TC Document

I. Basic Information for TC

▪ Country/Region:	COSTA RICA
▪ TC Name:	Support for the Development of the National Hydrogen Strategy towards a Decarbonized Economy
▪ TC Number:	CR-T1239
▪ Team Leader/Members:	Larrea, Sylvia Virginia (INE/ENE) Team Leader; Carvalho Metanias Hallack, Michelle (INE/ENE) Alternate Team Leader; Aoki, Issei (INE/ENE); Baltodano Carrasquilla, Fabiola (INE/ENE); Baruzze, Miguel (VPC/FMP); Echeverria Fernandez, Esteban (INE/ENE); Johnson Naveo, Odile Ivette (INE/ENE); Marquez Barroeta, Fidel (INE/ENE); Mora Vargas, Greivin Gerardo (CID/CCR); Ruiz Mora, David Jose (CID/CCR); Sanmartin Baez, Alvaro Luis (LEG/SGO); Ernest Mondol, William Carrasquilla, Fabiola (INE/ENE); Baruzze, Miguel (VPC/FMP); Echeverria Fernandez, Esteban (INE/ENE); Johnson Naveo, Odile Ivette (INE/ENE); Mora Vargas, Greivin Gerardo (CID/CCR); Ruiz Mora, David Jose (CID/CCR); Sanmartin Baez, Alvaro Luis (LEG/SGO); Ernest Mondol, William Baruzze, Miguel (VPC/FMP); Echeverria Fernandez, Esteban (INE/ENE); Johnson Naveo, Odile Ivette (INE/ENE); Mora Vargas, Greivin Gerardo (CID/CCR); Ruiz Mora, David Jose (CID/CCR); Sanmartin Baez, Alvaro Luis (LEG/SGO); Ernest Mondol, William
▪ Taxonomy:	Operational Support
▪ Operation Supported by the TC:	CR-L1147.
▪ Date of TC Abstract authorization:	26 Apr 2021.
▪ Beneficiary:	Government of Costa Rica: Ministry of Energy and Environment (MINAE)
▪ Executing Agency and contact name:	Inter-American Development Bank
▪ Donors providing funding:	Japan Special Fund(JSF)
▪ IDB Funding Requested:	US$500,000.00
▪ Local counterpart funding, if any:	US$0
▪ Disbursement period (which includes Execution period):	36 months
▪ Required start date:	August 2021
▪ Types of consultants:	Firms or Individual Consultants
▪ Prepared by Unit:	INE/ENE-Energy
▪ Unit of Disbursement Responsibility:	INE/ENE-Energy
▪ TC included in Country Strategy (y/n):	Yes
▪ TC included in CPD (y/n):	No
▪ Alignment to the Update to the Institutional Strategy 2010-2020:	Productivity and innovation; Institutional capacity and rule of law; Environmental sustainability

II. Description of the Associated Loan

2.1 This Technical Cooperation (TC) will support the execution of the loan operation “Towards a Green Economy: Support to Costa Rica’s Decarbonization Plan II” (CR-L1147). The loan operation CR-L1147, currently in preparation, is the second of two-consecutive single-disbursement operations, contractually independent, but technically linked, under the Policy-Based Loan (PBL) modality. The objective of the PBL is to continue to support the country’s progressive transition to net zero greenhouse gas (GHG) emissions by 2050, benefiting the entire population, through reforms to: (i) strengthen management and monitoring of climate action in Costa Rica;

(ii) conserve and restore ecosystems with high rates of GHG sequestration and replace GHG-emitting agricultural practices with GHG-sequestering ones; and (iii) incentivize the use of electric power. The necessary policy reforms to implement the National Decarbonization Plan will be supported under these subsectors. This is the second loan in a series of two consecutive single-tranche operations that are technically related to one another but contractually independent and financed as programmatic policy-based loans.

III. Objectives and Justification of the TC

3.1 The general objective of the TC is to support the government of Costa Rica in the development of the green hydrogen market, in accordance with the Decarbonization Plan (PD) 2018 - 2050[1], to reverse the growth of GHG emissions, promote economic development and job creation. The specific objective is to support Costa Rica to: (i) identify existing gaps for the development of the green hydrogen market; (ii) develop a National Green Hydrogen Strategy and a roadmap that describes the advantages, opportunities, and long-term benefits of producing, exporting, and consuming green hydrogen for the transportation and industrial sectors and sets the path forward for stakeholders; and (iii) obtain and use knowledge and experience in public policy strategies, regulation, subsidies and incentives, and public-private partnerships of other countries, in particular the Government of Japan. In close coordination with the counterpart, it is expected that this TC will generate empirical and practical evidence that will contribute to the implementation of the components of the CR-L1147 Program.

3.2 Since 2015, Costa Rica has managed to generate more than 98% of its electricity with renewable energy sources, such as hydroelectric, wind, geothermal[2] and solar[3]. However, in 2019 electricity only represented 21% of the total energy consumed in the country, while biomass represented 12% and the remaining 65% came from fossil fuels[4].

3.3 In 2018, the transportation sector consumed 61% of the total secondary energy consumed[5] and accounted for 69% of the country´s GHG emissions[6]. The great dependence of the transportation sector on fossil fuels is one of the most important problems to be solved and is one of the pillars of the country's Decarbonization Plan (see paragraph 2.7). For this reason, the transition of this sector towards the use of green hydrogen, an alternative fuel that produces no GHG emissions when used, and produced with renewable sources, is key in the process of decarbonization of the economy and achievement of the established goals. Furthermore, the viability of decarbonizing using hydrogen was identified as an action in the "Inter-institutional action plan to promote the use of hydrogen in the transport sector", prepared in 2018.

3.4 Hydrogen is significantly attractive, especially for large-scale and long-distance transportation, given its high energy density per unit mass[7], which is roughly three

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[1] National Decarbonization Plan Government of Costa Rica.
[2] IDB and Japan International Cooperation Agency (JICA) keep financing the development of geothermal power plants through their co-finance scheme (CORE).
[3] Electricity Generation and Demand. Annual Reports 2015-2019. CENCE, ICE.
[4] National Energy Balance 2018, Government of Costa Rica: Ministry of Energy and Environment (MINAE).
[5] Report: State of the Nation . National Provosts Council.
[6] National inventory of greenhouse gases and carbon absorption - MINAE, IMN, GEF, PNUD, 2012.
[7] Report: New Hydrogen Economy – Hope or Hype?, World Energy Council.

times that of gasoline, diesel, and methane, the main component of natural gas[8]. In terms of total cost of ownership (TCO), which includes acquisition and operating costs, hydrogen cargo trucks are expected to reach parity with internal combustion (conventional) diesel cargo trucks by 2025 at US$1.40 per km[9].

3.5 Additionally, the potential of hydrogen to decarbonize energy consumption in the Costa Rican industrial sector, which represents 8.8% of the consumption of fossil fuels in the country as of 2019 must be explored Worldwide, in the industrial sector, hydrogen represents an important input, useful in the manufacture of steel, chemical products, plastics, agricultural products, and synthetic fuels. This is due to its ability to generate high temperature heat, as well as its versatility to be combined with other elements. Therefore, the supply of hydrogen for industrial uses is currently a business of great relevance throughout the world, and the use of green hydrogen will be needed to decarbonize “hard-to-abate” industries[10].

3.6 With expectations of demand increases of green hydrogen in the coming decades, Costa Rica could consider using its clean energy matrix and unexploited renewable natural resources (solar, wind and geothermal) to become an exporter. The total renewable energy potential identified in the country, not yet used, is 11,954 MW, more than triple the currently installed capacity[11]. Moreover, Costa Rica is a country rich in water resources, necessary to produce green hydrogen. With an average annual rainfall of more than 3,000 mm, it has been estimated that there is an annual availability of 22,600 cubic meters per capita.

3.7 The development of a green hydrogen infrastructure, as well as its respective market, presents Costa Rica with a great opportunity for the development of a new industry that supports the path of economic growth and allows the development of new skills, new employment opportunities and income for the country.

3.8 As such, the PD, which identifies the key actions to consolidate the decarbonization process of the Costa Rican economy, mentions as key activities the design of a plan to boost hydrogen, the implementation of the Inter-institutional action plan and the definition of a transformative vision, as well as the design of pilot projects with public hydrogen buses and freight transport.

3.9 Considering the comparative advantages of Costa Rica, during the last years, the country has made important advances in the development of hydrogen, as presented below:

3.10 The development of the first green hydrogen generation pilot plant, by Ad Astra Rocket Company Costa Rica, was completed in 2013. It demonstrated the viability of generating hydrogen by electrolysis and storing it at pressures of 700 bar. Between 2013 and 2017 the project incorporated a 78 kW solar plant and a 5 kW wind turbine to the ecosystem and added two storage tanks of 40 kg at 450 bar and a H35-type dispenser for heavy-duty vehicles. At the beginning of 2017, an electric fuel cell bus was incorporated, and began operations in the city of Liberia in November of that year.

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[8] Report: Hydrogen Storage. Office of Energy Efficiency and Renewable Energy.
[9] Analysis of Total Cost of Ownership (TCO) of electric vehicles and penetration scenarios. Hinicio for BID Lab.
[10] Report: Heavy industries have a vital role to play in fighting climate change World Economic Forum.
[11] National electrical generation expansion plan (Spanish) , Costa Rican Institute of Electricity.

In 2018, the first fuel cell sedan-type vehicles (Toyota Mirai) entered the country. The pilot project, called “The Green Hydrogen Ecosystem,” showed the technical feasibility of generating green hydrogen from the electrolysis of water and the generation of renewable energy[12].

3.11 The IDB Lab Technical Cooperation (TC) CR-T1194 (2018)- "Road to Decarbonization: Promoting the Hydrogen Economy in Costa Rica", has allowed: (i) comparative studies of fuel cell electric vehicles (FCEV) and battery electric vehicles (BEV) such as Life Cycle Analysis and Total Cost of Ownership studies; and (ii) and the creation of the “Costa Rican Alliance for Hydrogen”[13], a public-private alliance to promote the development of business opportunities in the green hydrogen sector[14]. Additionally, this TC is financing a market analysis to assess the potential supply and demand of hydrogen at a national, regional, and global level, to determine investment opportunities, and accelerate the development of the green hydrogen market in Costa Rica.

3.12 The Ministry of Energy and Environment (MINAE) developed an "Inter-institutional Action Plan to promote the use of hydrogen in the transportation sector" and created, through the Energy Subsector Planning Secretariat (SEPSE), the Hydrogen Commission, integrated by different representatives of institutions related to the energy sector[15]. The plan identifies the actions required to create a legal framework that allow certain state institutions to enter the field of hydrogen for research, development, and commercialization of hydrogen in the transportation sector.

3.13 As one of the actions of the Inter-institutional Action Plan, through the Costa Rican Institute of Technical Standards (INTECO), the National Hydrogen Technical Committee was created to carry out a process of standardization of the technical standards used for the design of hydrogen generation, storage, transportation, and distribution plants.

3.14 To facilitate the adoption of this technology, the International Energy Agency (IEA) recommends, as one of the strategies, “establish a long-term vision, with concrete policies, declaring hydrogen as a necessary technology for decarbonization”. Consequently, the Government of Costa Rica, through MINAE, has requested IDB’s support to develop the National Hydrogen Strategy and action plan as well as prefeasibility studies of a pilot project for green hydrogen production and use, to use them as a coordination tool between stakeholders from both the public and private sectors, national and international, and thus reach an agreement on the objectives, responsibilities, barriers to eliminate, and incentives to be implemented. The publication of a Strategy will identify the country's potential contributions to the

[12] The pilot project was developed by: Ad Astra Rocket Company, the Costa Rican Petroleum Refinery (RECOPE), The Costa Rican Development Banking System, Cummins Power, and Air Liquide.

[13] Website of Costa Rican Alliance for Hydrogen.

[14] The Alliance for Hydrogen is made up by The Costa Rica-USA foundation (CRUSA), Ad Astra Rocket Company, Toyota Costa Rica (Purdy Motor), Cummins, Siemens, and the Costa Rican Institute of Electricity (ICE), among others.

[15] The Hydrogen Commission is made up of by Public Services Company of Heredia (ESPH), Costa Rican institute of Electricity (ICE), the Administrative Board of Cartago Electric Service (JASEC), the Costa Rican Petroleum Refinery (RECOPE), the General Directorate of Transportation and Marketing of Fuels (DGTCC), the Planning Secretariat, Energy Subsector (SEPSE) and the Ministry of Public Works and Transportation (MOPT).

development of the green hydrogen market worldwide to attract private investment and generate trade opportunities.

3.15 Additionally, the knowledge and lessons learned from developed countries in the hydrogen market and hydrogen technologies is of great importance. The government of Japan has acquired significant experience in: (i) the development of hydrogen products and fuel cells, such as vehicles, residential and commercial electricity generators, electrolyzers, and hydrogen dispensing stations; and (ii) the development of the hydrogen market and demand, as a result of the strategies implemented and the efforts made by the government. Learning from these and adapting them to the reality of Costa Rica is key. Specifically, it is of particular interest to study the strategies carried out to develop the demand for hydrogen in different applications in the transport and industrial sectors.

3.16 Safety is an important issue in the use of hydrogen in the transport and industrial sectors. Due to its geological location, bordering the Pacific Ring of Fire, Costa Rica is an earthquake-prone country and needs to develop resilient infrastructure dealing with high pressure gases including hydrogen. Costa Rica could learn from countries like Japan about the necessary regulation and technical safety norms and standards for facility construction and operation to develop resilient infrastructure to make use of hydrogen safely. The importance of the resilience of infrastructure is also highlighted in the internationally recognized principles[16].

3.17 This TC will support the execution of CR-L1147 by stimulating the use of electric power in the transportation sector and several industries, as it is supporting the development of hydrogen technologies, which are seen worldwide as an important complement for reaching the decarbonization of the world's economies.

3.18 **Strategic Alignment**. The TC is aligned with the IDB Country Strategy with Costa Rica 2019-2022, specifically in the priority of development of quality and resilient infrastructure and support to the Decarbonization Plan, where electrification of transportation is key[17]. The TC is also aligned with the Bank's Update to the Institutional Strategy 2020-2023. It aligns with the following development challenges: (i) Productivity and innovation, since the TC is promoting the development of a new and innovative energy market (green hydrogen); and (ii) Institutional capacity and rule of law, because the TC, through its Component III, will provide capacity building and knowledge transfer to key stakeholders in green hydrogen technologies, related infrastructure, role of the government, and related policies. In addition, the TC contributes to solving the cross-cutting issue of *Climate Change and Environmental Sustainability* by exploring the potential of green hydrogen to decarbonize energy consumption in the Costa Rican industrial sector. Moreover, this TC is also aligned with the Strategy on Sustainable Infrastructure for Competitiveness and Inclusive Growth (document GN-2710-5)[18], since it supports infrastructure modernization that contributes toward meeting energy demand in a sustainable manner. It is also consistent with the Energy Sector Framework Document (document GN-2830-8) in

[16] G20 Principles for Quality Infrastructure Investment.
[17] IADB Country Strategy with Costa Rica 2019-2022.
[18] TCs under the Japan Enhanced Initiative for Quality Infrastructure, Resilience against Disaster and Health (JEI) must be aligned with the Bank's "Sustainable Infrastructure for Competitiveness and Inclusive Growth" strategy (document GN-2710-5).

the thematic areas of energy sustainability and energy security, by supporting a green energy market and enhancing the efficiency of infrastructure investments. Finally, the TC contributes to the United Nations Sustainable Development Goals, specifically goal 11: Sustainable cities and communities, and goal 13: Climate action[19].

IV. Description of activities/components and budget

4.1 **Component I. Gap Identification Study and National Green Hydrogen Strategy.** Seeks to support MINAE in the process of formulating and communicating a National Hydrogen Strategy for Costa Rica. It will compare the current situation of hydrogen development in Costa Rica with leading countries, for example, Japan's regulatory strategy, safety measures, public policies, and incentives, concluding with the identification of the key issues pending to be solved and a strategy to address them. The expected results are: (i) a study that identify the gaps (regulatory, technical, financial, and new talent) that need to be addressed to enable the development of the hydrogen industry in the country, (ii) a proposal for a National Hydrogen Strategy and Action Plan; and (iii) public consultation sessions with stakeholders and an event to present the strategy at the national and international level. This component is aligned and supports the loan operation CR-L1147. A National Green Hydrogen Strategy will provide a clear roadmap outlining the long-term advantages, opportunities, and benefits of producing green hydrogen, setting a clear incentive to the electrification of the transport and industry.

4.2 **Component II. Development of Pre-feasibility Studies for Hydrogen Projects.** Will support the prefeasibility studies for one or two projects for green hydrogen production and use (e.g., use of hydrogen for fuel cell freight train of the Caribbean, use of hydrogen fuel cell trucks for fuel distribution, industrial hydrogen ecosystem in a free zone). The criteria to be used to prioritize and choose the projects will include mainly geographical locations with high concentrations of industrial activities, access to renewable energy and energy infrastructure, roads and ports infrastructure. The expected result is a pre-feasibility study for one or two projects.

4.3 **Component III: Capacity building.** As part of the process to define the National Strategy and the development of pre-feasibility studies for a hydrogen project, this component will support Costa Rica in capacity building and knowledge transfer to key stakeholders in hydrogen technologies, related infrastructure, role of the government, and related policies. It will include: (i) knowledge exchange event(s) with the Government of Japan (Ministry for Economy, Trade, and Industry etc.) and related entities in the energy and electricity sector, and study tour to Japan, to sites where the promotion of hydrogen is being implemented, and also technical sites where hydrogen is being generated, transported, and used, for the development of institutional capacities and strategies to increase the demand for green hydrogen in the transportation and industrial sectors, including safety measures to secure resilient infrastructure; (ii) capacity building to develop at least 10 expert technicians in the hydrogen field; and (iii) dissemination[20] to raise awareness and educate about hydrogen as an energy carrier and viable energy source.

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[19] United Nations 17 Sustainable Development Goals.

[20] Interviews, infographics, and other audiovisual content shared in TV, radio, and social networks.

4.4 **Component IV: Project management and coordination.** This component seeks to support the management, execution, and general coordination of the project in collaboration with MINAE and the IDB, with the objective of ensuring its physical and financial completion.

4.5 To finance the components of this TC, the following indicative budget has been prepared:

Indicative Budget (US$)

Activity/ Component	Description	IDB/Fund Funding	Counterpart Funding	Total Funding
Component I	Gap Identification Study and National Hydrogen Strategy	US$205,000	US$ 0	US$ 205,000
Component II	Development of Pre-feasibility Studies for a Hydrogen Project	US$200,000	US$ 0	US$ 200,000
Component III	Capacity Building	US$ 45,000	US$ 0	US$ 45,000
Component IV	Project management and coordination	US$ 50,000	US$ 0	US$ 50,000
Total		**US$ 500,000**	**US$ 0**	**US$ 500,000**

4.6 **Reporting, Monitoring and Evaluation:** The progress of this TC will be monitored through its expected results, as defined in the Result Matrix (RM). The RM also defines the indicators and their expected timing. The project team will be responsible for the preparation and submission to the GCF of all execution reports in compliance with the stipulation of the term sheet/Funded Activity Agreement FAA.

4.7 The required information will be also recorded in Convergence. The annual reports to be submitted will describe the progress toward completing each of the TC Components throughout its duration, presenting the degree of fulfillment of the output indicators and progress toward the outcomes of the RM as recorded in the updated Procurement Plan. It will also provide relevant information to identify any areas that require improvement and lessons learned.

4.8 If at the end of project execution, the project is closed with a positive uncommitted and unspent balance, the project team will be responsible for requesting ORP/GCM to transfer the unspent balance to the donor, pursuant to the terms of the GCF-IDB term sheet/Funded Activity Agreement FAA.

V. Executing agency and execution structure

5.1 The Executing Agency (AE) of the TC will be the Inter-American Development Bank (IDB), through the IDB Country Office in Costa Rica (CCR), considering the Bank's experience in the preparation and development of the operational and technical instruments proposed for this type of operation. This will be done in coordination with the Energy Division (INE / ENE) and MINAE, and is justified by the request made by MINAE, in accordance with Appendix 10 of the Operational Guidelines for Technical Cooperation Products (GN-2629-1). The execution of the TC will be overseen by the specialists of the Energy Division responsible for the portfolio of the Division in the Country Office of Costa Rica (ENE / CCR) and the designated Project Team and will have the support of the INE/ENE; located in Washington DC. It is appropriate for the IDB to directly execute it, so it can provide a centralized coordination of the various studies and ensure their proper dissemination in the country.

5.2 MINAE will designate a team of professionals who will act as the technical counterpart of the Bank's Project Team in the TC execution process.

5.3 **Procurement.** The funding for this operation will be used to hire consultancy services as well as to pay for travel costs and the organization of dissemination and capacitation events. The Bank will contract individual consultants, consulting firms and non-consulting services in accordance with the Bank's current procurement policies and procedures, as follows: (i) the individual consultants will be hired in accordance with the AM-650 Administrative Manual 'Complementary Workforce'; (ii) the procurement process for consulting firms will follow the Bank's Policy for the Selection and Contracting of Consulting Firms for Bank-executed Operational Work (GN-2765-1) and the related Operational Guidelines (OP-1155-4) for hiring consulting services of intellectual nature; and (iii) the procurement of non-consultant services will follow the Bank's Corporate Procurement Policy (GN2303-20). The initial procurement plan provides information on the contracts foreseen and their applicable monitoring and contracting methods.

VI. Major issues

6.1 The team has identified four potential risks associated with this TC. The first one is failure to achieve the proper appropriation of the products obtained, and its subsequent implementation, needed to guarantee the results pursued within the framework of this TC. This is mitigated by constantly addressing and analyzing the results being obtained, in close communication between the Bank, MINAE, and consulting firms developing the products.

6.2 The second risk identified is not achieving adequate stakeholder participation, as well as failing to communicate the benefits that hydrogen will have for their organizations. This risk is mitigated with the coordination of various entities such as the Costa Rican Hydrogen Alliance, MINAE and the Hydrogen Commission, communicating the initial objectives of this TC, and how these are aligned with their long-term interests.

6.3 Finally, the next presidential elections in Costa Rica in 2022 will generate changes in the Executive Branch, which could impact actions to support MINAE in the face of the arrival of new authorities. To mitigate this, MINAE technicians will be involved in all project activities since they are more resilient to changes in government.

6.4 The health emergency caused by COVID-19 could impact the activities of Component III. To mitigate this, virtual alternatives will be considered as a contingency plan.

VII. Exceptions to Bank policy

7.1 There are no exceptions to the Bank Policy.

VIII. Environmental and Social Strategy

8.1 This TC has no environmental or social implications as it deals with the preparation of studies. The TC has been classified by ESG as category "C" which confirms a minimal or non-existent negative environmental, social and / or cultural impact. Please see the SPF and SSF.

Required Annexes:

Request from the Client - CR-T1239

Results Matrix - CR-T1239

Terms of Reference - CR-T1239

Procurement Plan - CR-T1239