# Final report

## Study on possible political instruments to promote a sustainable supply of “green fuels” to Germany using the example of green ammonia from Namibia

Stiftung Klimaneutralität

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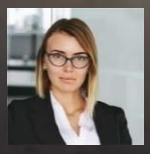

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# Contents

## Abbreviation

| | |
|---|---|
| BMWK | The Federal Ministry for Economic Affairs and Climate Action |
| CAGR | Compound Annual Growth Rate |
| CAPEX | Capital Expenditure |
| CfD | Contract for Difference |
| ECA | Export Credit Agency |
| EED | Energy Efficiency Directive |
| EIB | European Investment Bank |
| EPC | Engineering Procurement Construction |
| ESG | Environmental, Social, and Governance |
| ETS | Emissions Trading System |
| FDI | Foreign direct investment |
| GDP | Gross Domestic Product |
| GHG | Greenhouse Gas (emissions) |
| GIZ | German Society for International Cooperation |
| GW | Gigawatt |
| H-B Process | Haber-Bosch process (Haber ammonia /or synthetic ammonia process) |
| IEA | International Energy Agency |
| IRENA | International Renewable Energy Agency |
| LNG | Liquefied Natural Gas |
| LOHC | Liquid organic hydrogen carriers |
| Mt | Million tons |
| ProVET | Promoting Vocational Education and Training |
| PtX | Power-to-X products |
| RED | Renewable Energy Directive |
| SMR | Steam Methane Reforming (Products) |
| TWh | Terawatt hour |
| UFK | Untied Financial Loans |
| WTO | World Trade Organization |

## List of Figures



## List of Tables

# EXECUTIVE SUMMARY

**To reach climate neutrality by 2045 Germany needs secure and economically viable supplies of green fuels, with Ammonia being a major solution**

With its Green Deal initiative, the European Union aims to achieve carbon neutrality by 2050. Likewise, Germany is committed to reduce GHG emissions by 65% until 2030 and to achieve climate neutrality by 2045. Energy storage solutions in combination with on-demand power generation from renewable energies are required to replace natural gas and other fossil fuels. A major element of the transition to Net Zero are "green fuels" produced from renewable energy with a focus on green ammonia and other hydrogen derivatives. For Germany an expected volume of 3.5 Mt/y of green hydrogen is needed by 2035 and 11.3 Mt/y for reaching Net Zero.

**The threatening political situation between Europe and the Russian Federation sets the impetus for the immediate establishment of reliable partnerships with new countries, to ensure energy supply**

The Russian aggression against Ukraine marks a turning point for energy supplies to Europe and Germany, in particular. Russia's ignorance of democratic principles, international law and human rights can no longer be neglected. Rather, Europe, as well as Germany, are in dire need to replace energy supplies from Russia with new, reliable partners that can support Germany to achieve the climate change goals and stabilize its industrial sector. As grey ammonia in Germany is produced using natural gas alternative solutions are also needed to solve the energy crisis.

**Realizing low production cost green ammonia supply therefore has a positive impact on both, the climate and energy crisis**

If the aim is to cost-effectively achieve a Net Zero economy, ample opportunities must be provided. Part of this strategy is to secure access to green ammonia from diverse, stable, and reliable supply sources outside of Germany, which share EU democratic values and stable policies. Europe has neighbouring countries capable to supply hydrogen via pipelines. However, pipelines, like manufacturing capacity, are limited, and renewable resources are substantially better in the southern hemisphere.

**Global southern regions are attractive places to produce high volume and low-cost green ammonia**

Subject to feasibility studies and projected cost of green hydrogen/ ammonia production, Southern Europe (Portugal, Spain), South America (Chile), the US, Middle East (UAE), Australia, East Asia (China), and lastly Sub-Saharan Africa (especially Namibia) have attractive production conditions.

**Out of these options, Namibia, as a politically stable country with attractive opportunities for green ammonia production, is perceived to be a priority country**

Namibia, with excellent weather conditions and land availability, is one of the most attractive countries for producing low-cost green ammonia. Moreover, for the past 30 years, the country has been a stable, democratic country and continues to build strong institutions for an independent judiciary and press freedom.

**The Hyphen project is an excellent pilot for future supply of green ammonia to Germany and Europe**

In 2021, a competitive and open concept tender for the construction of a hydrogen plant on the south coast of Namibia was awarded to the Hyphen consortium. The project uses wind and solar power with a capacity of 6-7 GW to generate renewable electricity, and produce hydrogen through electrolysis, which is later converted into ammonia. The project will provide substantial amounts of green fuels (up to 2 Mt/y of ammonia, which is the equivalent of 0.36 Mt/y of hydrogen) at low costs for export to Germany and the EU.

**To realize the potential advantages existing risks must be managed and barriers must be overcome**

Risks can be divided into market risks, ESG, political, economic risks, as well as infrastructure and technical risks.

Market risks are connected to "first- mover" disadvantages. Today it is still unclear how fast a green ammonia market will develop and what the future demand- and price-levels will look like over timelines of 15 to 30 years. In addition, associated financial costs are a major factor affecting the production cost, making green ammonia currently uncompetitive to grey substitutes. This slows down general project implementation speed and lowers its bankability.

As another market risk, there is a lack of necessary logistic chains and infrastructure for green ammonia delivery in Germany and the EU. It is crucial to plan and build vessels, ammonia-ready ports, storage facilities and further product distribution to allow the planned transition to net-zero.

ESG, political and economic risks connected to large- scale projects need to be considered and managed. Strengthening the capacity and expertise within the Namibian government requires time and might affect scaling speed of Hyphen implementation plans. Moreover, from an ESG point of view, the development must follow high standards and avoid harm to national parks and social rejection in Lüderitz. Equally Namibia, Germany and the EU can exhibit lengthy bureaucratic processes that can delay necessary decisions and actions.

From a technical standpoint, the most significant risk arises from the speed and capacity of production required for large-scale renewable energy and electrolysis projects.

The above-mentioned risks are translated into the following barriers:

- First- mover disadvantages
- Lack of attractiveness for investors
- Bankability and Implementation speed

**Identified risks can be mitigated through a combination of policy instruments, which would speed up similar projects and are expected to reduce financing costs and improve bankability**

Based on the interviews outcomes, a qualitative and quantitative assessment of potential policy instruments has been prepared and four key instruments were identified to actively support future green ammonia supply to Germany.

It is recommended to implement them as one package to achieve maximum positive effects. In this case the impact on the financing cost is expected to positively affect the bankability of green ammonia projects. The combined policy mix minimizes off-take and country risks, as well

as price uncertainty. As Fatih Birol, Executive Director of the IEA said, "A high cost of capital is a roadblock for investors [...]".

*Policy instrument number one*

It is directed to the establishment of a Contract for Difference (CfD) guaranteeing a minimum price for ammonia considering the following criteria:

- Total duration of 15 years (e.g., 01/01/2026 until 12/31/2041)
- Total supported amount of ammonia covered by this instrument should be limited for each producer (e.g., 50% of the entire yearly production but not more 1 Mt/y of ammonia)
- Limiting the cumulated total amount for distributed compensations

The BMWK guarantees a fixed price that enables producers to cover their costs and have an appropriate margin. This guaranteed price will decrease over a duration of 15 years in a line with the reduction of first-mover disadvantages, and a late market entry.

In case the reference price (sum of the market price for grey ammonia and carbon price) falls below the threshold, producers will receive a compensation that equals the difference between the guaranteed price and the reference price. It is emphasized that this is a price guarantee and not a purchase guarantee.

*Policy instrument number two*

It represents governmental secondments for policy and project planning to Namibia. The instrument should promote and build specific competencies and capacities of the Namibian governments and ministries. Germany, ideally in partnership with other EU countries, can send experts to support the local government in establishing the legal frameworks for green ammonia project development and further rounds of tenders.

*Policy instrument number three*

The purpose of the third instrument is directed at developing environmentally oriented public infrastructure in Germany. It facilitates the construction of an efficient and functioning infrastructure enabling the switch from grey to green hydrogen/ammonia.

The instrument bundles additional promotion programs, provision of funding for construction works, as well as proposed incentives for companies to build the required infrastructure. It must be ensured that the future infrastructure allows the import and distribution of green ammonia to users.

*Policy instrument number four*

It defines green ammonia blending quotas and aims at demand and supply creation for green ammonia. The blending quota for green ammonia is set up in a similar manner as the "Fit for 55" agenda, proposing a 50% blending quota for hydrogen by 2035. The instrument also works in tandem with the CfD ensuring a swift market uptake for cost-efficient green ammonia and reducing compensation risks.

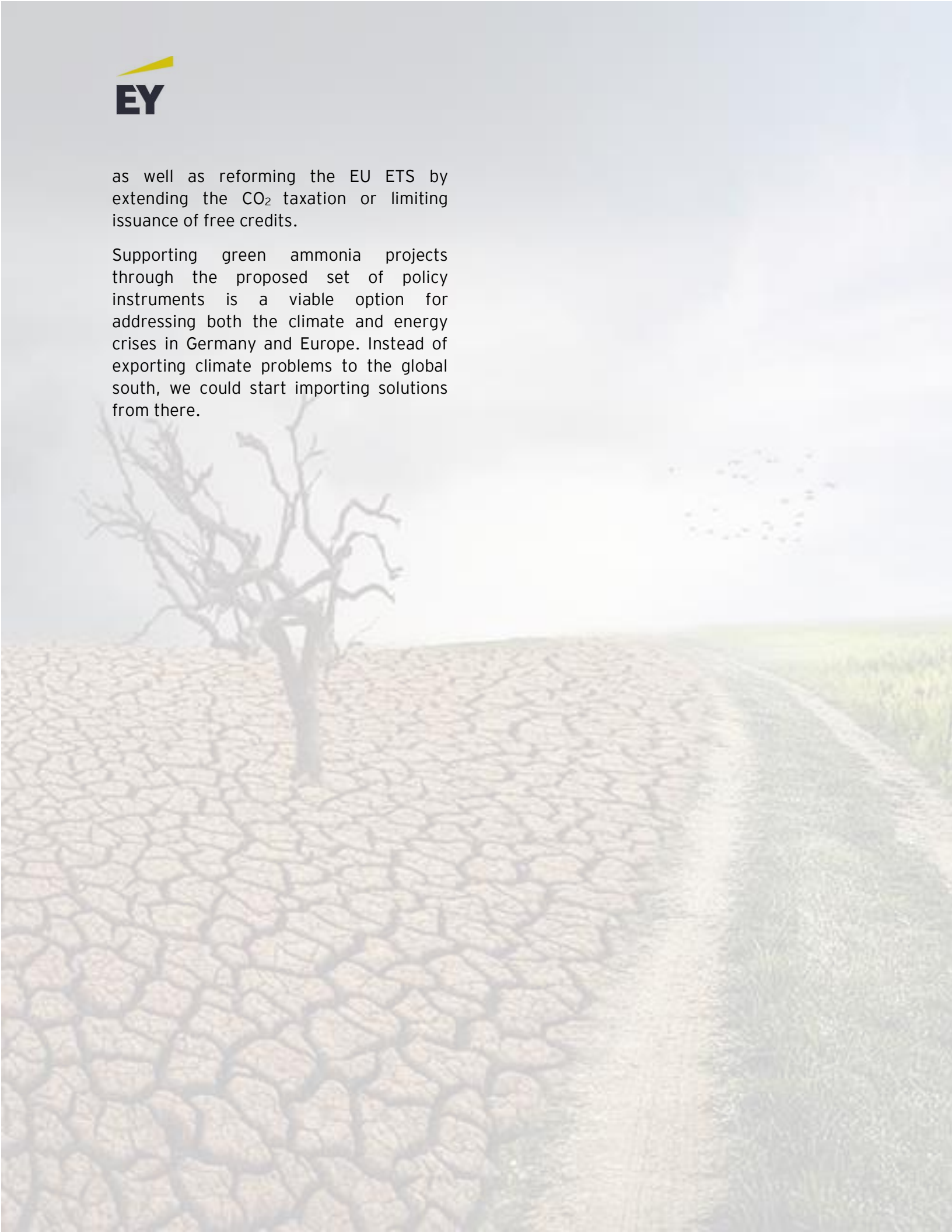
**Implementation of additional supplement policy instruments will strongly support green ammonia projects**

In addition to the key policy instrument package, it is recommended to review two supplemental instruments, which can be implemented at later stages.

They are directed to provide support for developing educational/research programs,

as well as reforming the EU ETS by extending the $CO_2$ taxation or limiting issuance of free credits.

Supporting green ammonia projects through the proposed set of policy instruments is a viable option for addressing both the climate and energy crises in Germany and Europe. Instead of exporting climate problems to the global south, we could start importing solutions from there.



# 1. INTRODUCTION

## 1.1. Authority of the assignment

This report has been prepared under the authority of the contract signed between the Climate Neutrality Foundation (Stiftung Klimaneutralität) and Ernst & Young GmbH Wirtschaftsprüfungsgesellschaft.

## 1.2. Purpose and scope of the project

The focus of this study is to deliver a distinct set of political instruments which could enable a supply of green ammonia to Germany at low-cost in large volumes based on imports from democratic partner countries.

Recommended political instruments should improve and simplify the existing framework for hydrogen/green ammonia production assuring a positive effect on:

- Accelerated implementation
- Improved affordability/ financing conditions
- Reduction of first- mover disadvantages
- Positive effects on the industry in Germany, as well as in Namibia

Using the case study of the Hyphen project in Namibia, it was helpful to understand and highlight potential barriers and risks, as well as evaluate the instruments not only theoretically, but also explicitly in this specific practical case. By evaluating potential cooperation between Germany and Namibia, it was possible to identify mitigation measures that could be relevant not only for Namibia, but also for other countries with similar socio-economic structures. Considering Hyphen as a case study, the proposed political instruments may have a strong positive impact on Namibia industries and a labour market development.

## 1.3. Structure of the report and main outcomes

The current report is structured with the objective of providing the Climate Neutrality Foundation (Stiftung Klimaneutralität) with insights on existing knowledge and plans in hydrogen/green ammonia sector in Germany, highlighting the risks and barriers to further industry development, as well as needs to extend the existing policy framework.

The report describes strategic recommendations including a high-level policy guidance to be considered by the German Government and relevant decision-makers. Moreover, the document addresses the importance of establishing a trustful cooperation with Namibia, as a politically stable and democratic country, for further supply of green ammonia.

The proposed policy instruments, that are connected to the Hyphen project in Namibia, have been qualitatively and quantitatively assessed and discussed during interviews with potential

suppliers, EPCs, banks and investors, as well as during workshops. These instruments clearly support the following:

- Support Hyphens project acceleration to ramp-up the supply of green ammonia to Germany in line with Germany´s climate goals, e.g., by speeding up development through commitments of companies to simultaneously develop projects and deliver green ammonia.
- Ensure bankability to reduce financing cost and accelerate financial close for green hydrogen/ammonia projects, thus attracting low risk, low return investors
- Reduce first-mover blockages - mitigation of "first-mover disadvantages" based on higher costs and risks

This report is divided into chapters that are structured in the following manner:

- Chapter 1: Introduction
- Chapter 2: Approach and Methodology
- Chapter 3: Overview of relevant literature
- Chapter 4: Investigation of a green fuel sector development in Germany. Issues and political priorities
- Chapter 5: Identification of main implementation risks and barriers
- Chapter 6: Overview of the potential policy instruments to mitigate identified obstacles and barriers
- Chapter 7: Proposed political instruments and final recommendations
- Annex

# 2. APPROACH AND METHODOLOGY

## 2.1. Overview of Hyphen

This study was conducted, considering the Hydrogen Power Hydrogen Energy, thus "Hyphen", project in Namibia and served as the example for a green hydrogen/ammonia project. It is one of the first initiatives of a vertically integrated green hydrogen and ammonia plant founded as a joint venture between Enertrag GmbH and Nicholas Holdings Ltd. As a part of the Southern Corridor Development Initiative envisioned by the Namibian government, Hyphen seeks to make the country a leading green fuel supplier and enable the global energy transition by building renewable hydrogen industry. The production site is planned to be located within the Tsau/ Khaeb restricted area, which is one of the world's richest resource locations for wind and solar energy. The plant area covers 4,000 $km^2$ with direct access to the Port of Lüderitz.

The project plans to have 6-7 GW renewable energy capacity. The renewable electricity will be used to desalinate seawater and then produce hydrogen using electrolysis. In a further processing stage, ammonia is produced with the addition of atmospheric nitrogen. Unlike hydrogen, ammonia could be easily transported by ships. Namibia will build new port

infrastructure for this purpose. The entire common infrastructure, from seawater desalination to pipelines for water and hydrogen, will be designed so that other projects could follow.

At the moment feasibility and engineering studies of Hyphen are being conducted (phase A, B). The construction (phase 1) is due to begin shortly after financial close in October 2024 and to be completed by December 2026. The first delivery of green ammonia will take place in the beginning of 2027, in parallel with the start of the second construction phase (phase 2), which will be completed by December 2028.

By the end of the first construction phase, the total production of green ammonia is estimated to 1 Mt/y which equals 175,000 tons of green hydrogen. This volume is planned to be gradually increased reaching double production capacity by 2029, with the completion of the second construction phase.

## 2.2. Implementation methodology

The study was carried out considering Hyphen as a potential supplier of hydrogen/green ammonia to Germany. The scope was divided into three work packages (WP):

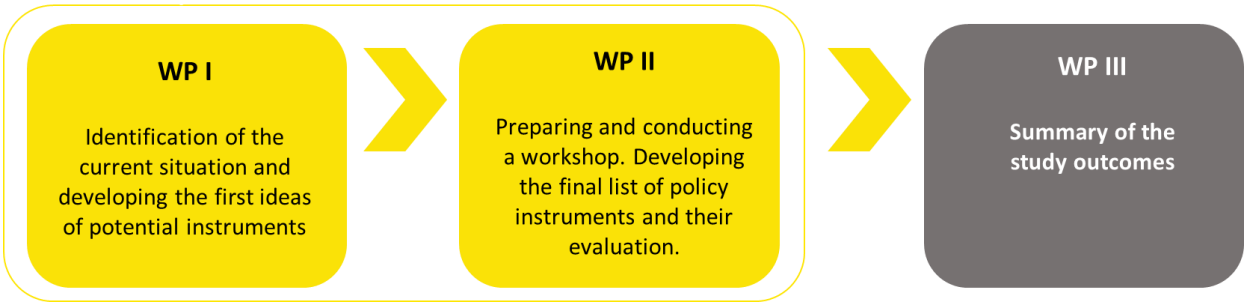



*Figure 1 Project implementation structure (source: EY)*

The approach of **WP I** (work package) covered an overview of the existing literature and analysis of relevant policy measures, which could potentially have a direct and indirect impact on the study scope. A broad assessment of current development trends and usage of hydrogen/ green ammonia in European countries with an overview of its potential production in Sub-Saharan Africa, supported the project phase I. The purpose was to establish a clear understanding of future sector development and necessary measures to promote usage of green ammonia in Germany and potentially in other European countries.

Through frequent communication with the Hyphen consortium in Namibia it was possible to identify existing and potential risks, financial and investment barriers for producing and supplying of green ammonia to Germany. Based on the discussion with the Hyphen consortium and literature research, a long list of possible policy instruments that could enable a potential supply of hydrogen/green ammonia to Germany was created. To match their relevance to Hyphen, all instruments were discussed in the workshops with the client and relevant external

stakeholders. In addition, the long list of potential policy instruments was reflected in numerous interviews with financial institutions (investors), potential suppliers, EPC contractors and insurance companies, researchers, and professionals. As outcomes of the phase I, policy instruments were assessed in terms of their relevance and impact area (please refer to the Figure 2).

The key scope of the **WP II** was a qualitative and quantitative evaluation of the long list of the selected policy instruments.

The qualitative assessment was carried out considering six criteria aimed at identifying the attractiveness and effectiveness of policy instruments:

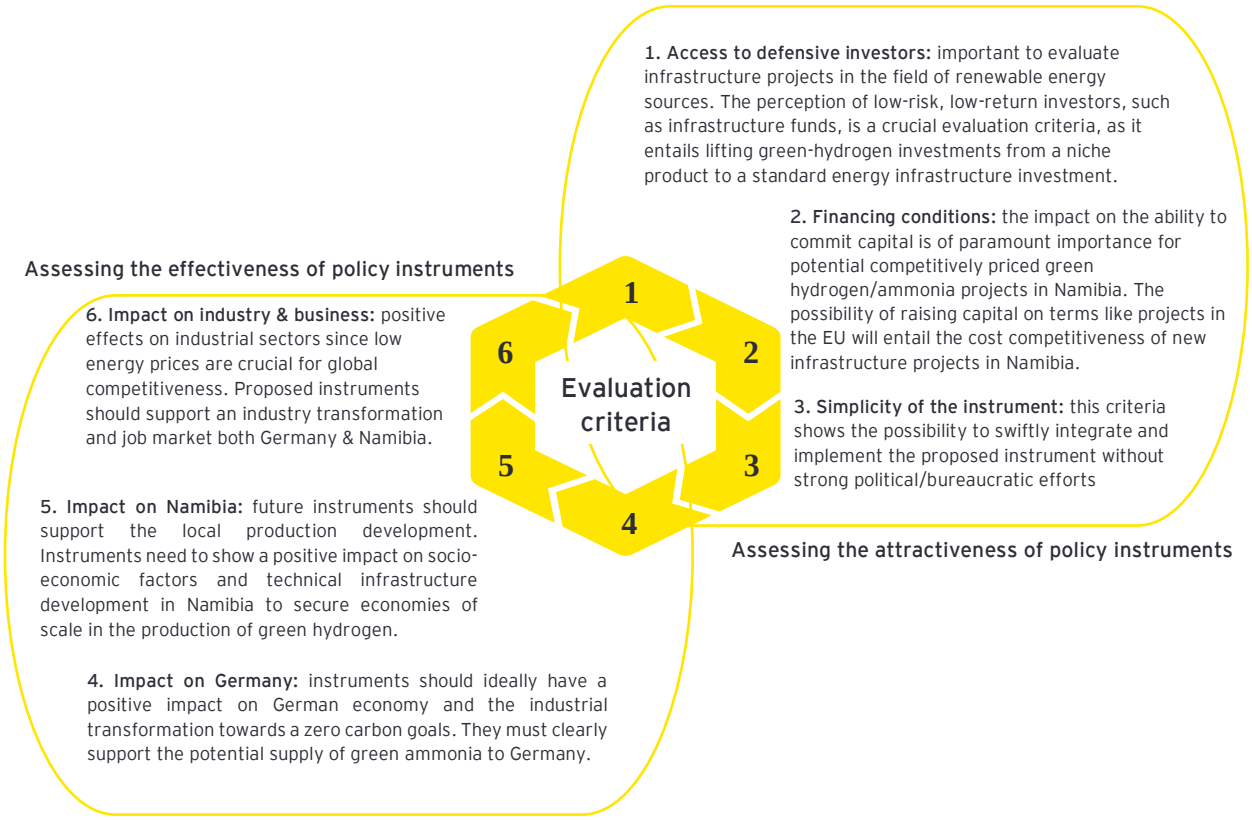



*Figure 2 Established qualitative criteria to evaluate proposed political instruments (source: EY)*

The criteria presented in Figure 2 above, have been assigned both to attractiveness and effectiveness of each proposed policy instrument. The decisive factor for classifying the attractiveness of each instrument is an assessment of the size of the financing terms, the simplicity of the instrument and access to a wider group of investors, while effectiveness aims at evaluating the impact on the individual countries, industries, and companies.

In general, the attractiveness and effectiveness of policy instruments were divided in equal percentage of 50%/50%, where each of the proposed criteria also had its respective weight (please refer to the Annex III). The proposed weight of criteria was based on the interview's outcomes and EY experts' opinions. It is important to notice, that the weights differ depending on stakeholder focus and their role, as well as their potential involvement in Hyphen.

The final outcomes were the following:

- Attractiveness of policy instruments (50%): identifies how future policy instrument will be reflected for investors, as well as how easy it could be introduced
  - Criteria 1: Access to defensive investors – 12%
  - Criteria 2: Financing conditions - 24%
  - Criteria 3: Simplicity of the instrument - 14%

- Effectiveness of policy instruments (50%): identifies potential positive impact on both countries and their industries
  - Criteria 4: Impact on Germany - 16%
  - Criteria 5: Impact on Namibia - 18%
  - Criteria 6: Impact on industry and businesses - 16%

To identify the exact impact of each political instrument against the six categories a ranking approach was created. The scale was applied from 0 to 10, where zero means no impact or no relevance to the evaluated criteria and ten shows a high impact. The middle score represents a corresponding relevance of the instrument but implies an indirect impact. The final rating assigned to each of the political instrument was established considering EY experts and interviewees' opinions.

Finally, rating outcomes were combined to obtain an attractiveness and effectiveness score. The results were presented in a matrix to easily determine the most attractive and effective policy instruments.

For the quantitative assessment, basic financial information including capital expenditures, debt-equity ratios, cost of capital and market price data was collected during interviews with Enertrag, as well as from external interviews and online available official financial information. The data was used to provide an indication of the impact of the policy mix instruments on a possible project financing. In the base assumption, financing is assumed under the current risks and uncertainties and without policy instruments.

As a next step, the financial impact of implementing the respective policy instruments was defined. However, this was only possible to apply on instruments which are measurable. In this case, non-quantified instruments play an important role in providing further stability and an indirect increase of bankability.

The assessment was conducted on a high level, aimed to provide an indication of the financial impact of a policy mix. Unlike the baseline scenario, which assumed that none of the policy instruments would be effective, the scenario was modelled for the full effect of the instruments.

The assessment results considering Hyphen needs and strategic political priorities in Germany and Namibia, indicated the strongest policy instruments that could support and promote a potential supply of green ammonia to Germany.

## 3. OVERVIEW OF RELEVANT LITERATURE

**With a shift towards Net Zero, substitutes for high-emission products are required**

In Europe, hydrogen accounts for less than 2% of the energy consumption and is mainly used for specific industrial processes, such as the production of ammonia or methanol[1]. Ammonia alone accounts 45% of the hydrogen consumption, equivalent to 33 Mt/y hydrogen in 2020. 85% of the ammonia is used to produce synthetic nitrogen fertilizer.

Although renewable ammonia has been produced since 1920, 72% of today's production still relies on natural gas and coal (22% as an additional energy source[2]) accounting for 1% of global GHG emissions and 15-20% of the chemical sectors carbon emissions. Therefore, to achieve Net Zero, it would be necessary to replace grey ammonia with green ammonia.

In Germany the chemical sector directly emitted 37.2 Mt $CO_2$ in 2017, of which the ammonia synthesis accounted for 6 Mt $CO_2$. Per ton of ammonia produced in Germany, 1.8 tons of $CO_2$ are emitted[3].

Currently, 0.02 Mt of green ammonia are produced annually, representing 0.01% of the global production. The current share of green ammonia is negligible; however, the demand will increase in the coming decades. The latter can be observed in Figure 3 which illustrates the existing and projected share of produced ammonia using fossil and renewable energy.

[1] European Parliamentary Research Service, 2021
[2] IRENA, 2022
[3] Agora Energiewende, 2019

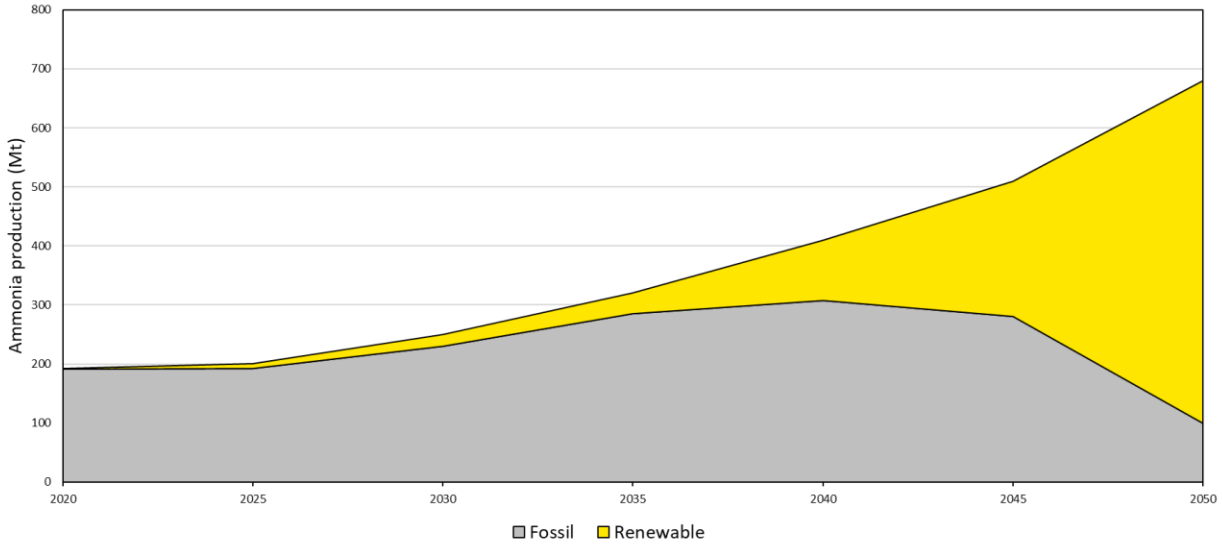



*Figure 3 Expected ammonia production capacity up to 2050 (Source: Irena Innovation Outlook Ammonia)*

According to research conducted by IRENA, future demand for ammonia in existing markets will increase to 223 Mt/y in 2030 and 333 Mt/y in 2050 in a 1.5°C scenario, up from 183 Mt/y today[4]. In 2021, the demand of ammonia in Germany amounted to 3 Mt, representing 1.6% of total worldwide demand. Assuming the same share for the ammonia demand in 2030 and 2050, Germany's demand will increase to 3.7 Mt and 5.5 Mt/y by 2030 and 2050 respectively (please refer to the Figure 14, chapter 7.1.1.). Moreover, a study prepared by Umlaut, estimated 55% of future demand needs to be imported[5].

The study also thematizes additional markets which will be developed, using ammonia as a carrier for hydrogen, and as a fuel for heating systems or in the shipping industry. Additional green ammonia demand will reach 355 Mt/y in 2050, overtaking grey existing ammonia markets in volume. With a total prognosis of 688 Mt/y by 2050, future production sites must be large scale to facilitate future demands. To estimate the demand of new markets in Germany, considering the current market share, 5.8 Mt of additional ammonia is required by 2050.

Currently, numerous projects that aim to produce green ammonia have been announced, most of them since 2020. Future demands create the need and opportunity to develop policies, establish appropriate incentives and tailor the existing regulatory framework to facilitate the industrial decarbonization and transformation[6].

[4] IRENA, 2022
[5] Umlaut, 2020
[6] IRENA, 2022

**According to available online sources, 60 global renewable ammonia projects have been announced during 2020-2021, with an expected total production capacity of 15 Mt/y by 2030, increasing to 71 Mt/y before 2040**

Only few projects are in operation, others are under construction phases, and most of them have not been financed yet. In many cases, first- movers' disadvantages and number of risks are holding back further development[7].

*Table 1 Excerpt of operational, in construction and announced renewable hydrogen projects (source: IRENA: Innovation outlook renewable ammonia)*

| Location | Company | Project type | Year | Capacity (in kt/y) |
|---|---|---|---|---|
| **Cusco, Peru** | Enaex | existing | 1965 | 10 |
| **EOM, Saudi Arabia** | NEOM, Air Products, ACWA Power | new | 2025 | 1,200 |
| **Western Jutland, Denmark** | Skovgaard Invest, Vestas, Haldor Topsøe | new | 2022 | 5 |
| **Porsgrunn, Norway** | Yara | revamp | 2022<br>2025-2026 | 5<br>500 |
| **Sluiskil, Netherlands** | Yara, Ørsted | revamp | 2024-2025 | 75 |
| **Donaldsonville, Louisianna, United States** | CF Industries, ThyssenKrupp | revamp | 2023 | 20 |
| **Puertollano, Spain** | Fertiberia, Iberdrola | revamp | 2021<br>2025 | 6.1<br>57 |
| **Antofagasta, Chile** | Enaex, ENGIE | new | 2024<br>2030 | 18<br>700 |
| **Pilbara, Australia** | InterContinental Energy | new | 2030<br>2035 | 3,000<br>9,900 |
| **Western Australia** | InterContinental Energy | new | TBD | 20,000 |
| **Al Wusta, Oman** | OQ, InterContinental Energy, EnerTech | new | 2028<br>2038 | n.a<br>9,500-11,400 |

**Facilitating the development is complex and faces barriers in several areas**

The competitiveness regarding the costs of green ammonia as a raw material is decisive. Current price estimates for green ammonia considering best solar and wind resources are $720 per ton, which should decrease to $480 in 2030, while grey ammonia ranges between $110 – $340.

[7] IRENA, 2022

Nevertheless, first movers within this sector are likely to produce for prices higher than $720 per ton, as high investments at an early stage will be required. The price gap is mainly due to high up-front investments in renewable energy generation, as well as new facilities and infrastructure. Consequently, green ammonia requires carbon prices of at least $150 per ton of $CO_2$[8] to be price competitive with fossil-based ammonia.

**Governments around the world, including Japan, Korean and several European nations started to work on a wide range of required policy instruments**

Existing, and well-known policy instruments could be used to fuel and accelerate the development, including the implementation of standards for green fuels, higher carbon prices or taxes on carbon, quotas, requirements for public procurement, providing project funding support and guarantees, long-term guaranteed price floors, contracts for difference, lower taxes for renewable fuels and information campaigns amongst others[9, 10].

At the European level, the EU Renewable Energy Directive (EU 2018/2001) lays down a legally binding definition of hydrogen, which includes clear targets (32% share of renewable energy in EU gross final consumption and 14% renewables share of transport energy by 2030). Also, the Fuel Quality Directive 98/70/EC indirectly promotes the use of hydrogen.

The HyLaw project identifies more than 50 EU legislative acts in wider regulatory areas covering hydrogen technology and indirect areas like health and safety, environment, labour, and transport. Additionally, the European Parliament adopted conclusions on the EU hydrogen market in December 2020, with a focus on renewable hydrogen for decarbonization, economic recovery and competitiveness[11].

The most recent example is the announcement of a European Hydrogen Bank. As declared in President von der Leyen's speech on the 14th of September, the EU aims to invest three billion euros for the development of a hydrogen market by supporting the purchase of green hydrogen for Europe[12].

**Additional issues are seen in lack of infrastructure**

These issues concern both Europe and producing countries in order to be ready to receive and deliver green ammonia. Additionally, supplier bottlenecks (high demand on the construction of green hydrogen facilities) and bankability of projects, are issues that are faced both in Europe and potential producing countries

[8] IRENA, 2022
[9] IEA, 2021
[10] IRENA, 2022
[11] European Parliamentary Research Service, 2021
[12] President von der Leyens State of the Union Address 14.09.2022

**Analysing available sources and existing initiatives, it was possible to identify five typical areas for governments to define their comprehensive policy frameworks to facilitate hydrogen adoption across the entire energy system:**

- Establishment of long-term targets and quotas
- Support and creation of demand
- Unification of standards and removing barriers
- Mitigation of investment risks
- Promotion of innovation
- Infrastructure investment incentives

**Potentially the following measures could support a production and supply of green ammonia in Europe**[13]**:**

- **Clear strategies and roadmaps which identify the role of hydrogen in the energy system at the national level** with concrete targets for deploying low-carbon production and stimulating significant demand.
- **Clear set of incentives for using low-carbon hydrogen to create** advantages over fossil fuels:
  - Required to have specific measurable goals and blending quotas
  - Align prices for low-carbon hydrogen and fossil-based hydrogen, increasing the relative attractiveness for switching
  - In some cases, adjusting carbon prices are used to close the cost gap but seldomly totally offset price differences
- **Establish standardization, and regulation regimes.** This will require changing the existing regulatory framework and defining new standards and certification schemes to remove barriers for widespread adoption.
- **Allocate high investments in a green hydrogen/ammonia sector.** Create a policy framework that could stimulate demand, prompt investment in low-carbon production plants, infrastructure, and manufacturing capacity. For example:
  - The European Investment Bank (EIB) invests in R&D in hydrogen projects and now shifted focus to offer financial and technical support and recently signed collaboration agreements with France Hydrogène (2020) and the Portuguese government (2021)
  - In June 2021, the German government launched the H2 Global initiative, through which ten-year purchase agreements on hydrogen-based products will be tendered. Aiming at increasing bankability and certainty to investors and producers, the program is funded with EUR 900 M and expects to leverage more

[13] IEA, 2021

than EUR 1.5 billion in private investments. Recently, the German and Dutch Government announced that the Dutch intend to financially participate in H2Global, which would support a European coordination of green hydrogen efforts[14].

  - Adequate infrastructure planning is critical to avoid delays or the creation of assets that can become stranded in the near or medium term.

- **Provide a strong support for further technical innovation**. This is necessary to reduce costs and increase the competitiveness of hydrogen technologies:
  - Important is to allow research, through setting regulatory measure or investment incentives, to also explore new technologies. Hydrogenious LOHC Technologies, for example, asked in an open letter for technological diversity with avoidance of any possible barriers[15].

**These measures are still not fully addressed within European countries national plans and the existing policy instruments are not sufficient to close the demand/supply gap and overcome such barriers as:**

- Establish clear policies that could support hydrogen and green ammonia and make them more competitive with the gas and oil sectors
- Current infrastructure is designed for natural gas consumption
- Lack of communication between European countries to determine a common strategy for decarbonizing the energy system and creating the appropriate infrastructure
- Lack of financing programs and support for developing new renewable energy production sites

**While other countries like the US take simple and direct actions for developing a green hydrogen sector, the EU is stuck in defining and classification of the product, over-regulating a market, that doesn't even exist yet[16]**

In the United States with the recent Inflation Reduction Act (IRA) a strong signal was sent to hydrogen producers. The IRA plans to limit the maximum $CO_2$ emissions per kilo of hydrogen and in addition, producers can decide between a production tax credit or investment tax credit. The amount of the tax credits depends on the life cycle emissions per kg of hydrogen and can amount up to $3 per kilo or 30%. The benefits are granted for 10 years and only for projects with construction date no later than 2032. Additionally, the existing tax credit for CCS is also raised. This calls for a European reaction in similar dimensions to ensure the future supply of green ammonia and hydrogen, which is required for a successful decarbonization of European industries.

[14] Bundesregierung, 04.10.2022
[15] Hydrogenious LOHC Technologies, 31.08.2022
[16] Süddeutsche Zeitung, "Jetzt soll es schnell gehen mit dem Wasserstoff", 17.10.2022

# 4. INVESTIGATION OF A GREEN FUEL SECTOR DEVELOPMENT IN GERMANY. ISSUES AND POLITICAL PRIORITIES

## 4.1. Existing political and economic situations. Overview of climate protection plans

**Germany experiences growing political and economic impacts from the global climate crisis**

Recent analysis shows that the gas crisis alone will cause a decline of up to 5% of GDP in 2022, and up to 2.6% points' higher inflation in the same year[17]. Environmental Damage in Germany summed up to 180 Eur/per one ton of $CO_2$ emission[18]. Considering an article published by Climate Disclosure Standards Board, about 50% of German corporates consider climate risks and disclosing environmental matters within their business models.

This exemplifies that Germany faces challenges concerning climate change which are complex and multidimensional. The existing issues have an extensive impact on industrial, energy and agriculture sectors. In addition, we can also observe the political and economic consequences of these changes and the geopolitical shifts that accompany the energy crisis in Germany.

**To fight climate change and its effects Germany has committed to multiple climate protection plans and measures**

In **the Paris Agreement**, which is an important milestone in the multilateral climate change process adopted in 2015, Germany committed to contribute to the achievement of the EU countries goals the following:

- Keep the global average temperature increase below 2° Celsius compared to pre-industrial levels and to make efforts to keep it below 1.5° Celsius to pre-industrial levels
- Increase the ability to adapt adverse climate impacts and to strengthen the resilience against climate change
- Make finance investments consistent with efforts to reduce greenhouse gas emissions

The relevance and scope of the Paris Agreement is also broader and includes African countries stating the need to promote universal access to sustainable energy on the African continent through greater use of renewable energy[19]. Despite the Paris Agreement approach to allocate investments to mitigate climate issues, currently the demand for climate financing in Africa substantially exceeds the existing financial flows from all sources, posing challenges to increasing funds mobilization[20].

[17] International Monetary Funds, 2022
[18] Umweltbundesamt
[19] United Nations Treaty Collection, 2015
[20] AfD, Integral Consult January 2021

Beyond that, in line with the EU climate goals, Germany has set high national targets to protect the climate. According to **the Federal Climate Protection Law** (adopted in June 2021), the country must reduce its GHG emissions:

- By 65% until 2030
- By 88% until 2040
- Establishing the GHG neutrality until 2045 and thereby contribute to keeping a global temperature rise well below 2° Celsius above preindustrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius[21]

These targets should affect all sectors, especially energy and manufacturing industries, transport, construction, and agriculture sectors.

Another equally important document on a European level is the **„Fit for 55" presented by the European Commission on 14 July 2021**. This package aims to align the EU's climate and energy legislative framework with its 2050 climate neutrality objective. The document consists of series of proposals to introduce new initiatives in a range of policy areas and economic sectors. An indicative target of an average annual increase in the use of renewable energy sources in industry is set at 1.1% per year. It also proposed that **35% of the hydrogen used in industry should come from renewable fuels of non-biological origin** by 2030 and 50% by 2035[22]. Parallel, the proposals to revise the Renewable Energy Directive (RED) and the recast of the Energy Efficiency Directive (EED) are to be reviewed.

**Germany brings a strong input to adopt the country measures to meet the established European policy to guarantee environmental integrity and address solidarity**

The German government adopted the **National Hydrogen Strategy** (June 2020), that provides the basis for private-sector investment in hydrogen generation both economically viable and sustainable and it includes measures to addresses:

- **Ambition goals** - position Germany as a global frontrunner and a market leader when it comes to green hydrogen and its technology. Use of green hydrogen in industry, the transport sector, and the energy system to maintain a future competitiveness and reach climate goals opening number of opportunities for new markets.
- To boost the hydrogen sector the following focus areas, need to be considered:
  - Assuming global responsibility to protect the environment and climate
  - Making hydrogen a competitive option, speed up the production and use globally, especially within the steel and chemical industry and the transport sector

[21] 1st Amendment to Bundes-Klimaschutzgesetz (Federal Climate Protection Law), 2021
[22] French presidency of the Council of the European Union, 28 July 2022

- Developing a domestic market for production and use of hydrogen, as well as its technology (for example establishment and operation of electrolysis) in Germany, paving the way for imports
- Establishing hydrogen as an alternative for other energy sources- this applies to aviation, maritime sectors, and heavy-duty transport
- Making hydrogen a sustainable base material for the industrial sector. The industrial sector is well positioned in Germany to become one of the main drivers of hydrogen adaption and a global pioneer in hydrogen technology
- Enhancing transport and distribution infrastructure. Developing the right transport and distribution infrastructure is central to be able to import and develop the sales markets for hydrogen and the products derived from it
- Building up and securing the quality assurance infrastructure for hydrogen production, transport, storage, and use
- Fostering science and mobilizing skilled labour. Thus, developing long-term research and innovation programs that cover the entire hydrogen value chain including storage, transport, and distribution
- Shaping and accompanying transformation processes by initiating dialogues to accompany the necessary transformations and aid stakeholders
- Strengthening German industry and securing global market opportunities for German firms
- Establishing international hydrogen markets, cooperation framework, ideally develop an international competition and export of hydrogen and Power-to-X (PtX) technologies
- Establishing international markets and cooperation for hydrogen
- Improve the policy environment addressing current developments. The implementation and achievement of the goals are subject to regular review by the new committee of secretaries of state for hydrogen from various ministries

- Action planning until 2030. There are 38 measures proposed. They should be implemented by government representatives in cooperation with relevant (also international) partners.

In addition, on 24 July 2021 the German Parliament passed an amendment to the Energy Act which contains new provisions for the regulation of hydrogen networks[23], ensuring that energy consumption becomes carbon neutral before 2050. In this document hydrogen is categorized as an independent energy carrier alongside gas. The new framework under this act included amendments to the conversion of natural gas pipelines to hydrogen, creating a hydrogen network for consumers. The draft amendment to the Energy Act was met with sharp opposition from the associations of network operators. The separation between the natural gas and

[23] The Renewable Energy Act (EEG)

hydrogen networks was criticized as an obstacle to rapidly and efficiently developing a hydrogen infrastructure. Separate tariffication, in which the network tariffs for hydrogen would have to be significantly subsidized in the start-up phase, would lead to higher network tariffs overall[24].

Moreover, so far it is not clear which public body will be responsible for the regulation of hydrogen projects. As far as hydrogen falls under the existing regulation of the gas and electricity markets the Federal Network Agency BNetzA is the competent authority on a federal level.

**To meet these plans and realize the strategies, a solution for green ammonia must be one of the political priorities. With over 3 Mt/y, Germany is the largest producer and consumer of ammonia in Europe and will also depend on it for the future**

Ammonia is one of the most important industrial gases. Furthermore, green ammonia is a fundamental solution for the renewable energy sector, both to store energy as well as to enable cost efficient transport over long distances. The product is necessary for fertilizers, to produce chemicals including different types of sodium compounds, explosives, fibers, plastics, or pharmaceuticals.

Green ammonia is becoming a key product for refrigerating technology, cleaning industry, steel production and it is the important basis for producing green fuels like e-fuels, green kerosene, LOHC and products under the PtX category. Thus, the product is not only required to transport hydrogen, but also as a substitute for current product applications.

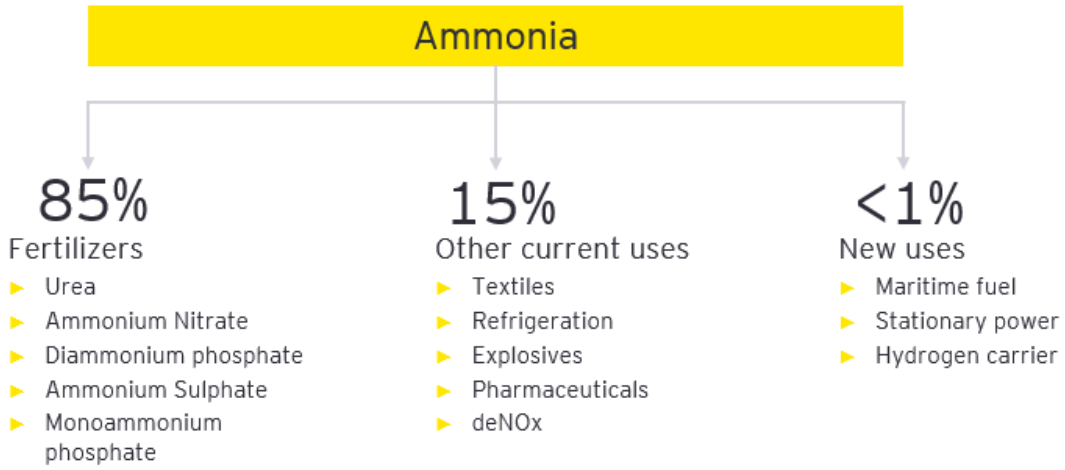



*Figure 4 Current uses of ammonia (Source: Irena Innovation Outlook Ammonia)*

[24] CMS Legal, 2021

In 2021 11% of the industry's natural gas consumption was used to produce ammonia equivalent to emissions of 6 Mt $CO_2$[25]. The basic materials industry is strongly depending on a climate-neutral energy carrier since efficiency gains will not be sufficient to adequately reduce emissions. Although efficiencies are constantly improved, the economic growth causes that the absolute demand does not significantly decrease in an appropriate manner[26].

Sustainable political framework conditions must be created, so that investments can be made with certainty in climate-neutral technology and facilities.

**Finally, ammonia can play the role of a transport product for green hydrogen:**

- The production of hydrogen is energy-intensive and must use renewable energy to be climate neutral. To have advantages of attractive costs, production is often not carried out in Germany. Storage and transport are therefore an issue
- Storage and transport of hydrogen are technically elaborate and expensive. Storing hydrogen as gas needs high pressures between 200 and 900 bar. To store hydrogen in liquid form it must be cooled down to -253° Celsius. In both forms transport leakages are considerable and can sum up to 5%[27]

While the production of ammonia does need hydrogen as pre-stage, storage and transport challenges can be solved by synthesizing hydrogen and nitrogen to green ammonia[28]. Ammonia is transportable under more feasible conditions, only requiring refrigeration to -33°C, which makes it technically easier and cheaper to transport, with fewer transport leakages.

**To further develop, as well as secure an efficient and climate-effective energy supply, Germany must be looking at importing sustainable energy around the world**

Due to the latest political difficulties at the East, that dramatically changed the conditions of Germany's energy supply security, this question became one of the most urgent one. The war between the Russian Federation and Ukraine, has put Germany in a position where a strong dependence on the energy carrier natural gas has become a problem instead of being an interim solution for decarbonization. Earlier attractive prices and high consumption of natural gas supplied by the Russian Federation were the main causes not to push green fuel sector development even faster. The risk of a protracted decline in the economy and production now forces Germany to seek alternative sustainable energy sources (without the "transition technology" natural gas).

**To promote further hydrogen production and its widespread use in Germany the focus should be on improving the existing framework for green fuels, which currently focuses on the demand side**

[25] Hintergrund-Daten Ammoniak
[26] Umweltbundesamt, 2022
[27] Center on Global Energy Policy, 2022
[28] Institut der Deutschen Wirtschaft, 2021

In this case, integrated energy or $CO_2$ pricing for fossil fuels and new business or strategic cooperation models, for example for producing electrolyzes, governmental support for the industrial sector to shift towards hydrogen production, should be considered. Additionally, several other measures like harmonizing technical and regulatory standards regarding hydrogen and fuel cell systems, promotion of climate-friendly industrial processes need to be reviewed in parallel. As part of the efforts to promote climate-friendly industrial procedures, the Federal Government will launch a new pilot program entitled 'Carbon Contracts for Difference '(CCfD), which mostly targets the steel, cement, and chemical industries with their process-related emissions[29]. Finally, this instrument should also be directed to support green hydrogen/ammonia projects.

Today, the production of green hydrogen and therefore uniformly green ammonia is more expensive than their fossil fuel-based (grey) equivalents. Future CfDs could minimize or even offset any price differences for green hydrogen and therefore support the implementation of hydrogen or ammonia projects such as Hyphen. There are two types of CfDs: one-sided and two-sided. For one-side CfDs, a minimum offtake price is fixed between the guarantor and producer. If the price falls below the threshold, the guarantor will compensate the producer losses associated with the sale of its products at lower market prices.

In a two-side CfD, equivalent to the one-sided CfD, a minimum price is agreed upon, however, an additional second threshold is negotiated. If the market price of the product rises above this threshold, the guarantor will participate in high market prices and make a profit (profit-sharing). Due to the profit-participating nature of the two-side CfDs, the minimum threshold will be higher than for the one-side CfD. Such a CfD mechanism could be established on a national level, but in the long run an EU-wide implementation as it is proclaimed in the European hydrogen strategy is favourable[30].

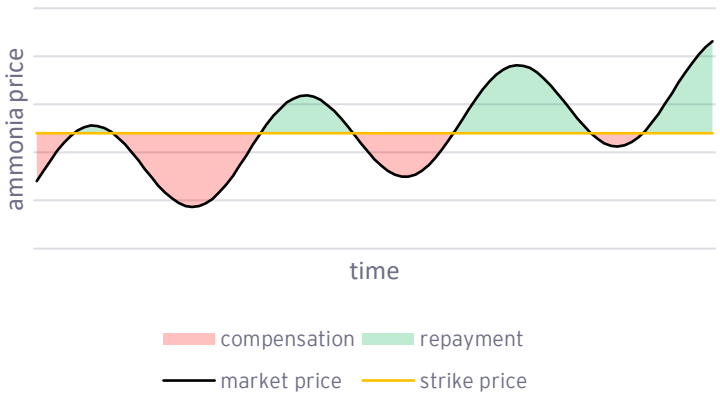



*Figure 5 Both-sided CfD mechanism (source: EY)*

[29] BMWi, 2020
[30] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 2020

## 4.2. The relevance of favourable environmental conditions for green fuel production

**The production green energy at the lowest operational cost is closely related to favourable environmental conditions (as the equipment and other cost are usually the same for all projects)**

Those favourable conditions can be particularly found in the global south. The Andes mountains, Southwest China, Sub-Saharan Africa, and South America, with a focus on Chile and Colombia have high potentials for future production of green ammonia. The typical benefits of the areas are great natural conditions for the green energy supplement, such as constant sun and strong winds.

In Europe, southern Portugal (Iberia) and Spain are attractive for a green ammonia sector development.

Looking at Sub-Saharan Africa, Namibia is one of the most attractive countries. With more than 300 sunshine days a year, solar plants in Namibia could produce three times more electricity than in Germany.

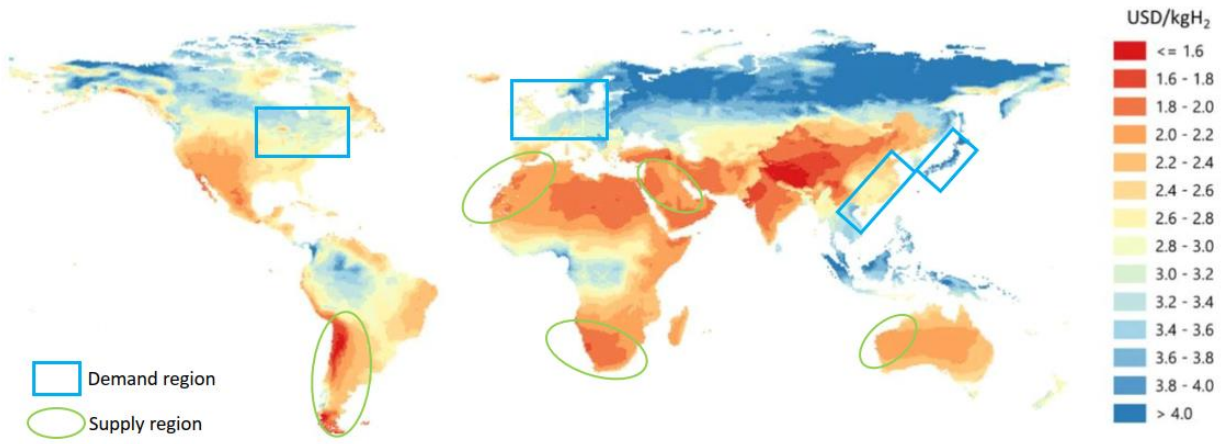



*Figure 6 Hydrogen costs from hybrid solar PV and onshore wind systems (source: IEA: The Future of Hydrogen, 2019, Hyphen)*

**Considering the requirement that future partners must be democratic to build stable and mutual relationships, countries in Sub-Saharan Africa such as Namibia are promising supply partners**

The figure 7 below, illustrates the democracy scale from not democratic (0) to most stable democracy (10). Only countries scoring higher or equal than 6 are selected and are combined with a yes/ no score for renewable energy support policies.

The figure shows that the combination of a democratic country and support for renewable energy development is particularly important because many countries exhibit excellent

wind/solar conditions are neither democratic nor supportive of renewable energies. Thus, considering the combination potential future partners could be identified.

It is also visible that beyond European and Anglo-Saxon partners, countries that are democratic and support renewable energies, are scarce[31, 32].

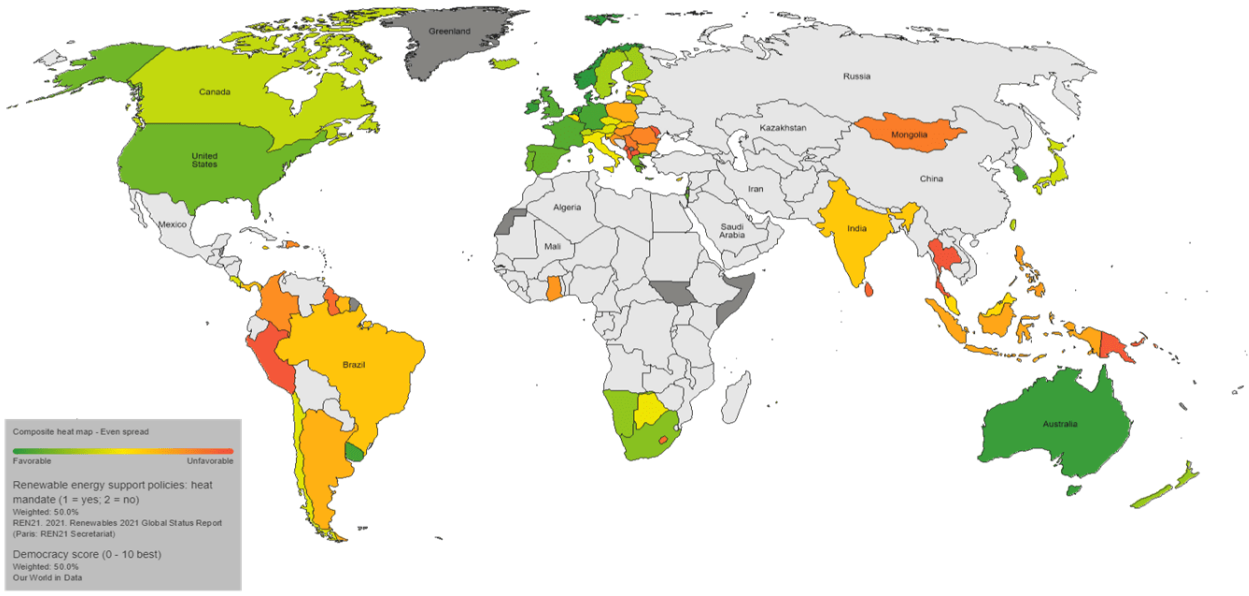



*Figure 7 Combined weighting of countries with supportive approaches to renewable energy, that are stable democracies (source: EY)*

## 4.3. The case for Namibia and Hyphen as a pilot and example to develop and apply political instruments

In 2021, a Green Hydrogen Alliance with Namibia has been signed, where Germany provides EUR 40 M for the further development of the green hydrogen sector in Namibia. Both countries recognize that they have a common interest in the renewable energy sector, specifically in green ammonia and that they will benefit from increased cooperation and exchange of knowledge and experience[33].

Thus, Namibia already envisioned a large-scale hydrogen production valley with numerous sites and in August 2021 one such site on the south was availed for bidding in a tender which was published globally. After a comprehensive selection process, Hyphen was identified as the preferred bidder and was given the opportunity to engage with the Government in negotiations to finalise a feasibility and implementation agreement. As shown in Figure 6 and Figure 7,

[31] REN21, 2021
[32] Our World in Data: Economist Intelligence Unit. 2022. Democracy Index 2021: The China challenge.
[33] Joint Communique of Intent between Germany and Namibia: Cooperation in the field of energy resources

Namibia offers excellent conditions to produce large amounts of green hydrogen/ammonia for low costs due to the abundance of available renewable energy sources.

Looking at a potential cooperation between Germany and Namibia, it could be highlighted that Namibia is a trustworthy country with a stable and functioning democracy which makes future planning processes reliable and resilient. In this case the project Hyphen has a chance to become an important energy producer not only for Germany, but also for other European countries. Green ammonia has a high potential to be a transport carrier for hydrogen, as it is more efficiently transportable and therefore competitive.

On March 29, 2022, the German Federal Minister Robert Habeck and Namibian Energy Minister Tom Alweendo concluded a cooperation agreement in the field of hydrogen economy. To implement the agreement, Mr. Habeck appointed former Energy State Secretary Mr. Rainer Baake as special envoy for the German-Namibian climate and energy cooperation.

Namibia presents a major opportunity for European FDI in production facilities for renewable and climate-neutral energy and infrastructure. Simultaneously the country can benefit from investments through increased economic stability and development aid, increased employment opportunities for the local population.

Future investments in modern and sustainable technologies will mean a long-term opportunity of economic growth and prosperity for the region. Industrial hydrogen production from wind and solar energy could generate large amount of surplus electricity. This could be used to make Namibia the first African country with 100% renewable electricity.

Supply of green ammonia from Namibia to Germany would have great and fundamental advantages:

- High to very high certainty for project execution
- High to very high security of supply
- Positive total cost balance
- High to very high price security

**Generally, Hyphen pilot project could generate a win/win situation**

Germany will gain access to attractively priced green ammonia, reducing its natural gas imports and avoiding greenhouse gas emissions. Namibia in this case makes a big economic leap forward, develops a sustainable energy industry and alleviates its unemployment problem.

Nevertheless, it is important to emphasize that the disadvantage for Germany would be:

- A potential disappearance of domestic ammonia production using fossil natural gas (limited disadvantage as a domestic production of emission intensive ammonia will

gradually decline and disappear anyhow if market conditions change as desired by the climate strategy of the Government[34])

- A potential loss of independence and the creation of a new dependencies of the imports from a third countries

## 4.4. Challenges for producing and transferring green ammonia from Namibia

Namibia and the Hyphen project are a good example to showcase challenges and obstacles which may occur during the implementation of a similar size project.

**The targeted production site for the Hyphen project is currently economically weak**

The region is an area where diamond mining used to be the dominant economic factor. However, most mines are exhausted or economically not attractive anymore.

Nevertheless, Namibia shows promising developments. The country halved the proportion of the population living below the poverty line between 2009 and 2016 to 17.4% in 2016. Additionally, the country experienced steep economic growth averaging at around 5% per year until 2015, since then the growth stagnated due to severe droughts, weaker economic growth in neighbouring countries, lower commodity prices and reduced public investment. However, during the first half of 2022, the GDP growth increased by 5.3% in Q1, with an expected GDP growth of 2.8% during 2022.

Today, the most important economic activities in the region can be bundled in the tourism, fishing, and partly port related sectors. Lüderitz, the closest city to the future production site, has an unemployment rate of 55%. With the creation of 15,000 jobs during the Hyphen construction phase with an additional 3,000 permanent jobs for qualified specialists, the project will have a large impact on the region.

Nonetheless, during the implementation different challenges may occur and part of the population may oppose the project. The composition of the population may change, as predominantly well-educated specialists are needed, leaving less opportunities to local inhabitants. Hence, citizens may potentially not directly benefit from Hyphen but instead will face higher prices due to a potential economic shift the project may cause. A potential Dutch phenomenon, which may touch the local inhabitants, describes the separation between different sectors by solely relying on the hydrogen sector, while neglecting other industries. Nevertheless, with adequate policies, such a Dutch-phenomena can be avoided, and potential shifts managed to the benefit of the Namibian population.

It is expected that the future ammonia boom will create an affluent class that will demand services, such as legal services and leisure activities amongst others. For that reason, increased service prices will shift labour to the service sector and therefore, the manufacturing sector will lose competitiveness on the labour market.

[34] Internationaler Handel und Wettbewerbsfähigkeit auf dem Weg zur Klimaneutralität, 2022

This phenomenon is already progressing and advanced in the region since Lüderitz was historically focused on diamond mining, which is a sector in decline.

**Required deliveries of construction materials to Namibia for Hyphen should be planned before any construction works**

Since Hyphen is in Namibia, it is important to emphasize that during the construction phase, the project may encounter some problems with the supply of materials. Delivery of different elements will require longer time and logistics. This is especially the case for electrolysis, pipeline construction and storage facilities.

**Future transport options and routes for delivering green ammonia from Namibia to Germany must be considered**

The existing and fastest way is water transportation across the Atlantic Ocean to the North Sea. This route is about 6,000 sea miles and will take more than two weeks to reach Germany. Particular attention should also be paid to a careful transportation. When ammonia enters water, it becomes a dangerous soluble toxic product.

In addition, the required tonnage of ships should be considered.

**Vessels designed to transport hydrogen/green ammonia are usually assigned to a particular route**

That means every new route needs to have additional ships[35]. The supply side for these ships is dominated by three manufacturers that control almost 90% of the market. As a future demand grows, prices for transport capacity will rise and buyers' bargaining power will weaken.

## 5. IDENTIFICATION OF MAIN IMPLEMENTATION RISKS AND BARRIERS

Based on the interview outcomes typical risks and barriers associated with large-scale green ammonia projects, such as Hyphen, were identified. These risks could be divided into the following three categories:

- Market risks, which consider "first- mover" barriers
- Political risks, both in Germany and Namibia
- Infrastructure and technical risks

[35] Each year, 18-20 Mt is transported by ship. Around 170 vessels are in operation that can carry ammonia, of which 40 carry ammonia on a continuous basis. (Source: IRENA)

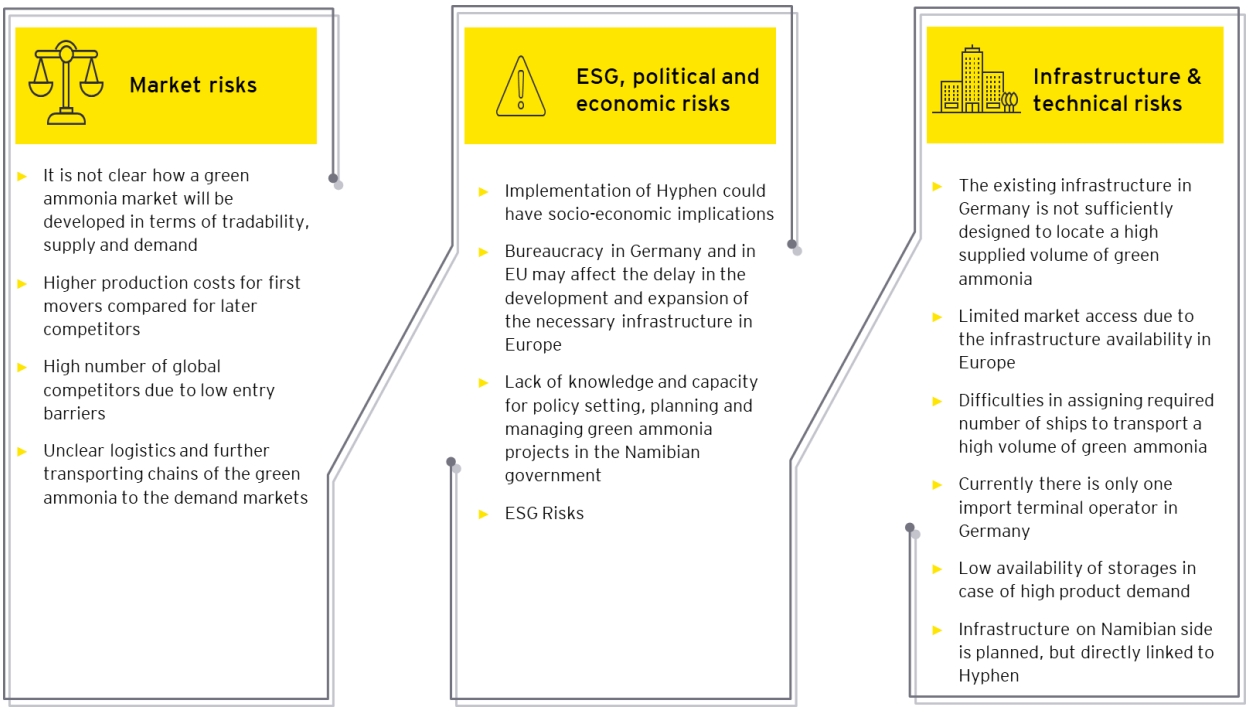



*Figure 8 Summarized overview of the identified risks per area of influence (source: EY)*

## 5.1. Market risks

**It is not clear how a green ammonia market will be developed in terms of tradability, supply, and demand**

As grey and green ammonia are traded as commodities and are chemically the same product, they are substitutable. Thus, due to the goals to decarbonize the industry in Europe, a high increase in demand and production of green ammonia is expected. An additional positive impact on demand could lies in exploring green ammonia by new consumers such as the shipping industry. On the other hand, timing and volume of the demand are unclear as switching to green ammonia entails initial investments in new fleets and infrastructure at higher prices.

**Higher production costs for first movers compared for later competitors**

The current pricing system for green fuels is still quite underdeveloped, thus future purchase prices cannot be modelled or relied upon as with more mature commodity markets such as oil, gas, and grey ammonia. On the global market ammonia is nowadays primarily produced using fossil fuels, in particular SMR natural gas and the H-B process. Green ammonia could be produced by the H-B process and electrolysis. Electrolysis is energy intensive, has a lower efficiency degree and is also expensive. Thus, the cost of producing green ammonia increases

proportionally. In the US, one of the largest ammonia producers in the world (CF Industries Inc.), estimated prices at around $500 per ton[36], which is 3.3 times more expensive than lower price point of grey ammonia. Meanwhile, in case prices for oil and gas will be quite low, it will disrupt green ammonia further development.

Nevertheless, with high initial investments, green hydrogen/ ammonia will become increasingly cost competitive since renewable energy resources are available in abundance in countries such as Namibia. With carbon prices likely to increase, and the unlimited supply of nature energy resources such as wind and sun, green ammonia will reach cost competitiveness to grey ammonia in the future.

**Potentially a high number of global competitors due to low entry barriers**

Despite the existing issues with high prices and costs, numerous global projects continue to be announced, although only a few of them are currently being implemented.

The process for producing hydrogen and green ammonia is not new and therefore cannot be protected by patents. Thus, the technology is accessible to all competitors. Important production factors such as renewable energy sources may also prove very favourable in other locations. Having that in mind it could be said that entry barriers into the market are low.

**Unclear logistics and further transporting chains of the green ammonia to the demand markets**

This is a fundamental market risk, but due to its dimension has been assigned to its own risk category (see below 5.3.).

## 5.2. ESG, political and economic risks

**Implementation of Hyphen could have socio-economic implications**

Hyphen could have a significant impact on the socio-economic system in Namibia, especially in the city of Lüderitz and surrounding regions. The project plans to invest a sum equivalent Namibia's gross domestic product, which means there is a risk of changes to the overall quality of life. Political instability and economic stratification of the local population should be avoided. The project should be well integrated into Namibian society, which requires political, infrastructural, educational, and social contributions. Additional measures for adoption and public acceptance must be explored.

**Bureaucracy and lack of knowledge can cause a delay in the development of Namibia and expansion of the necessary infrastructure in Europe**

[36] Expert Interviews

Likewise, for successful policy development in Namibia, problems such as the lack of local knowledge to determine legal and policy for permissions support, as well as management of such a large- scale project must be identified und addressed. One example here could be that the common-use-infrastructure needs to be regulated to avoid monopolistic structures.

**Environmental, Social and Governance risks must also be considered**

The port in Lüderitz, which is planned to be expanded to the Hyphen production side, is currently an important place of flamingo migration. Future construction could have a negative impact to the local ecosystem and lead to objections from political and societal organizations. Therefore, all major ecosystems should be examined at an early stage before construction begins. See also 4.4 for further details and possible impacts.

## 5.3. Infrastructure & technical risks

**The existing infrastructure in Germany is not sufficiently designed to accommodate a high supply volume of green ammonia**

The existing infrastructure, as well as required future infrastructure, are issues that need to be addressed swiftly to ensure that green ammonia can reach potential off-takers.

The use of green ammonia is depending on factors such as availability of transport infrastructure, supply chains and storages for further distribution of the product in Germany and Europe. The existing infrastructure capacity in Germany would only be sufficient for the first production phase of Hyphen.

**Currently there are not enough ships to transport a high volume of green ammonia to Germany / Europe**

In addition, the transport of green ammonia needs vessels that could handle the volume and ensure safety. Moreover, the number of potential suppliers of vessels is very limited and currently they might be full of orders and have a limited capacity.

Each year, 18-20 Mt is transported by ship. Around 170 vessels are in operation that can carry ammonia, of which 40 carry ammonia on a continuous basis.

**There are currently not enough import terminals in Germany**

The lack of terminals to unload ammonia from ships plays a crucial role. Ports such as Brunsbüttel and Rotterdam are currently not able to handle the planned full capacity of Hyphens production. Projects for the construction of import terminals have been announced by RWE and Yara but are not yet operational[37].

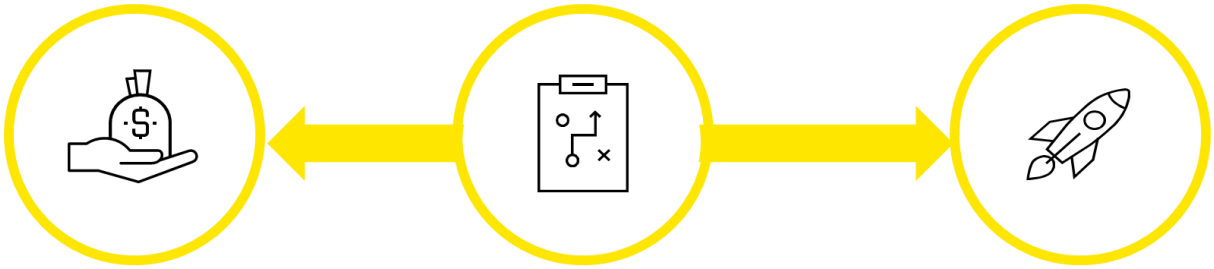
[37] RWE AG, 2022

**Infrastructure on Namibian side is planned, but directly linked to Hyphen**

With regards to infrastructure in Namibia, it is planned to build a common-use infrastructure, which requires high upfront investments. That fact needs to be considered to run future tenders for the management and usage of the common-use-infrastructure, to avoid monopolistic structures. This risk implies that Hyphen is more capital intensive than a comparable project realized at a later stage and therefore less competitive in terms of total production costs.

## 5.4. Translation of risks into barriers / obstacles for the projects

The above-identified risks could be translated into the three barriers, which according to our interview partners hinder an (faster) implementation/realization of the project.



**Bankability (defensive investors)**

- Complexity of such large/ scale green ammonia projects creates difficulties in risk assessment for investors
- ESG-Risks should be clarified for future investors
- Investors need a high security for purchasing and distributing green ammonia in Germany and Europe
- Uncertainties in purchase guarantees
- High sensitivity to critical planning parameters

**First-Mover Disadvantages**

- Lack of infrastructure and logistics
- High initial investment by constructing the common-use infrastructure
- The required high level of demand at this stage cannot be determined.
- Green ammonia production is currently expensive
- Cooperation with developing countries requires strong risk mitigation measures

**Implementation speed**

- High down payment requirements
- Uncertainties in the physical delivery of the product
- Important project phases have to be implemented in parallel and therefore it leads to higher costs

*Figure 9 Summarized barriers per impact areas (source: EY)*

**Project bankability is critical to materialize investments and is the key to support Hyphen or similar large-scale projects to build and operate a production site**

**The project bankability** is one the most relevant issue for any investor[38]. Currently, there is no global market for green ammonia. Financiers will need to take a long-term view of the market and deal with a host of credit problems to issue external bank debt. To support innovation and stimulate new uses for green hydrogen, it is important that projects could secure commercial

[38] Defensive investors- focuses on finding conservative investments that require little effort in portfolio management. They carry a portfolio of 50/50% stocks and bonds. A typical portfolio includes such types of investments like cash, fixed interests, shares and property.

funding for new markets. Especially the cost and availability of finance influences the cost of the product and the speed to market.

Additionally, revenue streams, such as selling surplus hydrogen, can significantly lower purchasing barriers. This could be also a key to attracting commercial investment.

**First- mover disadvantages must be considered not only in terms of prices and production costs, but also in terms of availability of necessary logistics and warehouses**

Disadvantages include lack of ports, storages and logistics within Germany and Europe. Potential difficulties could be also seen in cooperation with a developing country, which might require additional mitigation measures. These barriers will have a negative impact on Hyphen implementation speed and project bankability.

**The implementation speed of the project will depend on Hyphen's ability to quickly obtain investments to start the construction phase**

The presented barriers are the base for the identification of political instruments that could secure future supply of green ammonia to Germany.

# 6. OVERVIEW OF THE POTENTIAL POLICY INSTUMENTS TO MITIGATE IDENTIFIED OBSTACLES AND BARRIERS

## 6.1. Proposed long- list of policy instruments and their impact on the Hyphen

As part of this chapter, possible policy instruments supporting green ammonia production in Namibia and its supply to Germany have been selected. As the described barriers are similar for other green ammonia projects across the world, these instruments should be seen as universal.

The proposed long- list was developed based on the outcomes of the literature review and interviews with the Hyphen consortium, as well as external stakeholders. At the same time, all instruments with their potential impact and influence on the identified risks and barriers were reflected in the qualitative assessment and discussed during interviews with potential investors, financial institutions, insurances, and public organizations, as well as potential suppliers and advisors. The introduced long- list of feasible policy instruments are presented in the Table 2 below (for more detail please refer to the Annex II). Each of the instrument show a certain impact on improving the Hyphen project bankability, as well as mitigating first- mover disadvantages. From a global perspective, they aim to support rapid project implementation through the feasibility, investment, and operation phases.

However, one the most important decision- making roles lies with the German government and the European Union. To implement a project of the scale of Hyphen, a common basis for the

further development of the green ammonia industry is not sufficient, but an integrated approach necessary. Local knowledge and technical needs, existing capacities, and the required experience, which can be fostered through a combination of policy instruments, needs to be considered. In this context, also the Government of Namibia should take the important role of the local coordinator and executor. Local political support is a strong leverage for establishing a successful cooperation between the two countries with a potential future EU perspective.

*Table 2 Overview of the policy instruments to promote production and supply of green ammonia to Germany (source: EY)*

| Nr. | Instrument | Impact area | | Hyphen phase[39] | Short description |
|---|---|---|---|---|---|
| 1 | Equity participation | Bankability | Rapid project implementation | II | A strategic or strong financial partner, for example KfW, becomes an equity partner in the project company to provide capital and/ or expertise. Such an involvement would support the bankability through assurances and lower risks for debt investors. |
| 2 | Federal guarantee | | | II | Federal guarantees issued by the Germany government, such as export credit guarantees (Hermes guarantees), untied loan guarantees (UFK-guarantees) or ECA, hedge investment, cashflow or export risks against unforeseen political changes, ultimately reducing the risk. |
| 3 | Development loan | | | II | Development loans characterize by a longer duration with a reduced interest rate. They are granted by institutions such as development banks and are usually tied to specific, non-financial conditions (for example locally improving infrastructure, education, or employment). |
| 4 | Contract for Difference (CfD) | | | II & III | Establishing a framework to secure minimum price guarantees and long- term offtake agreements will be crucial for the project bankability and market creation for hydrogen and green ammonia. It will also ensure the financial attractiveness of projects and open opportunities for infrastructure investors and lenders to invest in such projects. |
| 5 | Public infrastructure support for hydrogen and green ammonia in Germany | Feasibility (first-mover disadvan-tages) | | III | This policy instrument aims at supporting and simplifying the process of building necessary infrastructure to distribute green ammonia in Germany and in the EU. |
| 6 | Green ammonia blending quota | | | II & III | An ammonia blending quota prescribes a mandatory usage quota for green fuels (ammonia) in Germany. Depending on the design, it can apply to a multitude of industries and use cases. The instrument explicitly aims at increasing the demand for carbon neutral solutions and support the development of production capacities. |
| 7 | Research and educational support | | | II & III | Research and educational grants support and facilitate green hydrogen and ammonia research projects, accelerating innovation and potentially identify approaches to minimize costs and risks, ultimately increasing efficiency. Moreover, the instrument helps develop the local workforce and build up the required skills and knowledge capacity. |
| 8 | Support cooperation between (EU) partner countries through ammonia/ hydrogen alliances | | | II | Supporting cooperation between EU countries to speed up construction of infrastructure and ensure that bureaucratic barriers are eased. Further, EU countries should extend their efforts to support countries like Namibia, on "eye-to-eye" diplomatic levels. |
| 9 | Reforming the EU ETS by extending the $CO_2$ taxation or limiting credit allocation | | | II & III | Reforming the EU ETS (as currently under "Fit for 55") is crucial to increase the attractiveness of green ammonia and hydrogen. Namely, the allocation of emission certificates will be lowered and restricted. Simultaneously, additional $CO_2$ taxation could increase the cost competitiveness of green fuels. |

[39] Phase I – Feasibility study (represents the phases A and B in chapter 2.1)
Phase II - Investments and financial close (represents the phases I and the start of the construction phase in chapter 2.1)
Phase III – Operation (represents phase after finalizing the second construction phase in chapter 2.1)

| Nr. | Instrument | Impact area | | Hyphen phase[39] | Short description |
|---|---|---|---|---|---|
| 10 | Reduction of incentives for emission-intensive energy sources | | | II & III | Reducing subsidies and incentives for fossil fuels as an energy source to make green fuels more price attractive and increase the demand for low carbon solutions. |
| 11 | Tax incentives for green ammonia/ hydrogen imports | | | II & III | Tax incentives for green ammonia/hydrogen imports can increase the cost-competitiveness of the commodity and boost production capacity in countries such as Namibia. |
| 12 | Governmental secondments for policy and project planning to Namibia | | | I & II | Availability of governmental/ policy- making experts is crucial to support countries like Namibia in designing implementation frameworks for renewable energy projects which will have a huge impact on economic and social development. |

Most of these instruments exist already and are used by governments. Some have found their effective application, others require further development or tailoring, considering the needs of the green ammonia industry in Germany and Europe.

Based on the interview outcomes, the impact of selected instruments was identified as following (for more information on each instrument please refer to the Annex III):

- **Instrument 1** for setting opportunities of equity participation, could support the political commitment of the Federal Republic of Germany in the project via an equity stake by KfW, representing a strong signal and anchor also for other financial investors. Ideally, Hyphen should have a strategically important partner and co-investor who is an equipment supplier (e.g., ABB, Linde, AirLiquide).

- **Instrument 2** for establishing Federal guarantees, could generally support Hyphen for its bankability. Project financiers usually requests ECA coverage in such kind of projects.

- **Instrument 4** for developing CfDs minimum price guarantees. This instrument was prepared by H2Global (through HINT.CO) considering financial support from the German government. With the first tranche of EUR 900 M, producers of green hydrogen/ammonia can apply for guaranteed offtake agreements by CfD from HINT.CO, which acts as a market intermediary. Producers can apply for a sub-tranche of up to EUR 300 M in the first round of H2Global, which does not necessarily need to cover the whole produced amount, thus larger projects can participate as well. A similar mechanism is planned to be utilized at the EU level through the establishment of a Hydrogen bank[40]. This instrument is quite efficient, however, there is a need to improve its mechanism establishing clear price formation, timeline, and relationship between involved parties.

[40] As per official announced by President von der Leyen

- **Instrument 5** directed on development and maintenance of public infrastructure for hydrogen and green ammonia and the lack of infrastructure that can sufficiently absorb large amounts of green ammonia, since it is currently produced in integrated factory parks where use and production are in proximity. The German government supports the development of the LNG-port in Stade with EUR 100 M. This practice could be revised to support future imports from projects such as Hyphen. In this case, the amount of funding may be higher, and a more sophisticated funding mechanism would need to be established.

- **Instrument 9** for reforming the EU ETS by extending the $CO_2$ taxation or limiting credits, currently exist at the national level for fuel and heating. Within the „Fit for 55" package the instrument needs to be reformed, especially with a reduction of free allocations of carbon credits in industries that are especially hard to decarbonize.

The existing policy framework should be widened to support potential first- mover projects like Hyphen. Additional measures implemented by the German government, such as collaborations for conducting research in the area of green hydrogen/ammonia between Germany and Namibia are not sufficient. Germany has no infrastructure that can sufficiently absorb large amounts of green hydrogen. Currently, hydrogen and ammonia are produced in integrated factory parks, where usage and production are in proximity. Therefore, infrastructure needs to be constructed. Also, Namibia has number of topics that need to be addressed, including the need for constructing infrastructure, improving governmental capabilities, and human capital available to produce green hydrogen and ammonia.

The final focus of the applied policy instruments to Hyphen must increase its bankability and simultaneously support Germany in establishing a sufficient supply of green ammonia from Namibia. For Namibia, instruments should deliver strong financial and educational support to run the construction and operational phased of Hyphen. Only integrated measures could create a successful solution to minimize risks and avoid barriers.

To understand the exact needs of Hyphen and its complexity in establishing business relationships, a high-level potential stakeholder structure has been developed (please refer to the Figure 10):

1. **Sponsors**: equity capital providers to Hyphen. They could act through acquiring shares in Hyphen in exchange for capital. Their involvement depends on governmental guarantees to mitigate country / political risks and the bankability of Hyphen.

2. **Public Bodies and institutions**: include governments and public organizations like GIZ, which could provide support Hyphen on implementing policies and developing on- side peoples capacity. Both organizations are critical to the success of the project and require guarantees associated with the development of the project.

3. **Investors**: debt capital providers, such as banks or other institutional investors that could offer loans to Hyphen. Their involvement largely depends on credit metrics, predictability of cash flow, governmental assurances / backing to decrease the risks related to Hyphen.

4. **EPC contractors**: experienced and financially strong turnkey contractors that can construct the required infrastructure and production plant in Namibia in time and at agreed costs.

5. **Suppliers:** potential partners that could otherwise supply only specific parts for the Hyphens construction phase, or also support the project during the operation phase and completely undertake technical proofs and maintenances.

6. **Operators**: potential stakeholders will operate at the production site in Namibia, they require qualified local staff to facilitate the production of green hydrogen/ammonia and run required proofs and maintenances of technics.

7. **Customers/Off-takers**: off-takers for green hydrogen/ammonia could be influenced by incentives, quotas and CfDs that would enable the purchase and use of green ammonia in industrial processes.

8. **Infrastructure companies** (Ports, Pipelines etc.): for Germany to absorb green hydrogen the infrastructure needs to be "green ammonia ready". The country needs to create incentives and support programs to run required developments in parallel to Hyphen.

In Figure 10 below, the long list of policy instruments was assigned to each of the interactions to show their positive impact.

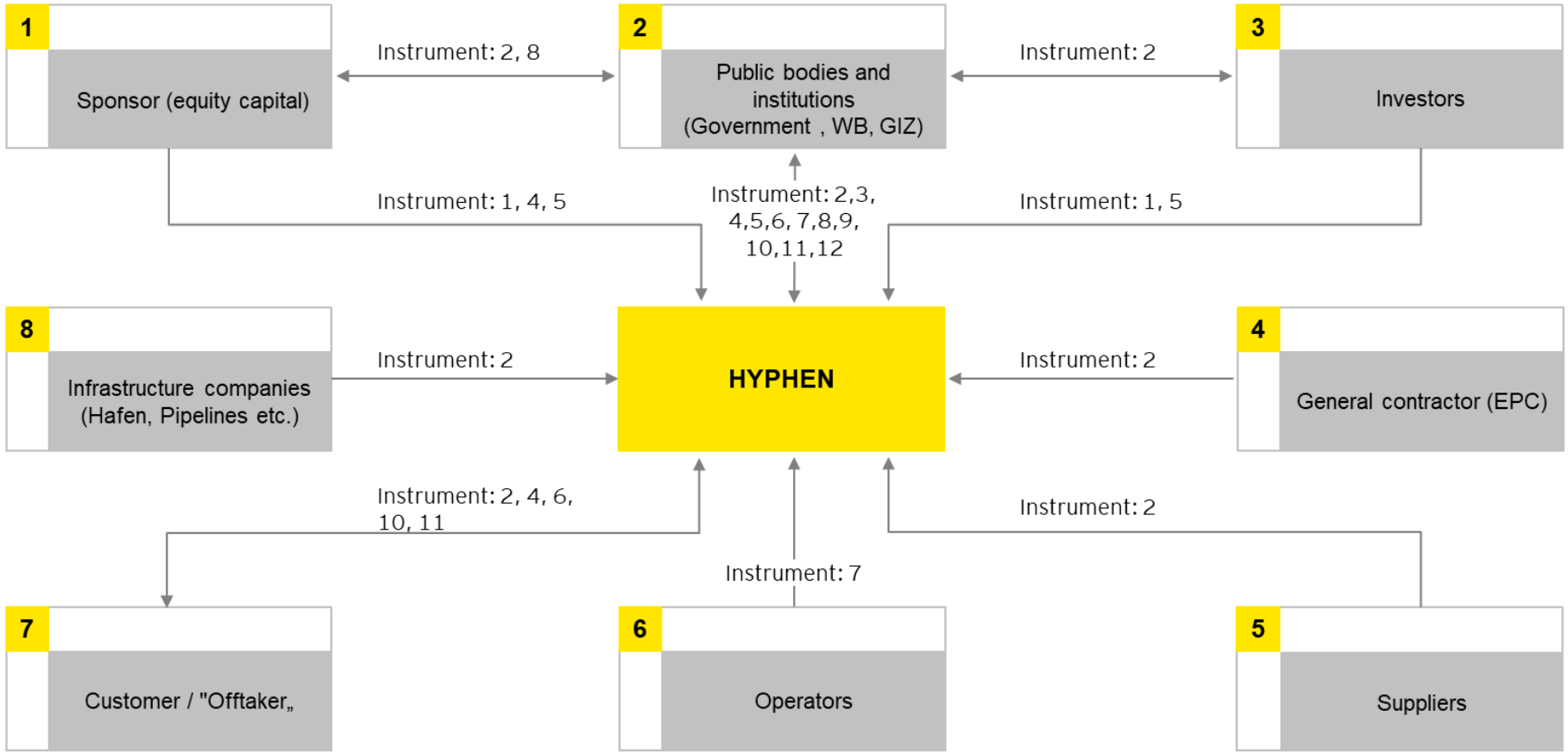



*Figure 10 Structure of the possible Hyphen involved stakeholders (source: EY)*

## 6.2. Qualitative and quantitative evaluation of the instruments

### 6.2.1. Overview of the qualitative evaluation outcomes

As described earlier in the methodology, the quality assessment of the twelve proposed policy instruments is linked to a rating system, the results of which were prepared based on feedback from external stakeholders (potential suppliers, investors, development banks and institutions and advisors to the Hyphen project) and the opinion of EY experts.

In total, EY experts conducted more than 18 interviews with external stakeholders:


*Figure 11 Summary of interviews per area of interest (source: EY)*

The outcomes per six categories to identify instruments are the following:

**Attractiveness (50%):**

- **Category 1: Access to defensive investors (12%):** during the interviews it became clear that the risk profile of green ammonia projects permits investments of "low risk – low return" investors, such as infrastructure funds. The majority of those interviewed emphasized the importance of policy instruments to classify Hyphen as renewable (energy) projects. Future policies should aim to reduce the risk profile of the project to attract defensive investors.
- **Category 2: Financing conditions (24%):** most of the interviewees agreed that improving project financing conditions should be a priority. Conditions for Hyphen's funding must be developed quickly, especially given the timetable and pipeline of global hydrogen projects. The interviewees stressed the importance of setting potential off-take agreements like CfDs, as well as government guarantees such as ECA coverage.
- **Category 3: Simplicity of the instrument (14%):** the interviewees acknowledged the inherent complexity of existing policy instruments that support the development of new industries (like green ammonia). However, some interviewees expressed concerns about the speed of instrument implementation and the regulatory issues in Germany. A slow and bureaucratic process could be a barrier for Hyphen which strongly relies on governmental support. Furthermore, interviewees pointed the necessity to scale up capabilities and relevant professional knowledge in Namibia.

**Effectiveness (50%):**

- **Category 4: Impact on Germany (16%):** the importance of such large-scale projects to Germany was acknowledged. Most of the interviewees agreed that African states, and especially Namibia, are not dependent on German intervention, but are free to choose potentially less complex and faster options. In case Hyphen will be realized, Germany could immensely benefit and play a leading role in the global market for a green ammonia sector. However, the country must act quickly, as interest in Namibia offering excellent conditions to supply European, as well as Asian markets, is very high.
- **Category 5: Impact on Namibia (18%):** interviewees showed concern about the ability of the Namibian government to develop the necessary infrastructure and create the regulatory, as well as management framework. Whereas financial stakeholders relied on their experience in African countries and were less concerned about potential risks resulting thereof. At present, the Namibian government lacks the experience and knowledge to define the needed regulatory framework to facilitate investment in excess of the country's total GDP.
- **Category 6: Impact on industry and business (16%):** ensuring stable supply and access to green ammonia is key to the competitiveness of German companies and industries. It was emphasized that swift and effective policy changes and incentives should be made to facilitate a fast substitution of grey ammonia with green ammonia. Quick action is not only wished but required considering the current developments in the energy supply sector. Nonetheless, instruments should allow wide innovation and the development of different technologies and should not limit to single production methods. Interviewees also stressed that policy actions need to facilitate the sustainable development of Namibia and the hydrogen/ammonia industry. Therefore, widespread upskilling programs and the use of the local workforce need to be emphasized.

Additionally, two workshops with the client and stakeholders (BMWK, ENERTRAG, Agora Energiewende, GIZ) were organized. The goal was to discuss the long list of potential policy instruments, identify their impact on Hyphen and similar projects, and finally select the most impactful instruments.

Summarizing both results from interviews and workshops, it could be highlighted that:

- the **CfD instrument** (one- or two-sided) was recognized by almost all participants as the most effective and needed for the implementation of Hyphen. Without CfD support, the required bankability of the project and its overall price competitiveness cannot be achieved.

- the **necessary infrastructure in Germany and Europe** should be built in parallel with the implementation of Hyphen. It must be ensured that in the future Germany and Europe could handle large volumes of green ammonia and ensure that it reaches consumers quickly. Additional funding programs from the German government may be issued to boost the development.

- to **increase demand** for green ammonia **establishing of blending quota** could be one of the key instruments to support the transition. The EU could decide what is considered as green ammonia and create its own supply market.

- **European strategy for using green ammonia** should be created. This will also help to increase the product demand and support Hyphen. Moreover, for this and other financial purposes the EU plans to establish a Hydrogen bank, that potentially could support the import of green hydrogen in the form of green ammonia. Especially considering the recent IRA Act in the USA that incentivizes green hydrogen production, the EU should establish coordinated and quick action.

- **Germany should build a trustful partnership with Namibia** and provide support on knowledge transferring and creating education programs.

Below are the results of the qualitative evaluation of policy instruments. The detailed rating of each instrument is presented in the Annex III.

*Table 3 Summarized qualitative evaluation of the policy instruments (source: EY)*

| Classification of instruments | Policy instruments | | Attractiveness | Effectiveness | Final score |
|---|---|---|---|---|---|
| High importance | 4 | Contracts for Differences (CfDs) | 3,5 | 3,3 | 6,8 |
| | 12 | Governmental secondments for policy and project planning | 3,3 | 3,4 | 6,7 |
| | 5 | Environmental-friendly Infrastructure funds | 3,4 | 3,3 | 6,7 |
| | 6 | Green hydrogen/ammonia quota | 2,8 | 3,6 | 6,4 |
| Secondary | 9 | Reforming EU Emission trading scheme | 1,9 | 3,4 | 5,4 |
| | 7 | Grants for Research and Education | 1,5 | 3,7 | 5,2 |
| Inferior | 2 | State Guarantees | 3,2 | 1,8 | 5,0 |
| | 3 | Development loans (reduced interest loans) | 2,4 | 2,1 | 4,5 |
| | 8 | Promoting cooperation with partner countries within the framework of a hydrogen alliance in coordination with EU initiatives | 0,7 | 3,7 | 4,4 |
| | 1 | Equity Financing | 2,6 | 1,3 | 3,9 |
| | 11 | Tax incentives for imports of green hydrogen from Namibia | 1,0 | 2,8 | 3,8 |
| | 10 | Gradual decline of incentivization for emission intensive energy sources | 0,7 | 2,7 | 3,5 |

Below is a matrix providing an overview of instruments evaluation outcomes.

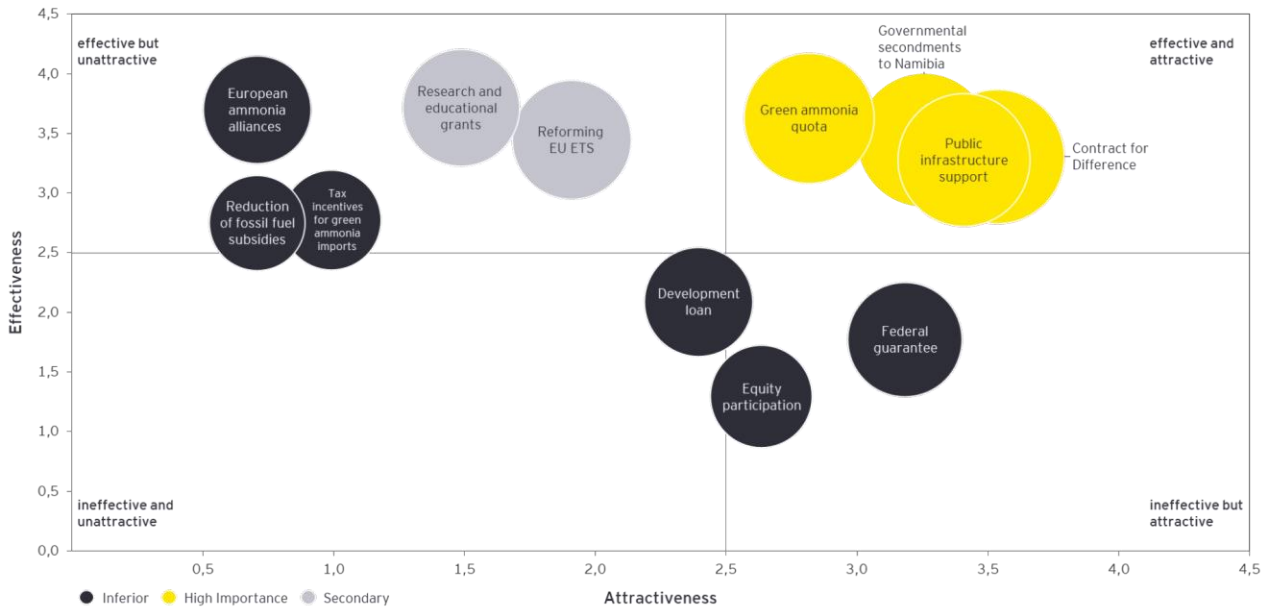



*Figure 12 Summarized evaluation outcomes Matrix (source: EY)*

In Figure 12 the bubble size represents the potential financial impact of the policy instrument on the financing costs of a potential project based on a high- level assessment whereas the attractiveness and effectiveness could be observed on the respective axis.

As a result of the qualitative evaluation of policy instruments, the following instruments would have the largest impact on Hyphen:

1. Creation of long-term off-take agreements and establishment of CfDs
2. Governmental secondments for policy and project planning. Deployment of qualified experts from Germany/EU to support the development of the policy framework and project implementation in Namibia
3. Create environmental-friendly Infrastructure funds
4. Set green ammonia blending quota

### 6.2.2. Overview of the quantitative evaluation outcomes

This part of the report focused on a quantitative evaluation of the four selected policy instruments for large-scale greenfield projects like Hyphen. The evaluation was used as a proxy to estimate the financial impact of the policy instruments. However, out of four instruments, only two have a direct financial impact, namely CfD and a green ammonia blending quota.

Environmental-friendly infrastructure funds and governmental secondments to Namibia in this case have only indirect influence.

The remaining eight policy instruments from the long list were not considered in this chapter. Nonetheless, they still play an important role in providing further stability and likely increase the bankability of Hyphen.

Based on available preliminary data, changes in parameters such as capital expenditure (Capex), leverage, cost of capital and duration, were performed and their effect was estimated.

For the base case, it was assumed that none of the policy instruments would be in effect and financing is solely based on market quotes considering the inherent risks of the project. Under this setup, financing will be extremely risky and in similar cases only possible with equity capital. The cost of capital reflected this circumstance and was in the range of similar green ammonia projects, combined with renewable energy. Since the project is being constructed in a Sub-Saharan country, the cost of equity also included a country risk premium. This base case was used as a reference and the financing costs were indexed with 100%.

Following, the potential effects of the implementation of single policy instruments were quantified and the financing impact was put into reference with the base case. More importantly, a scenario was assumed in which all four policy instruments come into force simultaneously.

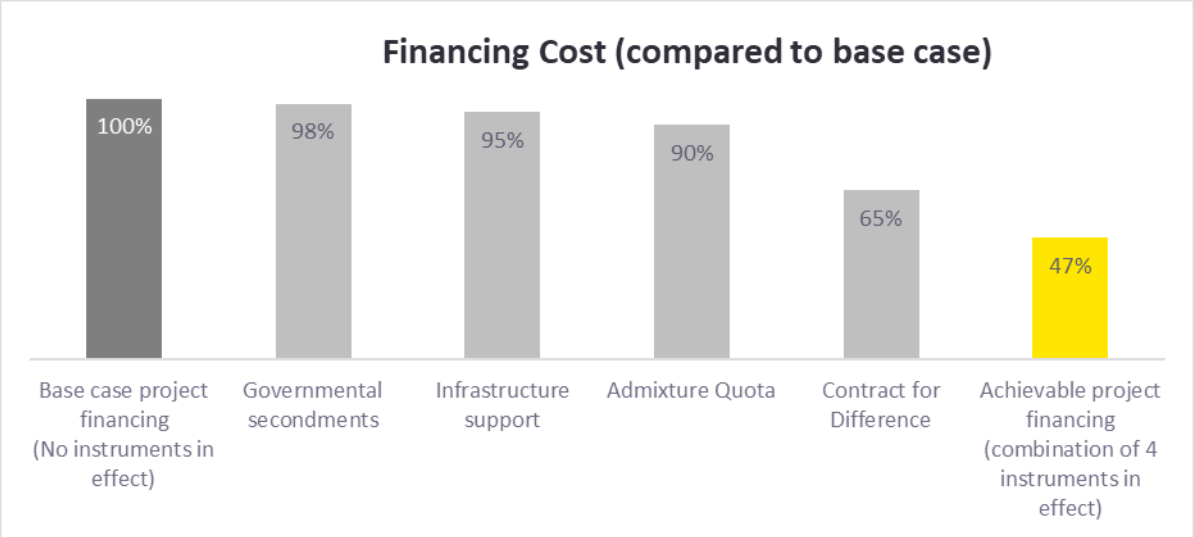



*Figure 13 Financing cost comparison (Source: EY)*

Figure 13 shows the impact on the financing compared to the base case. Displayed is the relative financing cost to the base case for each single instrument as well as the combined policy mix. Especially CfDs as a single instrument are effective and can decrease financing costs for the Hyphen project by a third. Due to a guaranteed minimum price, the bankability can be increased (for details please refer to chapter for details please refer to chapter 7.2**Error! Reference source not found.**). Most notably, in the combined case where all four instruments are applied simultaneously, the impact on the financing cost was disproportionately positive, highly affecting the bankability of green ammonia greenfield projects. The combined policy mix

minimized off-take risks, country risks and price uncertainty, making debt financing feasible and reducing the cost of financing by approximately half.

Electricity generation accounts for more than half of the cost of ammonia. Whereas for grey ammonia, electricity is purchased during the operations, for green ammonia renewable energy plants need to be built upfront, shifting the electricity cost from an operational cost to a capital cost. Therefore, lowering the cost of capital has a large impact on the price of green ammonia.

# 7. PROPOSED POLITICAL INSTRUMENTS AND FINAL RECOMMENDATIONS

## 7.1. Summarized proposed set of political instruments

Considering the results from the qualitative and quantitative evaluations, the final set of the most sustainable and effective policy instruments to enable the supply of the green ammonia to Germany by supporting projects like Hyphen, was developed. It is recommended to implement four policy instruments as one package. This means that they should be introduced preferably in parallel at the same time (Chapter 7.1.1).

In addition, two instruments have been selected to play a supplementary role to the main package. They could be however implemented at a later stage (Chapter 7.1.2).

### 7.1.1. Overview of the final setup of the selected four policy instruments

**CfDs can be a very effective instrument to support green ammonia production in a form of long-term off-takes – instrument 4**

A CfD mechanism could reduce first-mover risks and create a long-term bankable scenario with a predictable project cash flow stream. Thus, producers have the prospect of achieving the competitiveness of green ammonia. There are many ways to create such a CfD, however, as a rule, the mechanism should be aligned with H2Global.

More details on its exact setup are presented in Chapter 7.27.1.2 of this report.

**Namibian government institutions need support in managing large investments– instrument 12**

If projects like Hyphen are implemented, a number of challenges must be overcome. The government needs to have a strong capacity, as well as the right instruments to facilitate necessary developments simultaneously, such as developing infrastructure feasibility studies, or area planning initiatives in Lüderitz (for example for creating additional housing districts, strong public transport infrastructure, as well as establishing additional schools, hospitals etc.), as well as distribution of growing wealth in the society. To address these challenges, it will require extensive knowledge from a policy and legislative perspective in Namibia.

The proposed instrument for governmental secondments for policy and project planning (like Hyphen) to Namibia has the goal to support the country and policymakers in the creation of competencies and capacities to facilitate the required changes. This could potentially take place through the support from the GIZ, or other qualified international consultants. However, it is important to note that this policy instrument should be introduced considering cultural sensitivity. Current GIZ programs might be extended, only if the Namibian government wishes to do that.

Secondments could also promote the strategic cooperation between Germany and Namibia and strengthen the diplomatic ties to establish a trusting relationship between suppliers and off-takers. Particularly, the German government could set up a budget of at least EUR 10 M[41] that could allow approximately 30 experts to be deployed to Namibia as soon as possible. Potential cooperation organizations in Namibia could be the Ministry of Education, Arts and Culture, the Ministry of Mines and Energy, the Ministry of Environment and Tourism Namibia, the Ministry of Public Enterprises, Industries, and the Presidency (National Green Hydrogen Commission), that assist the ministries to create a framework for green energy and sustainable development. Considering the complex nature of secondments, several advantages and disadvantages stand out:

- **Advantages:** Germany could support the sustainable transformation of Namibia while proposing the development of framework conditions, from which both countries benefit. In addition, the policy framework created in Namibia can serve as a model for other developing countries on the cusp of rapid transformation. However, given the historical relationship between Germany and Namibia, future outcomes must be directed towards the development of Namibia as a whole country, and not to serve a small elite that extracts resources and makes a profit for itself.
- **Disadvantages:** There are not many disadvantages identified, beside a required high investment into needed programs. Cooperation between Germany and Namibia must be based on mutual respect and at eye level.

**The creation of infrastructure will support Hyphen bankability and will increase opportunities to fast utilize green ammonia in Germany and Europe – instrument 5**

Most stakeholders have stressed the crucial role of a functional infrastructure, ready to absorb green ammonia at an early stage. The infrastructure in Germany should be sufficiently transformed on time to allow the future supply of green ammonia. Public support of infrastructure development could indirectly affect Hyphen bankability, reduce first-mover disadvantages, and speeds up the realization of projects. Establishing the infrastructure that allows fast transport of green ammonia from ports to industrial sites will ultimately ensure a safe transition from grey ammonia to green ammonia. This is important because nowadays ammonia is mainly produced only in the area where it is used, thus future transport needs to facilitate the transforming supply and value chains.

[41] The data was obtained through interviews

Potentially, the German government should propose an infrastructure support program that includes public procurement measures, and allocation of funds for the construction and conversion of new and existing infrastructure. They should be created to support Germany in proper utilization of green ammonia. The need for general coordination of infrastructure development should be considered at the EU level between neighbouring countries, especially for the existing transport corridors like the shipping corridor from the port of Rotterdam to the Ruhr area. There could be, for example, further development of the LNG-Port in Stade, being adapted to green ammonia. Governmental incentives could simplify the dooming recession burden on industries and keep the infrastructure sector, which usually suffers from a recession, in permanent employment.

Additionally, infrastructure development will ease the transition process from current, proximity production and usage of ammonia to spatially distant supply and value chains that require novel transport solutions. Based on experience, governmental infrastructure programs at this large scale require considerable bureaucratic efforts and long time periods. However, this potential shortcoming only further underscores the need for direct and swift action.

**Establishing a blending quota to support Hyphen product transparency, and its competitiveness by offering attractive prices – instrument 6**

A green ammonia blending quota is primarily aimed at creating demand in the market. The EU Member States have already updated their legislative proposals under "Fit for 55" and identified a blending quota for hydrogen. The Council has agreed that 35% of hydrogen used in the industry should come from renewable fuels by 2030, rising to 50% by 2035. The EU developed a package of laws for the gas market, which includes the addition of hydrogen to the gas network.

Since a mandatory blending quota for hydrogen is very effective in creating demand for new products, it is recommended to follow the EU proposal and additionally include an ammonia-specific blending quota in both German and European laws. This means that every producer and user in Germany and the EU who utilizes ammonia for their production processes or as an energy carrier, must use a minimum quota of green ammonia. This will ensure a minimum demand for green ammonia and facilitate market formation.

In addition, over time, increased green ammonia prices will reduce the risk of CfD price guarantees to the government.

For the initial phase of Hyphen implementation, it is essential that a blending quota is feasible and thus supply is ensured. Therefore, blending quotas should be established in a line with future CfD, required infrastructure construction and supported by market developments.

Based on the expected increase in ammonia demand to up to 3.7 Mt in 2030 and 5.5 Mt in 2050 and applying a corresponding blending quota of 35% in 2030 and 100% in 2050, the minimum demand will increase to 1.3 Mt in 2030 and 5.5 Mt in 2050 respectively.

In addition, it is expected that ammonia will be the main product for the shipping industry being utilized as a fuel from 2030, significantly impacting the demand up to 5.8 Mt by 2050.

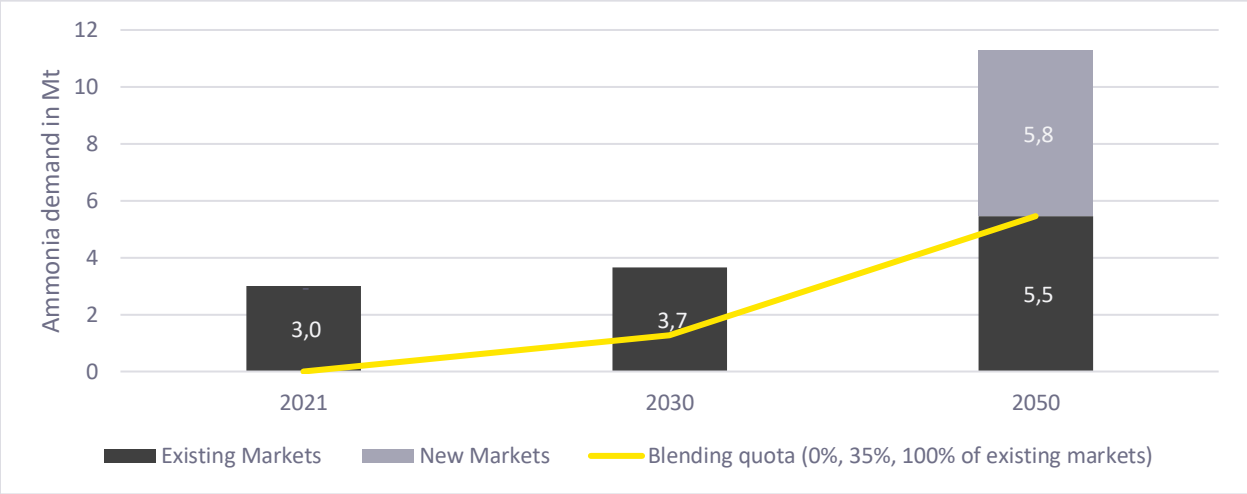



*Figure 14 Ammonia demand in Germany and blending quota (source: EY)*

Figure 14 shows the demand of ammonia in existing and new markets with their expected increase until 2050. The proposed blending quota will be applicable only for a future demand from existing markets.

Based on combined demand, a blending quota, like the hydrogen quota, is feasible, secures demand for green ammonia and is thus an important policy tool for a Net-Zero transition.

### 7.1.2. Overview of supplementary instruments

Besides a key package as per above, two additional instruments to support the Hyphen project and a future supply of the green ammonia product to Germany were identified.

They are directed to introduce programs to support education/research in the sector of green ammonia, as well as reform the EU ETS by extending the $CO_2$ taxation or limiting credits, especially by limiting the free allocation of credits in industries that are hard to decarbonize

It is important to note that these instruments are not interchangeable with the one mentioned in chapter 7.1.1 and only complement each other.

**To make sure that green ammonia products will be attractive for end-users, it is recommended to reform the EU ETS by extending the $CO_2$ taxation or limiting credits – instrument 9**

This will strongly support the creation of additional opportunities where green could compete with grey ammonia. Moreover, a further limitation of available carbon credits, as well as a limitation of free allocation of carbon credits, could supplement a blending quota for green ammonia by decreasing the attractiveness of grey ammonia.

**Given the size of the Hyphen and innovation, as well as the required technical knowledge of the local workforce, there is a political need to support the expansion of educational programs for Namibia– instrument 7**

Due to the past GIZ experience in the region, as part of ProVET (promoting vocational education and training) in Namibia, as well as the existing research partnership between Germany and Namibia, this instrument is not novel. Nevertheless, considering the Hyphen project size and its purpose, such kind of support is crucial to reinforce. As it is known, Hyphen and the Namibian government plan to mainly employ local specialists, therefore improving the skills of the local population will be decisive. Setting higher education standards should support the socio-economic development of the country and allow the citizens to participate in the anticipated wealth creation. New demand in the labour market will cause a decrease in the unemployment rate.

Nevertheless, this policy instrument must be quickly implemented, as upskilling and education of a workforce takes time. To this end, the current German-Namibian research partnership, which has a volume of EUR 40 million, should be expanded and other similar programs should be launched. Stronger collaborations between universities should lead to knowledge transfers, as well as the establishment of research to facilitate future hydrogen projects.

However, bureaucratic barriers to create funding applications should be reduced and research consortiums should introduce selection criteria of at least one German and one Namibian research institute.

## 7.2. Example of a long-term CfD and its potential mechanism

As today, the yearly demand for ammonia in Germany is about 3 Mt[42] and expected to significantly increase by 2030 and 2050 due to high fertilizer needs and new markets like a maritime sector. To support the further development, it is suggested to set a one-side CfD being opened for all companies that are qualified with state aid rules.

State aid is not permitted in the EU to protect competition in the common market, and here it can come from public aid, which is subject to mandatory notification. However, if the CfD-related support mechanism is in line with previous Commission practice, permission from the EU Commission is possible.

Typical timeframes for such a permit process take approximately 12 months. In this case, it is recommended to initialize the request as soon as it is possible.

The mechanism of the CfD should include clear parameters and framework considering:

- **A total fixed duration of 15 years** (e.g., 01/01/2026 until 12/31/2041) addresses first-mover disadvantages, creates a long-term predictability and therefore projects bankability

[42] Öko-Institut, 2022

- The **amount of subsidized ammonia shall be limited for each producer** (e.g., 50% of the entire yearly production but not more than 1 Mt/y of ammonia). Today, 2.5 Mt of ammonia are produced in Germany, and it is expected that this may help to diversify the supplier side and avoid monopolistic tendencies. Thus, competition between producing companies could improve the green ammonia industry
- The **cumulated total amount for compensations shall be limited**. With a contractual barrier, this CfD becomes predictable for public budgets and is justifiable to taxpayers

Over the last years, the grey ammonia price was about EUR 200 per ton and increased to EUR 800 - EUR 900 per ton, due to the natural gas price "explosion"[43]. In the medium run, a price level of approximately EUR 600 per ton is likely to constantly increase over the next decades. Existing forecasts assume that carbon prices will also steadily rise.

The CfD should be established in a way where BMWK guarantees a fixed price (between EUR 800 per ton and EUR 1,200 per ton of green ammonia) that enables producers (like Hyphen) to cover their costs and get an appropriate margin. However, the guaranteed price will have to decrease over 15 years, as the disadvantages of the first movers will decrease and late entry will no longer carry risks in terms of security and unpredictability of market development, thus improving bankability. Companies with later market entry may have access to more effective and more efficient technology.

In the case of Hyphen, a long-term CfD of 15 years significantly improves project bankability compared to a 10-year-mechanism. In the first stage, this will create a compensation demand of EUR 175 M per year (please refer to Figure 15, part 1), assuming an average price of EUR 650 per ton for grey ammonia (including carbon price) and a subsidized production of 500,000 tons of ammonia at a guaranteed price of EUR 1,000 per ton (as an average between EUR 800 and EUR 1200 per ton).

From 2030, when Hyphen will reach its second production phase, the guaranteed price decreases to EUR 950 per ton. At a price of EUR 750 per ton for grey ammonia (including carbon price) a compensation of EUR 200 M per year (with a maximum subsidized amount of 1,000,000 tons of ammonia) is needed (please refer to Figure 15, part 2).

It is assumed that green ammonia will reach competitiveness towards grey ammonia in the first half of the 2030s (please refer to Figure 15, part 3).

[43] Procurement Resource, procurementresource.com, 2022

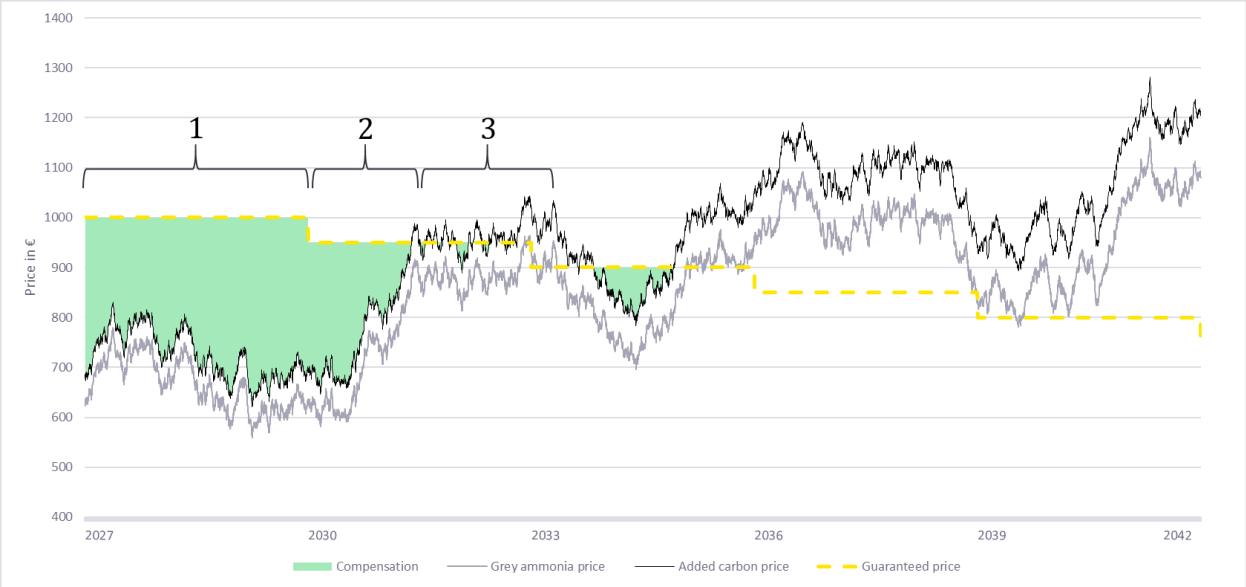


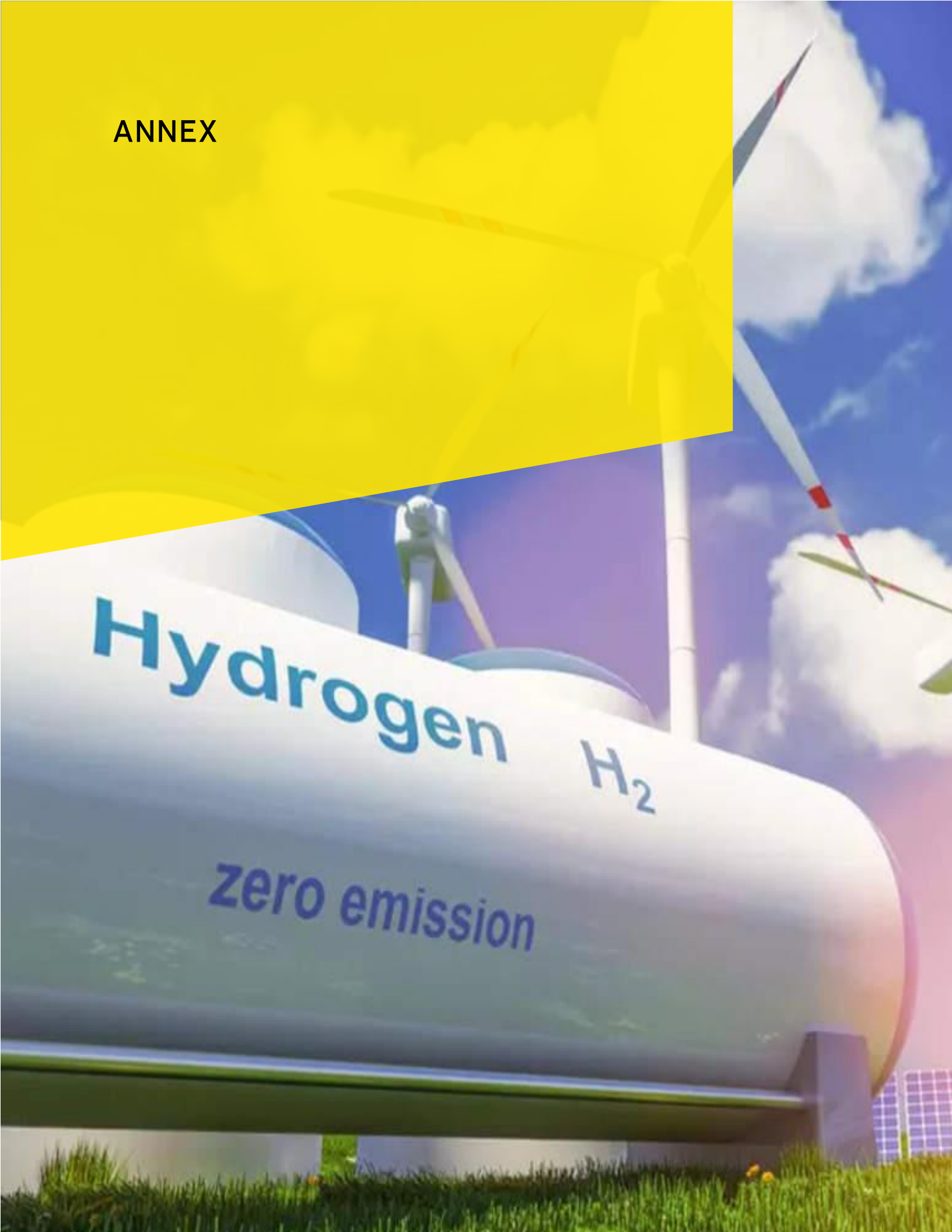

*Figure 15 Possible scenario for a CfD scheme (source: EY)*

The creation of such a mechanism should be in the interests of the government to accelerate the expansion of green ammonia production. So, the producers will receive compensations that equals the difference between the mentioned guaranteed price and the sum of the actual grey ammonia market price and carbon price. The price of grey ammonia could be set in accordance with averaged market prices. The compensation, therefore, will be limited to this amount. In this case, it could incentivize green ammonia producers not to sell the product for too low prices to drive a campaign for customer loyalty.

Finally, it is expected that prices for grey ammonia, as well as carbon prices, will increase over the next years, which will bring additional advantages for utilizing green ammonia. If the sum of grey ammonia price and the carbon price is already higher than the guaranteed price, there shall be no compensation nor any other cash flows from the government to green ammonia producing companies.

This long-term mechanism makes projects like Hyphen more predictable and therefore less risky and more bankable. The entire mechanism should operate at the national level, but it is recommended that it be extended to the EU level to help take the necessary steps toward climate neutrality across the EU.

# ANNEX



## Annex I – List of the used literature sources in the report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24. Renewables 2021 Global Status Report, REN21 Secretariat, 2021.
25. Background Data for ammonia, Öko-Institut e.V., 2022.

## Annex II – Detailed overview of the potential political instruments

**LEGEND:**

| Caption | Not applicable | Partly applicable | Applicable |
|---|---|---|---|

# Instrument #1: Equity participation

## Instrument Overview

### Scope of Influence
- Bankability, speed

### Objective and Goal
- Support and financing of a green hydrogen infrastructure in Namibia

### Main Function
- Strategic and/or financially strong partner participates in Hyphen
- Equity partners reduce the risk for outside capital providers and thus increase bankability
- Strategic partners contribute further know-how to the company; success is pushed by all parties involved

### Involved Organizations/Stakeholders
- KfW, strategic investors (Air Liquide, Linde, etc.)

### Practical Cases
- KfW's trustee investment of EUR 16 million in "Encourage Solarfonds" to finance small PV plants in India

## EY Suggestions

### General Suggestions
- Bringing in additional equity investors increases the financial stability of the project, but it should be noted that the more partners are involved, the longer decision-making paths become and agility can be lost. It is therefore recommended to involve 1-2 selected partners.

### Impact on "Hyphen" Project Phase II
- Financing and/or complementing competencies increases bankability, reduces the risk of default and increases attractiveness for investors
- Participation of KfW can bring further guarantees with it

### Advantages
- Increase in bankability due to mitigation of default risk for debt providers

### Disadvantages
- Smaller investor pool due to increased risk for equity providers
- Dilution of shares and operational decision-making power
- State investments in developing countries have been criticized in some cases in the past

## Evaluation Criteria

| Attractiveness | | | Effectiveness | | |
|---|---|---|---|---|---|
| Access to Defensive Investors | Financing conditions | Simplicity of the instrument | Impact on Germany | Impact on Namibia | Impact on industry and business |
| ● | ● | ● | ● | ● | ● |

# Instrument #2: Federal guarantees - export/ financing/ purchase

## Instrument Overview

### Scope of Influence
- Bankability, speed

### Objective and Goal
- Hedging of German Foreign Direct Investments (FDIs)

### Main Function
- The German government provides guarantees and thus secures investments by German companies abroad.
- Hedging against extraordinary losses such as those caused by political changes, but not against losses in profitability
- Hedging of loans, exports or cash flows to reduce the cost of capital
- Guarantees of acceptance of the product

### Involved Organizations/Stakeholders
- Federal government, ECA /Allianz Trade, buyers, banks

### Practical Cases
- The construction of an ammonia production plant in Mexico was secured by guarantees

## EY Suggestions

### General Suggestions
- Untied financial credits (UFK) can be used to cover up to 80% of the risks for the extraction of raw materials, provided that the green hydrogen/ammonia is delivered to Germany.

### Impact on "Hyphen" Project Phase II
- Securing the project against external political factors increases the feasibility of the project
- Securing the investment/acceptance of the product, secures the cash flow, which allows to reduce the cost of capital

### Advantages
- Proven instrument to secure German investments
- Supports the export of German technology to build infrastructure in Namibia
- Reduces uncertainties in developing countries
- Broadening the investor base for investors with lower margin requirements

### Disadvantages
- Risk is not 100% covered

## Evaluation Criteria

### Attractiveness
- Access to Defensive Investors
- Financing conditions
- Simplicity of the instrument

### Effectiveness
- Impact on Germany
- Impact on Namibia
- Impact on industry and business

# Instrument #3: Development loans (loans with lower interest rates)

## Instrument Overview

### Scope of Influence
- Bankability, speed

### Objective and Goal
- Securing more favorable financing options
- Development of the region

### Main Function
- Bank grants loans at more favorable conditions than the market interest rate.
- Loan is linked to other non-financial conditions, in which local communities are supported (e.g. education, jobs, infrastructure, etc.)
- Loan is usually concluded for a longer period of time

### Involved Organizations/Stakeholders
- KfW, EIB, AfDB, World Bank, Producers, local community

### Practical Cases
- NamPost and KfW - support for the expansion of the branch network in rural regions for the provision of financial services

## EY Suggestions

### General Suggestions
- Qualified personnel is needed for the implementation of the project, which can already be built up and promoted through this instrument

### Impact on "Hyphen" Project Phase II
- A development loan can increase feasibility, by building local staff and aligning local interests
- Bankability is increased through lower capital costs

### Advantages
- More favorable financing options increase feasibility
- Terms are usually longer than with commercial financiers
- Involvement of the local population and common alignment of interests

### Disadvantages
- Development loans have greater complexity as additional factors and guidelines are considered
- Activities are tied to ESG criteria, which may create additional workload

## Evaluation Criteria

### Attractiveness

| Access to Defensive Investors | Financing conditions | Simplicity of the instrument |
|---|---|---|
| 🔴 | 🟢 | 🟡 |

### Effectiveness

| Impact on Germany | Impact on Namibia | Impact on industry and business |
|---|---|---|
| 🔴 | 🟢 | 🟢 |

# Instrument #4: Long-term Contract for Differences (CfDs)

## Instrument Overview

### Scope of Influence
- Bankability, speed

### Objective and Goal
- The instrument is intended to guarantee a minimum purchase price and thus guarantee cost recovery for producers
- The instrument can be used to gain capital and hedge against a changing market environment

### Main Function
- Contract between two parties (or via intermediary) to compensate for difference between market and indexed contract prices.
- Government pays compensation if market price on demand side is below indexed contract price on supply side

### Involved Organizations/Stakeholders
- Federal government, producer, possibly an intermediary

### Practical Cases
- H2Global (HINT.CO) with loans from the federal government

## EY Suggestions

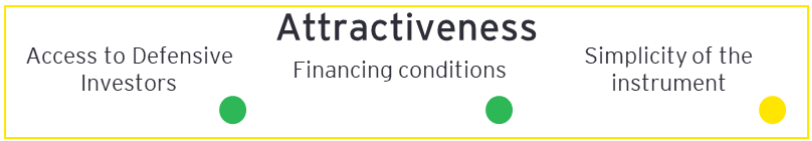
### General Suggestions
- The introduction of a long-term CfD (15 years) allows for the protection of a minimum price for the producer and allows for simultaneous participation above a certain market price
- Can be used as an additional insurance for projects

### Impact on "Hyphen" Project Phase II & III
- By hedging the price risk, bankability is increased and the attractiveness for lenders is enhanced
- During the Operational Phase (3), profitable operation is guaranteed by the cost recovery guarantee

### Advantages
- Support for the development of a commodity market for green hydrogen
- Price guarantees make projects bankable
- A market for green hydrogen/ ammonia is created

### Disadvantages
- Depending on the design, the federal government only assumes the downside risk and does not benefit from rising hydrogen/ammonia prices

## Evaluation Criteria




# Instrument #5: Public infrastructure support for hydrogen and green ammonia in Germany

## Instrument Overview

### Scope of Influence

- Bankability, market creation (first-mover), speed

### Objective and Goal

- Establishment of a hydrogen/ammonia infrastructure in Germany
- An efficient, functioning infrastructure facilitates the switch from gray to green hydrogen/ ammonia

### Main Function

- Adoption of an infrastructure development program
- Provide funding for the construction of an infrastructure
- Incentives for companies to build an infrastructure
- Develop infrastructure that enables the import, transportation and distribution of green hydrogen/ammonia

### Involved Organizations/Stakeholders

- Federal government, EU, infrastructure companies, federal states

### Practical Cases

- The construction of an LNG port in Stade receives EUR 100 million in funding from the state of Lower Saxony and Ministry of the Environment

## EY Suggestions

### General Suggestions

- Early impetus for infrastructure development
- Efficient and effective project management with overall coordination for Germany, involving private-sector companies

### Impact on "Hyphen" Project Phase II & III

- Germany needs the appropriate infrastructure to guarantee the purchase from the target country.
- Efficient distribution of hydrogen/ammonia imports increases the attractiveness and use of green imports

### Advantages

- Supports the demand for green hydrogen
- Enables the import of green hydrogen
- Efficient infrastructure also has a positive environmental impact

### Disadvantages

- The development of an infrastructure support program is a long bureaucratic process

## Evaluation Criteria

### Attractiveness

| Access to Defensive Investors | Financing conditions | Simplicity of the instrument |
|---|---|---|
| 🟢 | 🟢 | 🟡 |

### Effectiveness

| Impact on Germany | Impact on Namibia | Impact on industry and business |
|---|---|---|
| 🟢 | 🔴 | 🟢 |

# Instrument #6: Green hydrogen, ammonia blending quota

## Instrument Overview

### Scope of Influence
- Market creation (first mover), speed

### Objective and Goal
- Increasing the use and acceptance of green hydrogen/ ammonia
- Substitution of gray hydrogen/ ammonia

### Main Function
- Achieving climate targets through increased use and deployment of green hydrogen/ ammonia.
- Generating demand for green hydrogen/ ammonia, and increasing supply through quotas

### Involved Organizations/Stakeholders
- Federal government, producers, buyers

### Practical Cases
- Portugal plans use of a 10-15% hydrogen quota in the gas network by 2030
- "Fit for 55" proposes a use of 50% hydrogen

## EY Suggestions

### General Suggestions
- Create incentives for companies to replace current energy sources with green hydrogen
- Piecemeal, government-set quotas or penalties for non-compliance, should only be set and applied in the next step

### Impact on "Hyphen" Project Phase II & III
- Incentives for use and/or imposed quotas generate demand and ensure the purchase of hydrogen

### Advantages
- Artificial demand through quotas increases pressure for the expansion of an infrastructure and at the same time promotes expansion of supply
- CO2 emissions from production of gray hydrogen can easily be prevented

### Disadvantages
- Quotas require already installed infrastructure that can handle the supply
- Offer must first be created

## Evaluation Criteria

### Attractiveness
- Access to Defensive Investors
- Financing conditions
- Simplicity of the instrument

### Effectiveness
- Impact on Germany
- Impact on Namibia
- Impact on industry and business

# Instrument #7: Research and educational support

## Instrument Overview

### Scope of Influence
- Market creation, speed (first-mover)

### Objective and Goal
- Workforce creation and development in local communities
- Supporting cross-country/cross-company research and development

### Main Function
- Research cooperation between German & Namibian universities leads to knowledge transfer
- Educational programs secure competent workforce

### Involved Organizations/Stakeholders
- Namibische & Deutsche Universitäten, Bundesregierung

### Practical Cases
- EU Horizon Grants, Foundations (VW Foundation)
- HyGATE: Research funding along the hydrogen supply chain between Germany and Australia

## EY Suggestions

### General Suggestions
- This instrument strengthens the cooperation between the target country and Germany
- Building and promoting the Namibian workforce and research capacities

### Impact on "Hyphen" Project Phase I to III
- Workforce is built early and expertise is provided
- Involvement of the local workforce prevents enclave formation at the site

### Advantages
- Expertise is built up locally
- Workers who meet the future requirements of the Namibian labor market are promoted
- Unemployment is reduced and prosperity is built

### Disadvantages
- Building a competent workforce takes time
- Bureaucratic hurdles in the allocation of research funding

## Evaluation Criteria

### Attractiveness
- Access to Defensive Investors
- Financing conditions
- Simplicity of the instrument

### Effectiveness
- Impact on Germany
- Impact on Namibia
- Impact on industry and business

# Instrument #8: Support cooperation between (EU) partner countries through ammonia/ hydrogen alliances*

## Instrument Overview

### Scope of Influence
- Market creation, speed (first-mover)

### Objective and Goal
- Strengthening cooperation within and outside the EU
- Unified hydrogen/ammonia strategy in the EU

### Main Function
- Instead of building infrastructure and initiating country-specific incentives as a single country, this is coordinated at EU level
- EU-wide approach allows cross-country coordination and distribution of initiatives (e.g. hydrogen/ ammonia ports)

### Involved Organizations/Stakeholders
- EU, Namibia, Local governments

### Practical Cases
- "H2Global" is designed to stimulate investment in large-scale hydrogen production outside the EU and in the associated supply chains to Germany. The German government is funding this with 900 million euros

## EY Suggestions

### General Suggestions
- Advancing existing initiatives
- Energy supply must be seen as a European challenge - with a European solution

### Impact on "Hyphen" Project Phase II
- An EU-wide approach can be supported through simplification of legislation and specific funding

### Advantages
- Cooperation at EU level promotes long-term stable relations between EU countries and other partner countries
- Securing the future competitiveness of the economic region EU/Germany
- Securing the supply of hydrogen (EU-wide)
- All-round commitment accelerates will for implementation

### Disadvantages
- High bureaucratic requirements
- Long start-up times for cooperation's
- Long implementation and coordination lead times

## Evaluation Criteria

### Attractiveness

| Access to Defensive Investors | Financing conditions | Simplicity of the instrument |
|---|---|---|
| 🔴 | 🔴 | 🟡 |

### Effectiveness

| Impact on Germany | Impact on Namibia | Impact on industry and business |
|---|---|---|
| 🟢 | 🟢 | 🟢 |

*The announcement of an EU hydrogen bank has not been taken into account. As soon as new information is available, it will be taken into account.

# Instrument #9: Reforming the EU ETS by extending the CO2 taxation or limiting credits*

## Instrument Overview

### Scope of Influence
- Market creation, speed (first-mover)

### Objective and Goal
- Increasing the demand for green hydrogen

### Main Function
- An increase in CO2 prices will make the production of gray hydrogen/ammonia more expensive
- Further limitation of emission allowances leads to additional price increase
- Increased production costs make green hydrogen/ ammonia and/or conversion of energy production more attractive

### Involved Organizations/Stakeholders
- EU, federal government, local governments, industry

### Practical Cases
- EU Emissions Trading Scheme (ETS)
- CO2 tax for fossil fuels in Germany

## EY Suggestions

### General Suggestions
- Limiting the ability of industry to buy "clean consciousness"
- Increasing the cost of gray hydrogen to offset increased prices for green hydrogen

### Impact on "Hyphen" Project Phase II & III
- Demand for green hydrogen/ ammonia is stimulated and secures offtake
- Alignment of prices between gray and green hydrogen/ammonia increases relative attractiveness

### Advantages
- Companies pay the real price for their resources
- Increase demand and marketability of green hydrogen/ ammonia
- Incentive for investments & conversion to sustainable energy sources

### Disadvantages
- Waiting period during which demand exceeds supply of green hydrogen/ ammonia
- Higher costs reduce international competitiveness

## Evaluation Criteria

### Attractiveness

| Access to Defensive Investors | Financing conditions | Simplicity of the instrument |
|---|---|---|
| 🔴 | 🔴 | 🟡 |

### Effectiveness

| Impact on Germany | Impact on Namibia | Impact on industry and business |
|---|---|---|
| 🟢 | 🔴 | 🟢 |

*Current "Fit for 55" negotiations are not included. The instrument should be evaluated in light of the negotiation results.

# Instrument #10: Reduction of incentives for emission-intensive energy sources

## Instrument Overview

### Scope of Influence
- Market creation, speed (first-mover)

### Objective and Goal
- Ending the subsidy leads to a fair pricing of resources (real price)

### Main Function
- Reduction of incentives and subsidies for emission-intensive energy resources increases prices for emission-intensive energy sources
- Higher production costs/ investments of sustainable energy sources become relatively more attractive (alignment of prices

### Involved Organizations/Stakeholders
- Federal government, purchasers

### Practical Cases
- In the United States, there is a bill to eliminate part or all of the subsidies for oil and gas

## EY Suggestions

### General Suggestions
- Medium-term reduction in subsidies leads to acceptable price increases over a manageable period of time
- Resources prices equalize and the real price is paid

### Impact on "Hyphen" Project Phase II & III
- The increased relative attractiveness of green hydrogen/ ammonia leads to further stimulation of demand and competitiveness is increased

### Advantages
- Demand for green hydrogen is created
- Companies pay the real price for their energy needs
- Investment by companies in sustainable energy concepts is increased

### Disadvantages
- Energy-intensive producers are severely impacted and lose competitiveness to other producers abroad
- In the transition phase, demand exceeds supply

## Evaluation Criteria

### Attractiveness

| Access to Defensive Investors | Financing conditions | Simplicity of the instrument |
|---|---|---|
|  |  |  |

### Effectiveness

| Impact on Germany | Impact on Namibia | Impact on industry and business |
|---|---|---|
|  |  |  |

# Instrument #11: Tax incentives for green hydrogen/ammonia imports

## Instrument Overview

### Scope of Influence
- Market creation (first-mover), speed

### Objective and Goal
- Increasing the attractiveness of green hydrogen imports
- Increasing the attractiveness of the use of green hydrogen

### Main Function
- Reduction/ abolition of import duties on green hydrogen
- Reduction/ abolition of taxes on green hydrogen
- Promotion of green ammonia in agriculture (CO2-neutral fertilizer)
- Cooperation/ coordination at EU level

### Involved Organizations/Stakeholders
- EU, Federal Government, Industry

### Practical Cases
- Income / sales tax exemption of PV systems up to 30KW as of 2023

## EY Suggestions

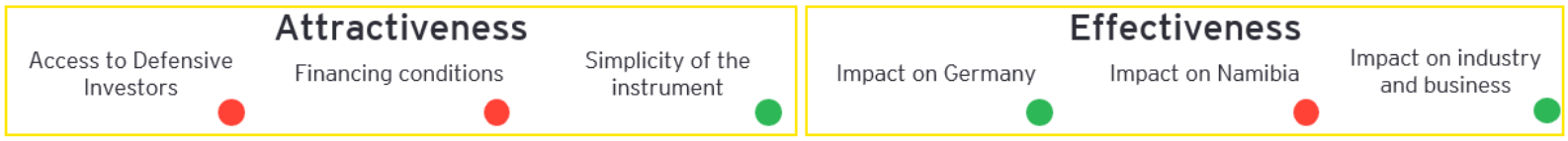
### General Suggestions
- Use as part of a policy mix to temporarily promote green hydrogen imports and boost demand
- Support the decarbonization of fertilizers in the medium term.

### Impact on "Hyphen" Project Phase II & III
- Green hydrogen/ammonia import is more attractive in price than gray hydrogen/ammonia import

### Advantages
- Increasing the attractiveness of green hydrogen through direct price advantages
- Simplification of imports and availability of green hydrogen

### Disadvantages
- Design must be brought in line with WTO guidelines
- Increased demand leads to supply bottlenecks and thus to lower price advantages
- Tariff and tax income of the state decreases

## Evaluation Criteria



# Instrument #12: Governmental secondments for policy and project planning to Namibia

## Instrument Overview

### Scope of Influence
- Market creation, speed (first-mover)

### Objective and Goal
- Promotion of framework conditions in Namibia
- Coordinated promotion and partnership

### Main Function
- Germany, ideally in partnership with other EU countries, sends experts on legal frameworks and hydrogen to assist the Namibian government.
- Key ministries (Presidential, Economic, Energy) in Namibia would each receive 10 experts.

### Involved Organizations/Stakeholders
- EU, German Government, Namibian Government, Development organizations

### Practical Cases
- GIZ is consulting the Namibian government and runs development programs

## EY Suggestions

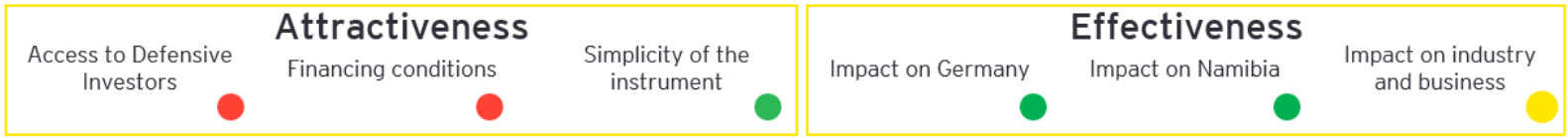
### General Suggestions
- The posting of 10 experts each can be adjusted or increased.
- In general, the federal government should provide a minimum of 10M€ in order to finance the secondment and make it possible quickly.
- Secondments should be sent as soon as Namibian government requests support

### Impact on "Hyphen" Project Phase II & III
- Framework conditions in Namibia are created to ensure that Projects can reach their goals and Namibia can supply the required workforce

### Advantages
- Support of sustainable development in Namibia
- Germany can support creation of framework conditions
- Policies could serve as blueprint for other developing countries

### Disadvantages
- Could be perceived as interference if not conducted sensitively in Namibia
- Could potentially be a disadvantage for Namibia to include foreign governments

## Evaluation Criteria



# Annex III – Overview of the ranking and weight of policy instruments

| LEGEND | | | | |
|---|---|---|---|---|
| Red | 0 | not relevant for the considered criteria | 3 | partially relevant, however with indirect impact |
| Yellow | 4 | partially relevant, however with indirect impact | 6 | quite relevant |
| Green | 7 | relevant | 10 | highest impact for the considered criteria |

## Attractiveness

| | | | | Attractiveness | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Weight | | Weight | | Weight | Total Weighted Average |
| Nr. | Instrument | Objective | Hurdle and Project Phase | Access to defensive investors | 12,0% | Financing conditions | 24,0% | Simplicity of the instrument | 14,0% | 50,0% |
| 4 | **Contract for Difference** | Feasibility (first- mover) | II-Increased Bankability<br>Feasibility Increased | 8 | 1,0 | 8 | 1,9 | 5 | 0,7 | **3,6** |
| 12 | **Governmental secondments to Namibia** | Feasibility (first- mover) | II & III- Promoting demand of green hydrogen imports | 6 | 0,7 | 6 | 1,4 | 8 | 1,1 | **3,3** |
| 5 | **Public infrastructure support** | Feasibility (first- mover) | II & III- appropriate infrastructure needed<br>Increased attrativeness green imports | 9 | 1,1 | 7 | 1,7 | 5 | 0,7 | **3,5** |
| 6 | **Green ammonia quota** | Feasibility (first- mover) | II & III - Increased Demand<br>Hydrogen purchase ensured | 3 | 0,4 | 5 | 1,2 | 9 | 1,3 | **2,8** |
| 9 | Reforming EU ETS | Feasibility (first- mover) | II & III- Stimulated green hydrogen demand and secured offtake | 3 | 0,4 | 3 | 0,7 | 6 | 0,8 | **1,9** |
| 7 | Research and educational grants | Feasibility (first- mover) | I,II & III- Early Stage Workforce and expertise | 1 | 0,1 | 1 | 0,2 | 8 | 1,1 | **1,5** |
| 2 | Federal guarantee | Bankability | II-Increased Bankability<br>Increased Implementability | 7 | 0,8 | 7 | 1,7 | 5 | 0,7 | **3,2** |
| 3 | Development loan | Bankability | II-Increased Bankability<br>Increased Implementability | 0 | 0,0 | 7 | 1,7 | 5 | 0,7 | **2,4** |
| 8 | European ammonia alliances | Feasibility (first- mover) | II- EU-wide approach supported through simplification of legislation and specific funding | 0 | 0,0 | 0 | 0,0 | 5 | 0,7 | **0,7** |
| 1 | Equity participation | Bankability | II - Increased Bankability<br>Further guaranteees KfW | 0 | 0,0 | 8 | 1,9 | 5 | 0,7 | **2,6** |
| 11 | Tax incentives for green ammonia imports | Feasibility (first- mover) | II & III- Promoting demand of green hydrogen imports | 0 | 0,0 | 0 | 0,0 | 7 | 1,0 | **1,0** |
| 10 | Reduction of fossil fuel subsidies | Feasibility (first- mover) | II & III - Increased relative attractiveness of green hydrogen | 0 | 0,0 | 0 | 0,0 | 5 | 0,7 | **0,7** |

## Effectiveness

| | | | Effectiveness | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Weight | | Weight | | Weight | Total Weighted Average |
| Nr. | Instrument | Objective | Impact on Germany | 16,0% | Impact on Namibia | 18,0% | Impact on industry and businesses | 16,0% | 50,0% |
| 4 | Contract for Difference | Feasibility (first- mover) | 8 | 1,3 | 4 | 0,7 | 8 | 1,3 | **3,3** |
| 12 | Governmental secondments to Namibia | Feasibility (first- mover) | 4 | 0,6 | 10 | 1,8 | 6 | 1,0 | **3,4** |
| 5 | Public infrastructure support | Feasibility (first- mover) | 9 | 1,4 | 3 | 0,5 | 8 | 1,3 | **3,3** |
| 6 | Green ammonia quota | Feasibility (first- mover) | 9 | 1,4 | 4 | 0,7 | 9 | 1,4 | **3,6** |
| 9 | Reforming EU ETS | Feasibility (first- mover) | 9 | 1,4 | 3 | 0,5 | 9 | 1,4 | **3,4** |
| 7 | Research and educational grants | Feasibility (first- mover) | 7 | 1,1 | 8 | 1,4 | 7 | 1,1 | **3,7** |
| 2 | Federal guarantee | Bankability | 5 | 0,8 | 0 | 0,0 | 6 | 1,0 | **1,8** |
| 3 | Development loan | Bankability | 2 | 0,3 | 7 | 1,3 | 3 | 0,5 | **2,1** |
| 8 | European ammonia alliances | Feasibility (first- mover) | 7 | 1,1 | 7 | 1,3 | 8 | 1,3 | **3,7** |
| 1 | Equity participation | Bankability | 3 | 0,5 | 0 | 0,0 | 5 | 0,8 | **1,3** |
| 11 | Tax incentives for green ammonia imports | Feasibility (first- mover) | 8 | 1,3 | 2 | 0,4 | 7 | 1,1 | **2,8** |
| 10 | Reduction of fossil fuel subsidies | Feasibility (first- mover) | 9 | 1,4 | 1 | 0,2 | 7 | 1,1 | **2,7** |