial financiers are better able to assess and price relevant risks to enable further investment in the global GH2 industry.
- Reinforcing Markets: Supportive regulatory environments for GH2 are being developed by target countries, with support from other development partners. The successful implementation of the *Program* will help to clarify and reduce perceived regulatory risks, while also establishing a track record, which can mobilize investment from the private sector. This will also help highlight the benefits to regulators and law makers at the national and municipal levels.
- Promoting High Standards: The final terms of the CTF tranche of all investments will be approved by IFC's Blended Finance Committee in line with the CTF funds risk tolerance, eligibility criteria, and parameters of this *Program*. All the parties to the legal agreements will be made aware that IFC is acting on its own account, as well as an implementing entity for CTF.

2.13 Risks

Potential risks associated with the *Program* include the following and are summarized in Figure 5:

- Fertilizer Demand and Prices. In Morocco, the price of di-ammonium phosphate fertilizer has increased significantly since the second half of 2020, from USD 200/ton to USD 1200/ton[23] in 2022, because of the COVID-19 pandemic, global supply chain disruptions and the Russian invasion of Ukraine. However, fertilizer demand growth is expected to be only around 1 percent a year over the medium term. Tempered demand growth and prices could negatively impact the Program's profitability.
  Mitigants: Morocco *is* one of the largest and lowest-cost producers of phosphate fertilizers and has shown in the past the ability to withstand dips in the market. To offset current supply problems, OCP has negotiated a deal to import ammonia from North America for the next two years. With large volumes and a strong cost position, it can also absorb market shocks in difficult times.

[23] International Fertilizer Association (2023), Global fertilizer market drivers

- *Project* Construction and Operations. The large scale of some of the proposed projects and lack of operational track record may result in technical, construction, production efficiency, geotechnical and grid interconnection risks. In Morocco, for example, the sub-project is likely to be implemented in phases which may lead to multiple financings.
  Mitigants: IFC has experience in supporting both complex large-scale renewable and manufacturing projects. The *Program* will reinforce the selection of adequate developers and contractors who have extensive experience in renewables and/or chemicals and will ensure sufficient warranties and minimum performance criteria for construction and initial operations in line with the current market. Liquidated damages clauses will be negotiated to ensure risk is appropriately absorbed by contractors. Implementation of equipment service agreement by experience O&M contractors.

- Electrolyzer Technology Readiness, Performance and Scale Up. As yet, there is no clear winner for a scalable option between the two types of electrolyzers that are already commercially viable, i.e., alkaline and polymer electrolyte membrane (PEM), since each technology has its own challenges, from critical materials to performance and longevity. In addition, the current size of electrolyzers (~max 20 MW) manufactured will need to increase to capture economies of scale to drive down production costs and will be dependent on manufacturers ensuring sufficient manufacturing capacity and technical performance from larger units operating for the first time in emerging markets like Morocco.
  Mitigants: Technology risks will be critically evaluated and will benefit from a lender's technical advisor, it will be assessed the need of performance or similar guarantees and maintenance reserve accounts. IFC will ensure proper planning, risk assessment, and response protocols are in place to manage technology risks. In Morocco, the Sponsor and a local university have already established prototype operations for both alkaline and PEM electrolyzers to test their performance under ambient conditions to produce green ammonia. The results of these tests will inform technology selection and specification.

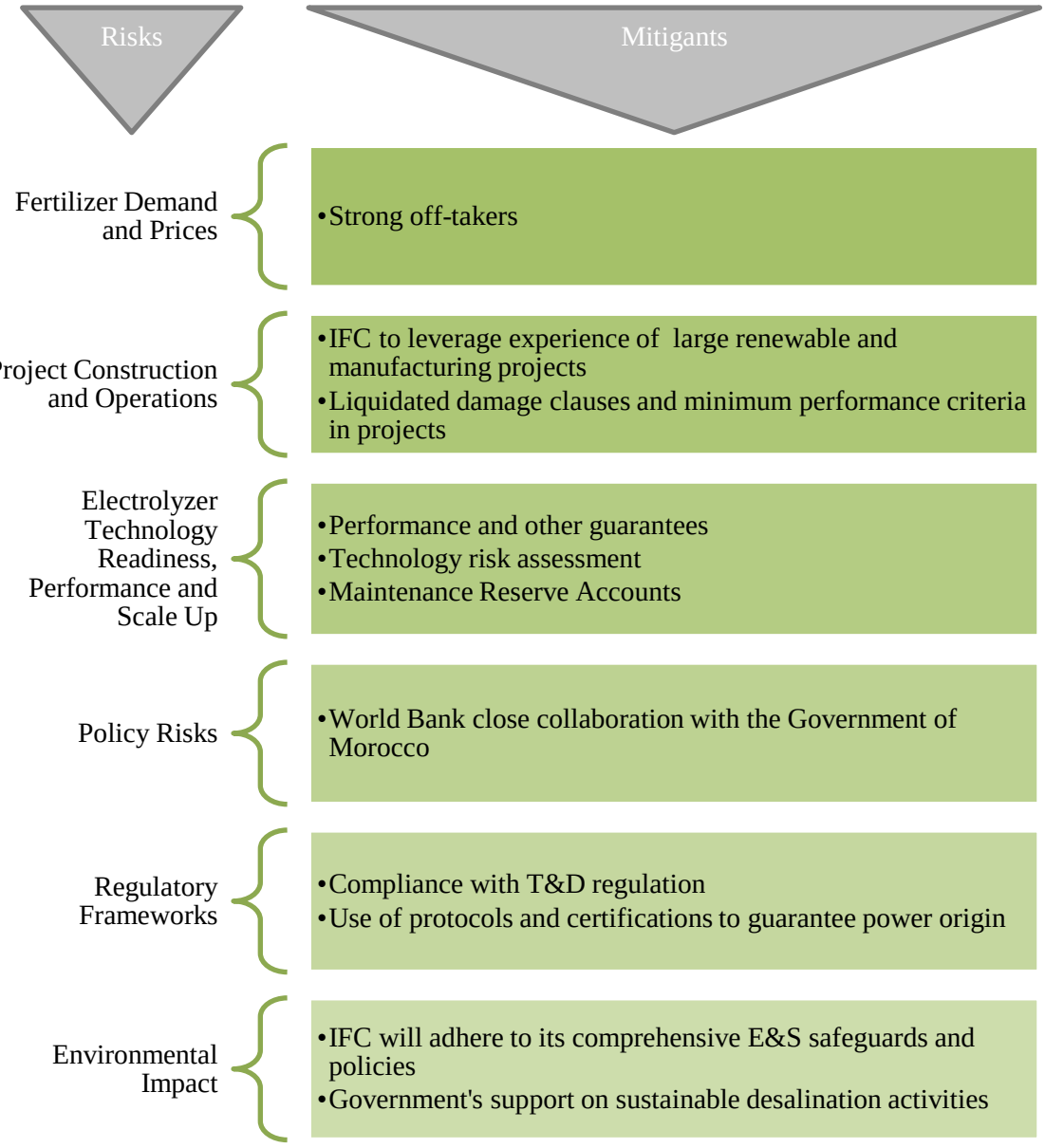
  Policy Risks. While committed to developing the green hydrogen supply chain in Morocco, the Government is continuing to evaluate its policies, incentives, and other regulations governing this nascent industry.
  Mitigants: The IBRD is working closely with the Government of Morocco to develop adequate policies that can facilitate the development of green hydrogen and green ammonia plants.

- Regulatory Frameworks. Proposed sub-projects intend to construct new solar and wind power to provide electricity to produce GH2. To the extent such electricity will not be directly connected to the plant and will be transmitted to the demand points.
  Mitigants: The *Program* should comply with regulations governing the transmission and distribution infrastructure and wheeling of renewable energy. Lenders will encourage the development or use of existing protocols and certifications to guarantee the origin of the power sources.

- Environmental Impact: The scale of land, water, and renewable energy installations needed for green hydrogen production is significant. Fresh water resources have become scarcer due to droughts in recent years. Furthermore, it will be extremely important to avoid hydrogen leakage to the environment. It will be crucial to engage local communities whose land and water is affected, as well as monitor the health and safety issues of transporting ammonia and hydrogen.
  Mitigants: IFC will adhere to its comprehensive E&S safeguards and policies to implement and monitor the *Program*, as well as follow the "equator principles" in all green hydrogen projects similar to other large infrastructure projects financed by IFC. The Morocco sub-project foresees

a renewable-energy powered desalination plant with capacity of 60 million cubic meters a year for hydrogen production and other industrial operations. In addition, the Government is promoting an increase in desalination activities by issuing tenders and supporting the use of innovative financing methods through public-private partnerships to help cities and agriculture cope with the effects of drought.

Figure 5: Summary of the Program's risks and mitigants



3 PERFORMANCE INDICATORS[24]

The performance indicators outlined below are derived from the CTF Results Measurement Framework. These indicators will be tracked at least annually and will include:

Indicator	Current Baseline	Anticipated Impact
CTF Core Indicators:		
GHG emissions avoided (tCO_2e): - per annum - over the indicative life of sub-projects	 0 0	 1,367,269 27,345,380
Incremental financing leveraged (of all non-CTF parties), USD million	0	6,968.5
Installed capacity of RE as a result of CTF interventions (MW) - wind - solar PV	 0 0	 2,300 1,000
Project-specific Indicators:		
Battery energy storage system (GWh)	0	2.7
Green hydrogen electrolysis capacity (GW)	0	1.85
Production of green ammonia (Mt) per annum	0	1
Development Co-benefit Indicators (as applicable):		
Job creation (#)[25] - direct - indirect	 0 0	 500 2,000
Number of companies adopting management strategies to attract, retain, and develop skills among women (#)	TBD	TBD

[24] At this stage, not all the technical details are yet known to precisely determine the anticipated impact of the relevant performance indicators under the *Program*. This information will be updated at the IFC Board approval stage for each sub-project.

[25] Gender-disaggregated targets to be determined based on results from gender analysis.