



The
Federal Government



Indo-German Green Hydrogen Roadmap

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THE GOVERNMENT OF THE REPUBLIC OF INDIA AND THE GOVERNMENT OF THE FEDERAL REPUBLIC OF GERMANY (hereinafter referred to as “India” and “Germany” respectively, and jointly referred to as “the participants”), reaffirm their commitments under the Paris Agreement to achieve net-zero emissions by 2070 and 2045 respectively, in the light of the global stocktake adopted at COP28. They emphasise the importance of transitioning away from fossil fuels in energy systems, reducing their import dependencies from fossil fuels and decarbonising their economies and aim at establishing resilient national green hydrogen economies, making green hydrogen economically viable in the long term, and supporting a global upscale of green hydrogen production and offtake. The participants consider that India launched its National Green Hydrogen Mission in 2023, which aims at making India a global hub for the production, usage, and export of green hydrogen and its derivatives whilst recognising that India’s renewable energy potential is high enough to cater to both national and international demand for green hydrogen; and that Germany adopted its National Hydrogen Strategy in 2020, which was updated in 2023 and aims at assuming global leadership in green hydrogen technologies whilst recognising that Germany will have to import an estimated 1.5 to 3 million tonnes of green hydrogen by 2030. The participants also consider that Germany adopted its Import Strategy for Hydrogen and Hydrogen Derivatives in 2024, which sets out a clear and reliable framework for the urgently needed imports of hydrogen and hydrogen derivatives to Germany. Furthermore, the participants consider that they are already cooperating closely on green hydrogen within various multilateral initiatives and institutions, such as the International Renewable Energy Agency (IRENA), the International Energy Agency (IEA), Technology Collaboration Programmes (TCPs), and the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) and that they are already cooperating bilaterally within the Indo-German Energy Forum and the Indo-German Green Hydrogen Task Force, which was established in 2022.

Recognising that common goals can be better achieved with close cooperation, and building on their individual strengths and capacities, the participants have reached the following understanding:

1. Identification and Promotion of Investment Opportunities

The establishment of a global green hydrogen economy requires massive investments from both public and private sector stakeholders in both countries.

The focus of global investment would be to roll out additional renewable energy capacities to deliver the required green electricity for the decarbonisation of economies. India and Germany have dedicated themselves under the G20 New Delhi Leaders' Declaration to support the tripling of renewable energy capacity globally by 2030. Energy efficiency measures and direct electrification with electricity from renewable energy sources have been identified as the most effective ways to achieve this and are therefore to be given priority when decarbonising carbon-intensive applications and manufacturing processes.

Against this background, the participants have decided to identify and promote investment opportunities for green hydrogen and its derivatives as follows:

- a) Grey hydrogen and other fossil fuels may be replaced by green hydrogen wherever direct electrification with renewable electricity does not seem to be a viable option.
- b) Bilateral cooperation on green hydrogen will be focused on decarbonising hard-to-abate industries such as steel, refineries, fertilisers, offtake in transport with the focus on shipping, aviation, and heavy-duty road transport,¹ decentralised stationary energy applications, as well as hydrogen transport and storage technologies. Among others, these include:
 - i. sustainable refuelling options for international cargo ships and aircraft in both countries;
 - ii. exchange of information for suitable short-, medium- and long-distance transport options for green hydrogen.
- c) Large-scale, export-oriented production of green hydrogen is to be facilitated.² Among others, this includes:
 - i. the establishment of terminals in India for the export of green ammonia to Germany;³

¹ A mapping and database of relevant stakeholders in the value chain for Sustainable Aviation Fuels (SAFs) and Sustainable Maritime Fuels (SMFs) in India has been undertaken by the Task Force and is being made available to interested stakeholders. In the light of the FuelEU Maritime regulation, which aims to support the decarbonisation of the shipping industry, and which provides potential opportunities for German and European shipping companies to explore green refuelling in India, this sector of common interest will be further examined.

https://www.energyforum.in/fileadmin/user_upload/india/media_elements/publications/20231022_SAF_SMF_Stakeholder_Mapping_Survey/20231115_SAF-SMF_GIZ_Dornier_Report_v4.pdf.

² Several studies have been undertaken to identify potential flagship projects for future cooperation. Results indicate that export-oriented production projects may require a large-scale production capacity of a minimum of 1000 metric tonnes per day of green ammonia production to reach viability.

³ A first study assessing the location of a potential large-scale green ammonia production has been undertaken and made available by the Task Force:

https://www.energyforum.in/fileadmin/user_upload/india/media_elements/publications/20230515_GNH3_Deloitte_Study/20230707_gs_GNH3_finalprint.pdf.

- ii. the development of regional hubs capable of large-scale production and utilisation of green hydrogen;⁴
 - iii. the identification of existing and upcoming hydrogen infrastructure as well as a mapping of companies and capacities of conventional hydrogen, ammonia, and methanol offtakers will be promoted in both countries;⁵
 - iv. the promotion of and information exchange on the establishment of green hydrogen hubs, clusters, and valleys will be further intensified, including the dialogue regarding the most effective governing structure.⁶
- d) The use of hydrogen for large-scale electricity generation in future power plants during peak power demand where battery storage is not feasible.
 - e) The existing list of known decarbonisation technologies with high technology readiness levels (TRLs) is to be updated and exchanged on a regular basis.⁷
 - f) A cost modelling tool⁸ will be developed to identify regions with the lowest production costs for green hydrogen and its derivatives and to identify the optimum configuration in both countries so as to deliver green hydrogen to the end consumer at the lowest cost to facilitate trade between the participants.

⁴ Two roadmaps for potential green hydrogen hubs have been elaborated for Kochi, Kerala and Ramagundam, Telangana:

https://energyforum.in/fileadmin/india/media_elements/publications/20240724_Kochi_GH2_Roadmap/20240909_Kochi_GH2_Valley_PRINT.pdf and

https://energyforum.in/fileadmin/india/media_elements/publications/20240910_Telangana_Roadmap/Final_Draft-Ramagundam-GreenH2_Roadmap.pdf.

⁵ A mapping of conventional and upcoming anticipated gas infrastructure as well as a mapping of companies and capacities for conventional hydrogen, ammonia and methanol offtake have been undertaken under the Task Force to identify potential green hydrogen hubs suitable for future investment. The mappings are being made publicly available through an online tool that visualises the anticipated future green hydrogen demand by the year 2030: <https://h2hubs.in>.

⁶ India has committed itself to support the establishment of at least two green hydrogen hubs under the initial phase of its National Green Hydrogen Mission. The Indo-German Green Hydrogen Task Force has initiated the exchange on the establishment of green hydrogen hubs in India involving relevant stakeholders from Germany and India. These include the Hamburg Green Hydrogen Hub (HGHH), which is aiming to decarbonise all port activities, the Kochi Green Hydrogen Hub (KGGH2), the National Centre of Excellence in Green Port and Shipping (NCoEGPS), the Research and Innovation Circle of Hyderabad (RICH), the India Hydrogen Alliance (IH2A), the Indian Chapter of the Green Hydrogen Organisation (GH2 India) as well as the Research Centre of the German Technical and Scientific Association for Gas and Water (DVGW) at the Engler-Bunte-Institute (EBI) of the Karlsruhe Institute of Technology (KIT). Of specific interest for involved stakeholders from India and Germany are the lessons learnt regarding the governing structure for such valleys. Initial findings of a comprehensive study initiated under the Task Force indicate that a private sector-driven association model that brings together a consortium of public, private, and knowledge-based bodies may be most effective. Such a unified approach towards the common goal of the success of the valley would facilitate easy access to funding, political backing, and public acceptance.

⁷ Decarbonising India – Potential for Electrification across India’s Economy & Assessment of Electricity Needs:

https://energyforum.in/fileadmin/india/media_elements/publications/Decarbonising_India/Max_electrification_India.pdf.

⁸ Cost Modelling Tool for Production of Green Ammonia in India:

https://www.energyforum.in/fileadmin/user_upload/india/media_elements/Presentations/20230501_Cost_Modelling_Tool_MEC/20230516_Cost_of_Green_NH3_Model_v1.xlsm.

- g) The database compilation of existing green hydrogen projects in India⁹ and Germany¹⁰ will be made publicly available and be updated on a regular basis.

2. Global Trade of Green Hydrogen and its Derivative Products

The participants have decided to support the global trade of green hydrogen and its derivatives, and commit to laying the groundwork for resilient and diversified supply chains as follows:

- a) Bilateral offtake agreements between German and Indian stakeholders will be facilitated and supported.
- b) The establishment of green hydrogen trading platforms in Germany and the European Union (EU) and an equivalent in India will be further supported.
- c) International government-backed auction mechanisms, such as H2Global and the EU Green Hydrogen Bank, will be further promoted.
- d) Solar Energy Corporation of India Limited (SECI) will explore the aggregation of green hydrogen production and its derivatives with a view to participating in international auctions such as those run by H2Global and by the EU Green Hydrogen Bank.

3. Promotion of Private Sector Networks and Partnerships

The establishment of a green hydrogen economy has to be driven by the private sector. Therefore, the participants have decided to promote private sector networks and partnerships as follows:

- a) Private sector participation in bilateral governmental formats will be further increased wherever possible and appropriate.
- b) The Indo-German Green Hydrogen Task Force will continue to foster the exchange of knowledge between the Indian and German governments, the private sector, and relevant research institutes. In particular, the following measures carried out in cooperation with the Indo-German Chamber of Commerce (IGCC), Invest India, Germany Trade and Invest (GTAI) as well as other relevant business associations and partner initiatives will be further supported:
 - i. mixed government and business delegation visits from India to Germany and vice versa;
 - ii. delegations to international trade fairs and conferences;
 - iii. green hydrogen country pavilions at international trade fairs;
 - iv. joint green hydrogen events, e.g. in the form of side events at international conferences;
 - v. roundtables for Indo-German green hydrogen investors;

⁹ Green hydrogen project database for India:

https://www.energyforum.in/fileadmin/user_upload/india/media_elements/Presentations/20230320_GH2_Project_list_India/20230320_GH2_Projects_India.pdf and <https://ngm.mnre.gov.in/project?language=en>.

¹⁰ List of green hydrogen projects in Germany:

https://www.energyforum.in/fileadmin/user_upload/india/media_elements/Presentations/20230309_GH2_Projects_Germany/20230224_GH2_Projects_GER.pdf.

- vi. business to business (B2B) buyer and seller meetings;
 - vii. business to government (B2G) and business to business (B2B) green hydrogen networking sessions;
 - viii. issue of speaker invitations and promotion of conferences and workshops in both countries.
- c) The Indo-German network of organisations and initiatives that have partnered with the Task Force (see [Annex 1](#)) will be further strengthened and extended.
 - d) Supplier directories that compile Indian and German technology providers will be continuously updated and exchanged.
 - e) The establishment of green hydrogen hubs and valleys will be supported and international partnerships between such valleys will be promoted.¹¹
 - f) The establishment of green shipping corridors will be further promoted.
 - g) Increased participation of women in the abovementioned activities will be specially encouraged. Networks such as the Women in Renewable Energy Campaign and Women in Green Hydrogen will be promoted and proactively engaged with.
 - h) The existing joint calendar of green hydrogen-related trade fairs and conferences will be made publicly available and updated on a regular basis.
 - i) The introduction of fast-track mechanism for green hydrogen related visa applicable to private sector companies and associations from India and Germany will be favourably considered to enable the accelerated establishment of business relations.

The implementation of the above will be jointly supported by the H2Uppp programme (until the end of the commissioning in 2026) and the Indo-German Energy Forum Support Office.

4. Promotion of Joint Development of Research and Development (R&D) Projects and Partnerships

The participants will promote research in green hydrogen technologies across the entire value chain.

With its R&D Roadmap for Green Hydrogen Ecosystem, developed under the National Green Hydrogen Mission, India seeks to ensure that green hydrogen can be traded at a global scale whilst also ensuring the sustainability and safety of production. Germany, on the other hand, embraces the EU Strategic Research and Innovation Agenda (SRIA) and the EU Clean Hydrogen Partnership.

Against this background, the participants have decided as follows:

- a) Indo-German research cooperation involving both the public and private sector will be further encouraged and facilitated.
- b) Research institutions and companies from India and Germany will be invited to form consortia with each other to participate in suitable funding programmes.

¹¹ Establishment of hub and valley partnerships is a recommendation made by the Indo-German Green Hydrogen Task Force based on several workshops and studies undertaken on the concept of hydrogen valleys, clusters and hubs. Please refer to [Annex 4](#) for more information.

- c) International research cooperation in the fields of storage, transportation, and integrated end use application technologies for green hydrogen and its derivatives will be continuously promoted under the funding guidelines for international hydrogen projects as jointly established by the German Federal Ministry of Education and Research (BMBF) and the German Federal Ministry of Economic Affairs and Climate Action (BMWK).
- d) Cooperation between the Indian Department of Science and Technology (DST) and the German Fraunhofer Institute for Solar Energy Systems (Fraunhofer ISE), which focuses on increasing technology readiness levels of hydrogen technologies and establishing green hydrogen clusters, will be strengthened.
- e) The Indo-German Science & Technology Centre (IGSTC), which was jointly initiated by the Indian Department of Science and Technology (DST) and the German Federal Ministry of Education and Research (BMBF), will continue to facilitate the exchange between Indian and German experts, including on green hydrogen and related areas.
- f) European research data on safety-related green hydrogen incidents will be made available to interested parties. Future research cooperation that aims to support building a national Indian green hydrogen incident database, as has been suggested by various stakeholders from academia and the private sector, will be encouraged.
- g) Innovative renewable energy-based electricity generation technologies for green hydrogen production will be further explored and considered for close cooperation with strong involvement of the private sector. In particular:
 - i. green hydrogen production from offshore wind¹² and information exchange on German research projects such as H2Mare that explore the potential of offshore green hydrogen, methanol, and ammonia production will be continued;
 - ii. the potential for green hydrogen production from agrivoltaics will be further analysed;
 - iii. the economic potential of such technologies will be further evaluated with the involvement of private and public stakeholders from India and Germany.

5. Identification of Instruments to Support Investment in Flagship Projects

The participants concur that the majority of funds to upscale a global green hydrogen ecosystem will have to be mobilised by the private sector. Therefore, they welcome initiatives between German and Indian companies to sign bilateral agreements for the international offtake of green hydrogen and its derivatives, such as green ammonia and other Power-to-X (PtX) products. Private-sector stakeholders will need further support to make projects economically viable and kickstart the market development.

Against this background, the participants have decided to carry out the following activities to promote identified instruments to support investment in flagship projects:

¹² A joint Indo-German Task Force study explored the promising potential for 100 GW of green hydrogen production via offshore wind in Tamil Nadu and Gujarat, which would be sufficient to fulfil the capacity goal of 5 million metric tonnes green hydrogen production:
https://energyforum.in/fileadmin/india/media_elements/publications/Offshore_Wind_Study/Offshore_Wind_Study.pdf.

- a) A frequent and ongoing exchange and dissemination of information on funding instruments for joint Indo-German green hydrogen projects and related activities will be maintained.¹³
- b) A list of the most relevant instruments to support Indo-German green hydrogen flagship projects (see [Annex 3](#)) will be updated regularly and made publicly available to interested stakeholders. In particular, these include:
 - i. international offtake auction programmes which incentivise the establishment of green hydrogen projects with a focus on international imports and exports of green hydrogen derivatives, such as H2Global (implemented by Hintco), will be further promoted;
 - ii. green hydrogen projects based in India will be encouraged to apply for up to €30 million in non-reimbursable grants provided by the PtX Development Fund of KfW Development Bank;¹⁴
 - iii. establishment of consortia for joint Indo-German project proposals under the public-private partnership model through the H2Uppp cooperation programme will be further encouraged;¹⁵
 - iv. funding under the German funding guideline for international hydrogen projects will remain open to Indo-German cooperation in the field of green hydrogen and its derivatives.
- c) The participants will further explore the signing of a Memorandum of Understanding to promote green hydrogen production in India and its use domestically, which may be suitable to generate domestic and international carbon credits based on India's determination of Article 6 areas for cooperative approaches under Article 6.2 and Article 6.4 of the Paris Agreement.¹⁶
- d) The participants fully embrace the leveraging of national and international carbon markets as an effective measure to boost the financial viability of green hydrogen projects.¹⁷

¹³ A separate subworking group on “Finance, Insurance Industry and Trading” has been established under the Task Force to facilitate the exchange and dissemination of information on funding instruments for joint Indo-German green hydrogen projects. Twelve green hydrogen business roundtables and numerous further topic-specific webinars to present and facilitate access to international project finance and funding opportunities have been carried out and otherwise supported. A list of relevant funding instruments can be found in [Annex 3](#).

¹⁴ The Government of Germany has endowed KfW with a €270 million PtX Development Fund to provide non-reimbursable grants for green hydrogen projects. India is one of the seven countries eligible for access to the fund. Each selected project can receive up to €30 million in grants.

A call for expression of interest to identify potential flagship projects is underway. Indian companies from both the private and public sector are encouraged to apply.

¹⁵ The commissioning of H2Uppp ends in 2026. Project proposals submitted after the last call for proposals will not be considered.

¹⁶ Green hydrogen production has been officially selected by Government of India as an activity eligible for carbon credits trading under bilateral and cooperative approaches under Article 6.2 of the Paris Agreement.

¹⁷ Under the Bureau of Energy Efficiency (BEE), the Government of India has committed itself to initiating the development of an Indian Carbon Market (ICM), which will mobilise new mitigation opportunities through demand for emission reduction credits by private and public entities.

- e) Innovative private-sector initiatives to enable the financing of green hydrogen projects through voluntary carbon emissions trading, such as the Hydrogen for Net Zero (H2NZ) initiative, will be further promoted.

6. Sharing Knowledge and Experiences in Regulation, Standards, and Safety Procedures as well as Sustainability Criteria of Green Hydrogen

Under G20, the participants dedicated themselves to develop voluntary, mutually consented and harmonised standards as well as mutually recognised and interoperable certification schemes in alignment with the “G20 High Level Voluntary Principles on Hydrogen”. The participants acknowledge the importance of standardisation and certification for ensuring safe, reliable, and sustainable trade in green hydrogen.

Against this background, the participants have decided the following:

- a) The Indo-German Working Group on Quality Infrastructure, co-chaired by the Indian Department of Consumer Affairs and the German Federal Ministry for Economic Affairs and Climate Action (BMWK), will further facilitate the exchange on quality infrastructure across entire green hydrogen value chains.
- b) Identified gaps in regulations, standards, and certifications will be addressed during the bilateral meetings with recommendations provided for future developments and adoption.
- c) The participants will continue to organise focused knowledge-sharing sessions, seminars, and workshops on standards, certifications, and norms to harmonise the required green hydrogen ecosystem in India and Germany.
- d) Regulations on renewable energy sourcing and the establishment of robust quality standards will be further aligned.
- e) Technical clarifications will be provided to facilitate a country-specific application of officially recognised international certification schemes for green hydrogen (see also Chapter 7 on certification).
- f) The establishment of testing facilities following international standards for hydrogen-related equipment testing as supported under the testing scheme of the National Green Hydrogen Mission (NGHM) by the Government of India will be further explored.
- g) The participants will promote international testing regulations with clear guidelines and foster their application in reputed institutions with robust quality standards in both countries.
- h) Safety-related data on green hydrogen incidents will be shared to support building national incident databases in both countries.
- i) Further safety-related training materials will be exchanged and adopted as per national requirements.
- j) Exchange on insurance-related aspects will be initiated.

7. Cooperation on Certification Schemes for Green Hydrogen

The participants aim to produce green hydrogen with the lowest carbon emissions possible while at the same time supporting sufficient ramp-up of the market to meet national and international demand. The participants further concur that cooperation on interoperable

certification schemes for green hydrogen is crucial to facilitate the development of a sustainable global green hydrogen market. Certification of sustainability criteria can assist in assuring the transparent comparison of carbon emissions in green hydrogen production.

Against this background, the participants decide on the following to intensify their cooperation on certification schemes for green hydrogen:

- a) To facilitate the information exchange with investors, scheme owners, certifiers from Indian authorities such as the Indian Bureau of Energy Efficiency (BEE) and other relevant stakeholders on formulation of a national Indian methodology to be announced for the measurement, reporting, monitoring, onsite verification, and certification of green hydrogen and its derivatives.
- b) To focus on the removal of regulatory uncertainties expressed by the private sector associated with the international certification of sustainability criteria for green hydrogen.
- c) To support the alignment of green hydrogen project certification with legally binding sustainability criteria as specified under the two Delegated Acts (DA) pursuant to Article 27 and Article 28 of the EU Renewable Energy Directive (RED II) for plants exporting green hydrogen and its derivatives to the EU.
- d) To mitigate uncertainties in the national interpretation of criteria related to elements such as the bidding zone concept or the eligibility of country-specific contracts for renewable power.
- e) To invite stakeholders of accredited certification schemes and associated certifiers to organise country-specific technical workshops.¹⁸
- f) To support preliminary testing certifications for potential green hydrogen projects focused on export. These testing certifications will provide additional relevant information to national policymakers as well as potential international investors and offtakers.

8. Exploring Opportunities for Manufacturing

The participants aim to further explore opportunities for the manufacture of electrolyzers and other relevant components of green hydrogen value chains in India and Germany. Against this background, the diversification of international supply chains for components that are critical in terms of national energy security is of particular importance.

For these purposes, the participants have decided as follows:

- a) Invest India and Germany Trade and Invest (GTAI) will continue to support investments in green hydrogen manufacturing in India and Germany.
- b) Under the Strategic Interventions for Green Hydrogen Transition (SIGHT) programme, India will provide incentives to companies manufacturing electrolyzers to be used

¹⁸ A study undertaken under the Task Force concludes that legal compliance with the required criteria strongly depends on the country-specific interpretation of said criteria. Different private stakeholder organisations with slightly different certification schemes and respective methodologies will thus be tasked with interpreting the criteria. Relevant certification schemes will be those which have been officially recognised by the EU Commission and the Government of India. Certifiers will then be able to decide which certification scheme they prefer to use to carry out a given assessment.

within the green hydrogen value chain. German companies may also participate in the programme as per the conditions stated in the tender document.

- c) German subsidies for the establishment of electrolyzers for the green hydrogen value chain manufacturing in Germany should be open to Indian companies as per eligibility criteria under the respective subsidies scheme.
- d) The Indo-German Green Hydrogen Task Force will continue to further facilitate business-to-business (B2B) and business-to-government (B2G) exchange on manufacturing opportunities.

9. Capacity Building

The participants aim to strengthen institutions and agencies engaged in the implementation and regulation of their respective national green hydrogen strategies. Therefore, they are determined to facilitate skill advancement and workforce development for their green hydrogen economies and share knowledge and resources to help streamline and complement national efforts in skills development.

In particular, the participants decide to support capacity building as follows:

- a) Training courses organised under Indo-German cooperation (see [Annex 5](#)) will align with the German National Skills Strategy and the Scheme for Skill & Human Resource Development of the Indian National Green Hydrogen Mission.
- b) Such training courses will focus on practical, hands-on training for installers, project developers and public decision-makers. Training courses organised under the bilateral cooperation programmes PtX Hub and H2Uppp will be continuously updated and carried out in cooperation with line ministries, state agencies and training institutes, while considering the end of the commissioning of H2Uppp in 2026. In particular,
 - i. training courses for national training institutes will be expanded to facilitate access to training for a larger target group;
 - ii. a web-based PtX e-Academy edition of training courses will be made publicly available;
 - iii. target group-specific deep-dive modules on specific topics such as Sustainable Aviation Fuels (SAFs) and Sustainable Maritime Fuels (SMFs) will be further developed.
- c) Publicly financed and licence-free training materials will be made available for training institutes willing to carry out such training courses on a non-profit basis. The participants concur to facilitate further implementation of such training with a view to international best practices.
- d) The participants will continue to offer training courses focusing on certification criteria that are relevant for green hydrogen exports to Europe. To increase the practical relevance of these training courses, representatives from relevant certification schemes accredited by the European Commission will be invited.
- e) The establishment of a national training facility for project installers of green hydrogen electrolyser and fuel cell equipment will serve as another flagship project for Indo-German green hydrogen cooperation.
- f) A corresponding training curriculum for the development of stationary green hydrogen installations with the ability to perform physical electrolyser and fuel cell installations

will be developed and carried out. Training will focus on installers, project developers, and startups. It is to be brought into line with the qualification packs being developed by the Indian Ministry of Skill Development and Entrepreneurship (MSDE) wherever possible.

- g) Increased participation of women in training will be further encouraged.

10. Establishment of IGEF Working Group on Green Hydrogen

The continued information exchange on the effectiveness of different green hydrogen policies is of utmost mutual interest. The participants therefore concur to further institutionalise the existing dialogue by establishing a permanent working group under the Indo-German Energy Forum to replace the existing Green Hydrogen Task Force.

11. Status and Implementation

This roadmap is not legally binding and does not create any rights or obligations for the participants.

The participants will prioritise the jointly decided topics and joint action points, invite related institutions to be included in relevant meetings, and will decide on further actions to meaningfully address the concurred topics.

The Indo-German Green Hydrogen Working Group will continue its work to support the implementation of the Indo-German Green Hydrogen Roadmap pending further notice.

12. Interpretation and Dispute Settlement

The participants will settle any disputes concerning the interpretation or implementation of this roadmap amicably through consultations and negotiations between them through relevant diplomatic procedures.

13. Final Provisions

This roadmap will come into effect on the date of presentation by the participants, and will remain in effect for next five (5) years.

The participants may give mutual written consent to renew or modify this roadmap to ensure it continues to align with priorities identified by both participants.

Either participant may terminate the roadmap at any time. They should inform the other participant in writing of their intention to end the roadmap at least three (3) months prior to the desired date of termination. In such an event, the participants will consult to determine how any outstanding matters should be dealt with upon termination of the roadmap.

Annex 1: Partners of Indo-German Green Hydrogen Task Force

Partner initiatives and projects:

develoPPP

German Centre for Research and Innovation (DWIH) New Delhi

German Offshore Wind Initiative (GOI)

H2Uppp

Indo-German Working Group on Quality Infrastructure

Invest India

Make in India

Make in India Mittelstand

Mittelstand Global – Energy Solutions Made in Germany

NOW

PtX Hub

Start Up Energy Transition

Women Energize Women Campaign

Women in Green Hydrogen

Partner associations, foundations, networks:

Alliance for an Energy Efficient Economy (AEEE)

Association for Plant Engineering and Industrial Service (VAIS)

Bundesverband Erneuerbare Energie

Bundesverband Solarwirtschaft

Bundesverband WindEnergie

CleanTech Business Club (CBC)

Confederation of Indian Industry (CII)

Energy saxony

Excellence Enhancement Centre for Indian Power Sector (EEC)

Federation of Indian Chambers of Commerce and Industry (FICCI)

Foundation Offshore Wind Energy

German Asia-Pacific Business Association

German Hydrogen Association (DWV)

Green Hydrogen Organisation India (GH2 India)

H2Global

Hydrogen Association of India

Hypos

Hzwo

India Energy Storage Alliance (IESA)

India Hydrogen Alliance

Indian Chamber of Commerce

Indian Wind Energy Association (INWEA)

Indo-German Chamber of Commerce (IGCC)

National Solar Energy Federation of India (NSEFI)

PHD Chamber of Commerce and Industry

The Federation of German Industries (BDI)

TUV Association

VDMA

VGBE

World Forum Offshore Wind

Partner think tanks:

Agora Energiewende

Council on Energy, Environment and Water (CEEW)

Prayas Energy Group

The Energy and Resources Institute (TERI)

Partnering government funded organisations:

Bureau of Energy Efficiency (BEE)

Deutsche Energie-Agentur (dena)

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Fraunhofer-Gesellschaft

German National Metrology Institute (PTB)

Germany Trade & Invest (GTAI)

Indian Renewable Energy Development Agency Limited (IREDA)

Indo-German Science and Technology Centre (IGSTC)

KfW Development Bank

National Institute of Solar Energy (NISE)

National Institute of Wind Energy (NIWE)

Solar Energy Corporation of India Limited (SECI)

Steinbeis Foundation India

Annex 2: Relevant trade fairs and conferences

Trade fairs related to green hydrogen in Germany and Europe:

[European Hydrogen Week, Brussels](#)

[Green Steel World, Essen](#)

[Hannover Trade Fair](#)

[Hydrogen Technology Expo Europe, Hamburg](#)

[The smarterE Europe/ Intersolar Europe, Munich](#)

[WindEnergy Hamburg](#)

[World Hydrogen Summit, Rotterdam](#)

Relevant trade fairs in India:

[Elecrama, Greater Noida](#)

[India Energy Storage Week, New Delhi](#)

[India Energy Week, Goa](#)

[Renewable Energy India \(REI\) Expo, Greater Noida](#)

[The smarterE/ Intersolar India, Gujarat](#)

[Vibrant Gujarat](#)

[Windergy, Chennai](#)

International conferences in Germany/EU and India:

[18th Asia-Pacific Conference of German Business, New Delhi, by IGCC](#)

[Berlin Energy Transition Dialogue \(BETD\) by Govt. of Germany](#)

[EU Hydrogen Research Days](#)

[GH2 Conclave](#)

[Global Dialogue on Energy Transformation by CII, New Delhi](#)

[Global Industrial Decarbonization Summit India, New Delhi](#)

[Indian Smart Grid Week \(ISGW\) by ISGF, New Delhi](#)

[International Conference on Green Hydrogen \(ICGH\) by Govt. of India](#)

[RE-Invest by Govt. of India](#)

[Women Energize Women by Govt. of Germany](#)

[World Sustainable Development Summit \(WSDS\) by TERI, New Delhi](#)

[World Utility Summit](#)

If you would like a trade fair or conference to be added as part of the Indo-German Green Hydrogen Working Group, please write to hydrogen@energyforum.in.

Since the establishment of the Task Force, dozens of international conferences in India and Germany have been supported with speaker placement and promotion. Seven government and business delegations with a focus on green hydrogen project development have visited Germany to date: In September 2022, a high-ranking government delegation on green hydrogen travelled to Brussels, Rotterdam, and Hamburg (25.–30.9.2022). In addition, a private-sector delegation on green hydrogen and wind energy visited Hamburg, Germany (26.–30.9.2022). In April 2023, a business delegation on green hydrogen technologies and manufacturing participated in the Hannover Trade Fair (16.–20.4.2023). In May 2023, a mixed government and business delegation to Brussels and Rotterdam participated in the World Hydrogen Summit (7.–13.5.2023). In June 2023, a business delegation on green hydrogen production with photovoltaics participated in the Intersolar Europe Conference in Munich, Germany (11.–17.6.2023). In November 2023, a business delegation attended the European Hydrogen Week in Brussels and visited further green hydrogen sites in the Netherlands and Germany (19.–25.11.2023). In May 2024, a mixed government and business delegation participated in the World Hydrogen Summit and visited green hydrogen sites in the Netherlands and Germany (13.–17.5.2024).

Annex 3: Selection of sources for the roadmap

Hydrogen strategies:

[IND – National Green Hydrogen Mission](#)

[GER – National Hydrogen Strategy – Update 2023](#)

[GER – National Import Strategy for Hydrogen and Hydrogen Derivatives – 2024](#)

Research strategies:

[IND – R&D Roadmap for Green Hydrogen Ecosystem in India](#)

[GER/EU – Strategic Research and Innovation Agenda \(SRIA\)](#)

Multilateral agreements:

[G20 New Delhi Leaders’ Declaration](#)

[G20 High-Level Voluntary Principles on Hydrogen](#)

Identified funding instruments for flagship projects:

[PtX Development Fund](#)

[H2Global](#)

[International Hydrogen Ramp-up Program \(H2Uppp\)](#)

[Funding guideline for international cooperation in the development of green hydrogen production plants](#)

[Carbon Border Adjustment Mechanism \(CBAM\)](#)

[Hydrogen for Net Zero Initiative \(H2NZ – Upcoming\)](#)

[European Energy Exchange Green Hydrogen Trading \(Upcoming\)](#)

[International auction mechanism under EU Hydrogen Bank \(Upcoming\)](#)

More information on financing of PtX projects here:

[Financing of PtX Projects in Non-OECD Countries](#)

More information on the potential for electrification in India: A joint Indo-German study under Subgroup 3 of the Indo-German Energy Forum analysed the potential for electrification of all sectors of the Indian economy in order to reach net-zero CO₂ emissions by 2070. The findings revealed that around 90 % of India’s entire economy, including sectors such as industry, agriculture, transport, building, and appliances, can be directly electrified with existing technologies. This would result in an emission reduction of around 40 % through energy efficiency gains, primarily due to the fact that sector electrification translates into an enormous reduction of inefficient primary energy use. In a subsequent step, green hydrogen-based processes are to be considered wherever direct electrification is not possible, for which a total need of 3,800 GW in installed renewable energy capacity by 2050 and around 5,800 GW of

renewable energy capacity in 2070 was estimated. Around 40 million tonnes of green hydrogen would be required by 2050 and more than 3500 GWh of battery storage by 2070. A list of all known technologies with high technology readiness levels (TLRs) has been compiled and is intended to guide both governments and the private sector as they move to consider accelerated application:

https://energyforum.in/fileadmin/india/media_elements/publications/Decarbonising_India/Max_electrification_India.pdf.

Annex 4: Activities carried out under the Indo-German Green Hydrogen Task Force

30+ dedicated workshops and knowledge sessions, 12+ green hydrogen business roundtables, four German pavilions at Indian trade fairs, and various other activities have thus far been carried out or supported under the Indo-German Green Hydrogen Task Force.

Numerous knowledge-sharing sessions and webinars have been initiated by the Task Force and organised by the Indo-German Energy Forum Support Office in its function as the secretariat to the Indo-German Green Hydrogen Task Force. A few are listed here for exemplary purposes: Indo-German Exchange on Green Hydrogen Support Programmes (29.9.2022), Workshop on Safety Standards for Green Hydrogen, Green Ammonia and Green Methanol (29.11.2022), Workshop on CO₂-Certificates as Additional Revenue Stream for Green Hydrogen Sales (15.2.2023), Session on the process to obtain public approvals for the setup of Green H₂-plants in India (6.3.2023), Webinar on Hydrogen Clusters around Ports (22.3.2023), Session on German Funding Instruments (22.3.2023), Webinar on EU Sustainability Criteria for Green Hydrogen (11.4.2023), Webinar on Decarbonising Shipping in India with Global Maritime Forum (18.4.2023), Participation in Webinar on Green Hydrogen Ports – From policy to practice organised by BMWK (25.4.2023), Second Webinar of Hydrogen Hub for Kerala (15.5.2023), and a Webinar on Green Hydrogen Cluster in Germany and India with DVGW, India Hydrogen Alliance (IHA) and Renewable Energy Hamburg (4.7.2023).

An up-to-date overview of activities, studies, reports and other products developed in connection with the Task Force can be found here: <https://energyforum.in/highlights/indo-german-green-hydrogen-task-force/>.

Annex 5: List of green hydrogen training courses

Several training formats for green hydrogen and derivatives have been developed and will be deployed. Training formats organised by the International PtX Hub are delineated below:

The International PtX Hub offers training courses and workshops for green hydrogen and PtX decision-makers. The goal is to train and connect a critical mass of people who are enthusiastic about renewable PtX and can accelerate the uptake of PtX production, usage, and trade in their countries. The training provides a comprehensive overview of the entire value chain of PtX. Since its inception, eight Renewable Power-to-X Basic Training Courses have been carried out with government officials and PSUs in India on behalf of the Indian Ministry of New and Renewable Energy under Indo-German Cooperation on Green Hydrogen. In addition, one special module on certification has been carried out in India with participants from the government and the private sector. The following training courses have been offered:

- a) 5–10 day course for Renewable Power-to-X Trainer Training- (PtX Hub): The training provides an in-depth immersion into the principles and practical aspects of PtX;
- b) 2–3 day course for Renewable Power-to-X Basic Training (PtX Hub) with participants from academia, government, PSUs, and the private sector to upscale and multiply the reach of PtX training courses;
- c) add-on (virtual) trainings ranging in length from 2 hours to 2 days.

Furthermore, a 3-month E-Learning Scholarship Programme on Green Hydrogen Economics and Project Development (PPP with RENAC) for private-sector stakeholders including the finance sector is being offered under H2Uppp, which is commissioned until 2026. The online programme provides project developers from finance institutions with the necessary knowledge and skills to navigate the emerging field of green hydrogen economics and project development. Additionally, a 3–5 day Green Hydrogen and Power-to-X Production Training Course based on a concept developed by Fraunhofer IEE is being offered to participants from the private sector.

A training curriculum for the development of stationary green hydrogen installations with the ability to perform physical electrolyser and fuel cell installation has been developed and carried out. The 5-day training course is targeted towards installers, project developers, and startups.