Guidelines:

- This Request Submission Form should be completed by the organisation requesting technical assistance from the Climate Technology Centre & Network (CTCN) in collaboration with the National Designated Entity (NDE) of the country in question
- The Form must be signed by the NDE. Please see updated contact list of NDEs here: http://unfccc.int/ttclear/support/national-designated-entity.html
- The Form can be submitted as a Word file containing a digital signature or as a signed and scanned PDF file in combination with an un-signed Word file
- For requests submitted by multiple countries, all the NDEs of the respective countries shall sign identical Forms before official submission to the CTCN
- NDEs have the opportunity to submit CTCN requests in collaboration with National Designated Authorities (NDAs) for the Green Climate Fund (GCF) if targeting the GCF Readiness Programme.

Requesting country or countries:	Indonesia
Request title:	Technical Assistance for an Integrated Renewable Energy, Green Hydrogen and Blue Economy System for Climate-Resilient Fishing Communities in Karimunjawa, Indonesia
NDE	Name of Organization: Ministry of Environment/Environmental Protection Agency Indonesia Name of Individual: Mr. Ary Sudijanto Position: Deputy Minister of Climate Change and Carbon Governance email: ndectcn.idn@kemenlh.go.id Address: Plaza Kuningan, Jl. H.R. Rasuna Said Kav. C11-14, Kuningan, Jakarta Selatan
Request Applicant:	Name of Organization: Research Center for Energy Conversion Technology - National Research and Innovation Agency (BRIN) Contact Person: Dr. Eng. Deni Shidqi Khaerudini Position: Research Professor email: deni.shidqi.khaerudini@brin.go.id Address of the organization: Bld. 625, National Science Techno Park (KST) BJ Habibie, South Tangerang 15314, Banten, Indonesia.

Climate objective:

☐ Adaptation to climate change

☐ Mitigation of climate change

☑ Combination of adaptation and mitigation of climate change

Mitigation: PV-BESS → excess renewable electricity → PEM electrolyzer → green H_2 → DDF → diesel displacement → CO_2 reduction.

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Adaptation/Resilience: Cold storage + ice production + desalination + productive fish processing → enhancing the resilience of fishing communities to energy constraints, water scarcity, changing marine and weather conditions, and the risk of losing the value of their catch.

Geographical scope:

☑ Community level

☑ Sub-national

☐ National

☐ Multi-country

If the request is at a sub-national or multi-country level, please describe specific geographical areas (provinces, states, countries, regions, etc.).

Geographical Area

The request is focused on **Karimunjawa District (Kecamatan Karimunjawa), Jepara Regency, Central Java Province, Indonesia**, an island-based and isolated electricity system located in the Java Sea.

The primary demonstration area is the **main island of Karimunjawa**, where the PLN-operated **PLTD Legon Bajak (2 × 2.2 MW)** provides the main dispatchable electricity supply. The technical assistance will focus on the integration of the existing **PV-BESS system, excess renewable electricity, green hydrogen production, and hydrogen utilization through Diesel Dual Fuel (DDF)** with the existing electricity infrastructure.

The broader Karimunjawa island group will also be considered as a potential replication area, particularly **Parang, Genting, and Nyamuk Islands**, where PLN operates renewable-energy-based electricity systems. These smaller islands provide relevant examples of off-grid renewable-energy deployment and potential future applications for community-scale energy, productive activities, and climate resilience.

Accordingly, the geographical scope is:
Country: Indonesia
Province: Central Java
Regency: Jepara
District: Karimunjawa
Primary demonstration area: Karimunjawa Island
Potential replication areas: Parang Island, Genting Island, and Nyamuk Island

The request is therefore **sub-national in geographical scope and does not involve multiple countries at the implementation site**. International collaboration is proposed separately through technical and R&D partnerships with institutions in **Korea and ASEAN/regional partners**.

Problem statement related to climate change (up to one page):

Karimunjawa is a small-island archipelago in the Java Sea whose local economy and community livelihoods are strongly dependent on fisheries, marine resources, tourism, and reliable access to energy and water. Its geographical isolation creates structural challenges related to energy security, fuel logistics, freshwater availability, cold-chain infrastructure, and access to productive technologies. These challenges are increasingly relevant in the context of climate change and the need to strengthen

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the resilience of small-island communities.

Electricity supply in island communities remains constrained by the variability of renewable energy resources and continued reliance on diesel generation for system reliability. Diesel fuel must be transported to the islands, creating additional logistical costs, exposure to fuel-price volatility, and greenhouse gas emissions.

At the same time, Karimunjawa has existing solar photovoltaic infrastructure that provides an opportunity to increase the utilization of locally available renewable energy. However, periods of solar generation exceeding immediate electricity demand and battery charging requirements may not be fully utilized for productive applications.

The fishing community faces another interconnected challenge: limited access to reliable cold-chain infrastructure, ice production, fish processing facilities, and clean water. These constraints can contribute to post-harvest losses, lower product quality, limited value addition, and reduced income opportunities for fishing households.

The challenge is therefore not solely an electricity-supply problem. It represents an interconnected water-energy-food and livelihood nexus requiring an integrated climate technology approach.

Karimunjawa provides an opportunity to demonstrate how excess renewable electricity can be converted into green hydrogen through a modular electrolyzer system, stored, and subsequently utilized in an existing diesel generator through a Diesel Dual Fuel (DDF) configuration. In parallel, renewable electricity can support cold storage, ice production, fish processing and desalination.

Such integration could reduce fossil fuel consumption and associated greenhouse gas emissions while simultaneously improving energy security, water security, fish preservation, productive economic activities and climate resilience of the local community.

Past and on-going efforts to address the problem (up to half a page):

Existing renewable energy infrastructure in Karimunjawa provides an important foundation for the proposed initiative, particularly the existing PLN solar PV system and associated electricity infrastructure.

Diesel generation is also used as part of the island electricity system, while electricity supports households, public facilities, tourism activities and local productive activities.

Various national and local programmes have promoted renewable energy deployment, sustainable fisheries, marine conservation, community empowerment and development of Indonesia's small islands.

Nevertheless, these interventions have generally been implemented as individual sectoral initiatives. An integrated assessment combining renewable electricity, battery storage, green hydrogen production, existing diesel generation, cold-chain applications, desalination and community-based productive activities has not yet been established for Karimunjawa.

The proposed CTCN assistance will therefore build upon existing infrastructure and programmes rather than replacing them.

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Specific technology[1] barriers (up to one page):

Barrier 1 – Lack of Integrated Energy Assessment
There is currently no time-series energy assessment that simultaneously captures **PV generation, community load, BESS state of charge (SOC), diesel generator operation, curtailment/excess electricity, and productive-load requirements**.

Barrier 2 – Appropriate Electrolyzer Sizing
The optimal electrolyzer capacity has not yet been determined based on the **actual excess electricity profile**. This is important to avoid oversizing the electrolyzer relative to the available renewable electricity.

Barrier 3 – Technology Selection and System Integration
PEMEL, AEM, and SOEC have different operating characteristics. For a **dynamic PV-BESS system at community scale**, the preliminary assessment indicates that **modular PEMEL has the greatest potential**, but this still needs to be validated through a comprehensive techno-economic assessment.

Barrier 4 – Hydrogen Integration with the Existing Diesel Generator
An engineering assessment is required for **Diesel Dual Fuel (DDF) integration**, including **H_2 injection, control strategy, safety, allowable hydrogen substitution ratio, engine performance, and emissions**.

Barrier 5 – Limited Local Technical Capacity
Local operators and community members require capacity building in **PV-BESS operation, hydrogen safety, DDF systems, desalination, cold storage, and fish-processing technologies**.

Barrier 6 – Lack of a Sustainable Business and Ownership Model
There is currently no established business model defining **system ownership and operation, tariff structure, operation and maintenance (O&M), cooperative participation, revenue generation from cold storage and fish processing, and financing mechanisms for future scale-up**.

Contribution to Programme of Work 2023-2027:

As per 3rd Programme of Work of the CTCN[2], please indicate the system transformation area, key enablers and cross-sectoral themes related to the request:

System transformation areas (mandatory)

- [V] Water-Energy-Food Nexus **(Primary)**
- [ ] Sustainable Mobility
- [V] Energy Systems **(Primary)**
- [ ] Buildings and Infrastructure
- [V] Business and Industry **(Supporting)**

[1] *"**any equipment, techniques, practical knowledge and skills** needed for reducing greenhouse gas emissions and adapting to climate change" (Special Report on Technology Transfer, IPCC, 2000)*

[2] https://www.ctc-n.org/resources/ctcn-third-programme-work-2023-2027

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Key enablers (optional)

[V] National Systems of Innovation
[ ] Digitalization

Cross-sectoral themes (optional)

[V] Gender
[ ] Youth
[V] Indigenous Peoples

Sectors:

Please indicate the main sectors related to the request:

[V] Coastal zones
[ ] Early Warning and Environmental Assessment
[ ] Human Health
[ ] Infrastructure and Urban planning
[V] Marine and Fisheries
[V] Water
[ ] Agriculture
[ ] Carbon fixation
[V] Energy Efficiency
[ ] Forestry
[V] Industry
[V] Renewable energy
[ ] Transport
[ ] Waste management

Please add other relevant sectors:
Green hydrogen; energy storage; cold-chain technology; desalination; blue economy; community-based enterprise development.

Technical assistance requested (up to one page):

Overall Objective
To develop a technically feasible, safe, economically viable and community-based integrated renewable energy and green hydrogen model for Karimunjawa that utilizes excess solar electricity to strengthen energy security, reduce diesel consumption, support sustainable fisheries, improve clean-water access and enhance climate resilience of fishing communities.

Proposed Technical Assistance Packages
TA-1 – Baseline & Community Needs Assessment
PV generation profile; load profile; BESS operation; diesel consumption; fishing-community energy needs; cold storage; ice demand; freshwater demand; socio-economic baseline. Baseline validation will distinguish verified asset data, operator-confirmed records, secondary information, estimates and unresolved data gaps. BRIN will coordinate data validation with PLN and relevant local authorities, subject to data access and stakeholder agreement. The main Karimunjawa site will be assessed separately from Parang, Genting and Nyamuk, which are potential replication sites.

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TA-2 – Integrated Energy System Assessment
Develop: **PV → priority loads → BESS → excess electricity → PEMEL**
Then: **H_2 → storage → DDF genset → electricity**
and: **electricity → cold storage / ice making / desalination / fish processing**.

The time-series model will assess PV generation, demand, BESS SOC and dispatch, diesel dispatch and fuel use, curtailment, productive loads and seasonal variation. Alternatives will be compared on a consistent basis: existing system, direct use of renewable electricity, additional/optimized BESS, hydrogen-DDF, and an integrated configuration where justified.

TA-3 – Electrolyzer Technology Assessment
Modular PEM Electrolyzer: approximately 50–150 kW pilot range. The final electrolyzer technology and capacity will be determined through detailed resource, load, technical and techno-economic assessments. The 50–150 kW range is a preliminary scenario range, not a confirmed installation size. At least three capacity scenarios will be assessed against the validated surplus-energy profile, seasonal availability, electrolyzer utilization, hydrogen demand, storage needs, system constraints and lifecycle cost.

TA-4 – Hydrogen DDF Engineering & Safety Assessment
H_2 injection strategy, substitution ratio, genset compatibility, HAZID/HAZOP, hydrogen detection, ventilation, storage, emergency response, applicable standards. The review will also address combustion stability, load response, engine performance, NOx and greenhouse-gas emissions, leak scenarios, shutdown criteria and acceptance requirements. Any physical testing will be conditional on technical compatibility, an acceptable safety case and required approvals.

TA-5 – Blue Economy Technology Assessment
Cold storage, ice block machine, fish grinder, fish-flour processing, drying, packaging dan fish-waste valorization.

TA-6 – Renewable-Powered Desalination Assessment
RO capacity, specific energy consumption, water demand, pre-treatment, brine management, operation and maintenance.

TA-7 – Capacity Building & Technology Transfer
PV-BESS; green hydrogen; hydrogen safety; DDF; cold-chain management; desalination; blue economy; fish processing; entrepreneurship.

TA-8 – Business, Financing & Scale-up Model
Community/cooperative ownership model, CAPEX/OPEX, LCOH, diesel savings, revenue streams, financing strategy, replication roadmap. Work-package budgets will distinguish CTCN technical-assistance costs from subsequent equipment, construction and implementation investment. The assessment will define proposed ownership, operator and O&M responsibilities, lifecycle costs, prospective funding sources and decisions required before implementation; prospective funding will not be represented as committed.

Anticipated Deliverables
1. Karimunjawa Integrated Energy Baseline Assessment
2. PV-BESS Excess Energy Assessment
3. Electrolyzer Technology Selection & Sizing Study
4. Green Hydrogen–DDF Preliminary Engineering Design
5. Hydrogen Safety & Risk Assessment

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6. Cold Storage and Fish Processing Technology Assessment
7. Renewable-Powered Desalination Feasibility Study
8. Techno-Economic and Environmental Assessment
9. Community Business & Ownership Model
10. Training Modules and Training-of-Trainers Programme
11. Comparative Assessment of Energy-System Alternatives and Seasonal Surplus-Energy Scenarios
12. Monitoring, Evaluation and Indicator Framework with Baselines, Methods and Acceptance Criteria
13. Work-Package Responsibility Matrix and Post-Assistance O&M and Financing Plan
14. Investment and Implementation Roadmap
15. Replication Guideline for Indonesian Small Islands

Expected timeframe:

Months 1–3: baseline + community assessment
Months 3–6: technology assessment
Months 5–9: engineering + techno-economic analysis
Months 7–11: community/business model
Months 9–13: training & capacity building
Months 12–15: investment + implementation + replication roadmap

Anticipated gender and other co-benefits from the technical assistance:

The technical assistance will adopt an inclusive community-based approach with targeted participation of women, youth and fishing households. Women will be actively involved particularly in fish processing, product development, entrepreneurship, cooperative management and financial literacy activities, while youth participation will be promoted in renewable energy, digital monitoring, hydrogen technology and technical operation and maintenance.

Expected co-benefits include reduced diesel consumption and emissions, improved fish preservation, reduced post-harvest losses, increased value addition of fisheries products, new local business opportunities, improved access to clean water, enhanced technical skills, youth employment opportunities and strengthened community resilience.

Environmental safeguards will include sustainable fisheries principles, efficient water utilization, appropriate desalination brine management and responsible utilization of fish-processing residues. Monitoring and evaluation will distinguish completed deliverables, modelled technical outcomes and measured post-implementation impacts. Indicators will include baseline-data completeness; surplus renewable electricity (kWh by interval/season); recommended electrolyzer capacity and utilization; projected or measured diesel displacement (L/year); net greenhouse-gas emissions avoided (tCO_2e/year); energy cost and CAPEX/OPEX; electricity-service continuity; fisheries post-harvest loss rate; clean-water volume and service availability; and training completion. Each indicator will specify its baseline, unit, source, verification method and target or acceptance criterion. Numerical impact targets will be set after baseline validation. Until a pilot is operating, fuel savings and community impacts will be reported as modelled projections, not measured results.

Anticipated follow-up activities after this technical assistance are completed:

The outputs of the CTCN technical assistance will form the technical and investment foundation for implementation of a pilot integrated renewable energy–green hydrogen–blue economy system in Karimunjawa.

The feasibility studies, preliminary engineering designs, safety assessments, business model and

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investment roadmap will be used by relevant national and local government institutions, PLN, research institutions, private-sector technology providers, development partners and community organizations to mobilize financing for implementation.

Following successful pilot implementation, the model will be evaluated for replication across other Indonesian small islands and remote fishing communities.

CTCN TA → Bankable Feasibility Study → Pilot Investment → Demonstration → Replication
The implementation roadmap will distinguish (i) CTCN technical-assistance resources for studies, engineering, capacity building and investment preparation from (ii) capital investment and recurring operating costs for any subsequent physical system. For each proposed work package and deliverable, the inception phase will confirm a lead, contributors, data owner where relevant, reviewer/acceptance authority, completion evidence and budget assumptions. Post-assistance planning will identify the proposed asset owner and operator, routine and major maintenance, safety-management responsibilities, spare parts and replacement needs, operator training, and feasible funding or revenue arrangements. Roles and financing will remain proposed until formally agreed by the relevant parties.

Key stakeholders:

Stakeholder	**Role to support the implementation of the technical assistance**
Indonesia NDE (Ministry of Environment / Environmental Management Agency - Deputy of Climate Change and Carbon Governance)	CTCN coordination, endorsement and national policy alignment
BRIN	Request applicant / technical coordinator / R&D and technology assessment
PLN	PV-BESS and electricity-system data, integration assessment
Jepara Regency / Karimunjawa authorities	Local coordination and community development
Fisher community/cooperative	Beneficiary, co-design, operation and business model
University/research partners	Technical analysis and capacity building
NGOs/LSMs	Community facilitation, gender/youth inclusion, environmental safeguards
Technology providers	PEMEL, BESS, DDF, cold storage and desalination technical inputs
Private sector/off-takers	Fisheries value chain and investment/business development

Governance and accountability: During inception, BRIN and participating stakeholders will agree a responsibility matrix for each work package, including lead, contributors, data access/validation, technical review and deliverable acceptance. PLN operational data and site access will be subject to PLN confirmation and applicable data-sharing arrangements. Community/cooperative roles in operating productive-use assets will be defined through consultation rather than assumed in advance.

Alignment with national priorities (up to 2000 characters including spaces):

Please describe how the technical assistance is consistent with national climate priorities such as: Nationally Determined Contribution, national development plans, poverty reduction plans, technology needs assessments (incl. whether this request refers to any technologies prioritized within Technology Action Plans), Long-term Low Emission Development Strategies, National Adaptation Plans, GCF

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Country Programme, sectorial strategies and plans, etc.

Reference document (date)	Extract (chapter/page)
Republic of Indonesia, Second Nationally Determined Contribution (October 2025)	**Ch. I.1 General Policies, pp. 2–3:** Climate targets are aligned with RPJMN 2025–2029, LTS-LCCR 2050 and RPJPN 2025–2045, maintaining the goal of Net Zero Emissions by 2060 or sooner. **Ch. III Adaptation, p. 15:** priorities include economic, social/livelihood and ecosystem resilience, particularly food, water and energy, supported by local capacity and adaptive technology. **Ch. VI.2, p. 32:** Indonesia calls for technology development/transfer, international collaboration and RD&D. (Republic of Indonesia, 2025, pp. 2–3, 15, 32)
Indonesia Technology Needs Assessment for Climate Change Mitigation and Technology Action Plan (2012)	**Section I, Ch. 1.4.5, p. 27:** Photovoltaic (PV) was identified as the highest-priority mitigation technology in the energy-supply sector. The proposed TA builds on existing PV infrastructure and investigates its integration with BESS and green hydrogen. (Ministry of Environment, 2012, p. 27)
Indonesia Long-Term Strategy for Low Carbon and Climate Resilience 2050 (2021)	**Ch. 1.1.2 Energy, p. 5:** promotes energy efficiency and increased renewable energy. **Ch. 4.2.2 Energy Sector, pp. 56–57:** identifies solar PV, increasing renewable generation, smart-grid integration and off-grid/micro-grid systems as components of the low-carbon pathway. (Republic of Indonesia, 2021, pp. 5, 56–57)
RUPTL 2025–2034, PT PLN (Persero) (2025)	The plan targets **52.9 GW (76%)** of additional renewable-energy and energy-storage capacity, including solar PV and storage, supporting increased renewable integration and system reliability. The proposed TA addresses this direction at community/small-island scale through PV-BESS and excess-electricity utilization. (PT PLN [Persero], 2025)
Indonesia Blue Economy Roadmap, 2nd Edition (2024)	**Strategic Actions/Action Plans, p. 87:** promotes investment in seafood production/processing and cold-chain storage, sustainable seafood processing and value-added industries. The proposal links renewable energy, cold storage, ice production and fish processing to resilient blue-economy livelihoods. (Bappenas, 2024, p. 87)

The requested technical assistance is directly aligned with Indonesia's climate, energy-transition and blue-economy priorities. Indonesia's Second NDC (2025) links climate action with national development planning and the goal of achieving Net Zero Emissions by 2060 or sooner, while prioritizing resilience of food, water, energy and livelihoods, local capacity development, technology transfer and R&D (Republic of Indonesia, 2025, pp. 2–3, 15, 32).

The request is consistent with Indonesia's Technology Needs Assessment, which identified photovoltaic (PV) as a priority mitigation technology in the energy-supply sector (Ministry of Environment, 2012, p. 27). It further supports the LTS-LCCR 2050 pathway through renewable energy, solar PV and distributed/off-grid energy systems (Republic of Indonesia, 2021, pp. 5, 56–57).

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The RUPTL 2025–2034 strengthens this direction through large-scale deployment of renewable energy and energy storage (PT PLN [Persero], 2025). The proposed PV-BESS–excess electricity–green hydrogen pathway therefore supports renewable-energy integration and diesel displacement in a small-island context.

Finally, the proposal also aligns with Indonesia's Blue Economy Roadmap, particularly sustainable seafood production, value-added fisheries and cold-chain development (Bappenas, 2024, p. 87). By integrating green hydrogen, DDF, cold storage, ice production, fish processing and desalination, the TA simultaneously addresses **climate mitigation, energy and water security, livelihood resilience, and sustainable blue-economy development**.

Development of the request (up to 2000 characters including spaces):

Please describe how the request was developed at the national level and the process used by the NDE to approve the request before submitting it (who initiated the process, who were the stakeholders involved and what were their roles?) and describe any consultations or other meetings that took place to develop and select this request, etc.

The request was initiated through a technical development process led by the **Request Applicant, Research Center for Energy Conversion Technology - BRIN**, in collaboration with relevant national stakeholders to identify a practical climate-technology intervention for fishing communities in Karimunjawa. The initial concept emerged from the need to improve renewable-energy utilization, reduce dependence on diesel fuel, strengthen energy and water resilience, and support productive fisheries activities through an integrated PV-BESS, green hydrogen, DDF, cold-chain and desalination system.

During the development process, the concept was progressively refined from a technology-deployment approach into an **applied R&D and technical-assistance request**, consistent with the CTCN mandate and its focus on technology assessment, system integration, capacity building and preparation for subsequent implementation. The technical discussions specifically examined the existing PLN PV-BESS context, excess renewable electricity utilization, electrolyzer technology options (PEMEL, AEM and SOEC), hydrogen storage, DDF integration with the existing diesel generator, cold storage and ice production, fish processing, desalination, and local capacity requirements.

Key stakeholders considered in developing the request include **BRIN as the technical/R&D lead; PLN as the owner/operator of the existing PV-BESS energy infrastructure; relevant national and local government institutions for policy and community coordination; local fishing communities as the end users and beneficiaries; and potential research and technology partners from Korea and ASEAN/regional institutions**. Their respective inputs were used to ensure that the proposed assistance addresses technical feasibility, community needs, institutional requirements and future replication.

The request was subsequently discussed and refined through stakeholder consultations and technical exchanges, with particular attention to defining the technology barriers, scope of technical assistance, expected outputs and potential follow-up financing. The final submission will be formally endorsed and signed by the **Indonesian NDE**, in accordance with the CTCN request process.

Background documents and other information relevant for the request:

- Please list all relevant documents that will help the CTCN analyse the context of the request and national priorities. Please note that all documents listed/provided should be mentioned in this request in the relevant section(s), and that their linkages with the request should be clearly

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indicated. For each document, please provide web-links (if available) or attach to the submission form. Please add any other relevant information as required.

No.	Reference document / information	Relevance to the request	Web-link / Attachment
1	Republic of Indonesia. (2025). *Second Nationally Determined Contribution (NDC).*	Provides the latest national climate priorities, including mitigation, adaptation/resilience, energy, water, livelihoods, technology development and international cooperation. Directly supports the proposed PV-BESS–green H_2–DDF pathway and community resilience components.	https://unfccc.int/sites/default/files/2025-10/Indonesia_Second%20NDC_2025.10.24.pdf
2	Republic of Indonesia. (2021). *Long-Term Strategy for Low Carbon and Climate Resilience 2050 (LTS-LCCR 2050).*	Provides the long-term national framework for low-carbon development, renewable-energy deployment and climate resilience. Supports the renewable-energy and distributed-energy aspects of the request.	https://unfccc.int/documents/299279
3	Ministry of Environment, Republic of Indonesia. (2012). *Indonesia Technology Needs Assessment for Climate Change Mitigation and Technology Action Plan.*	Identifies priority climate technologies, including photovoltaic technology in the energy-supply sector. Provides a national technology-policy basis for utilizing existing PV infrastructure as the starting point of the proposed intervention.	https://unfccc.int/ttclear/TNA/IDN-TNA-TNA_and_TAP_Mitigation_2012.pdf
4	PT PLN (Persero). (2025). *Rencana Usaha Penyediaan Tenaga Listrik (RUPTL) 2025–2034.*	Provides the national electricity-sector planning context for renewable energy, energy storage and increased integration of variable renewable electricity. Directly relevant to the proposed PV-BESS and excess-electricity utilization strategy.	shttps://jdih.esdm.go.id/dokumen/download?id=2025kmesdm188k.pdf
5	Ministry of National Development Planning/National	Provides the national framework for sustainable fisheries, seafood value addition, cold-chain development and	https://www.icctf.or.id/wp-content/uploads/2024/05/Indonesia-Blue-Economy-

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	Development Planning Agency (Bappenas). (2024). *Indonesia Blue Economy Roadmap: 2nd Edition.*	resilient blue-economy livelihoods. Supports the cold storage, ice production and fish-processing components.	Roadmap.pdf
6	Climate Technology Centre and Network. (2022). *CTCN Third Programme of Work 2023–2027.*	Provides the CTCN framework for technical assistance, technology assessment, capacity building, collaborative R&D, technology transfer and implementation planning.	https://www.ctc-n.org/resources/ctcn-third-programme-work-2023-2027
7	Ministry of Energy and Mineral Resources of the Republic of Indonesia. (2024). *National Hydrogen Strategy.*	Provides the national policy context for hydrogen development and supports the proposed investigation of green hydrogen production and utilization.	https://ebtke.esdm.go.id/artikel/undefined/strategi-hidrogen-nasional-dukung-transisi-energi-indonesia
8	Ministry of Energy and Mineral Resources of the Republic of Indonesia. (2025). *National Hydrogen and Ammonia Roadmap.*	Provides the latest national direction for hydrogen and ammonia development and strengthens the relevance of the proposed green-hydrogen R&D and technology-transfer activities.	shttps://ebtke.esdm.go.id/elibrary
9	Karimunjawa site and system information.	Technical information concerning the existing **PLN-owned PV-BESS system, community electricity demand, diesel generation, productive loads, fisheries/cold-chain activities and freshwater requirements** will provide the site-specific baseline for the technical assessment.	**Attachment 1: Site/PV-BESS baseline data**
10	Karimunjawa Integrated PV-BESS–Green Hydrogen–DDF Concept.	Provides the initial technical concept for the CTCN request, including excess renewable electricity utilization, electrolyzer technology assessment, hydrogen storage, DDF, cold storage, fish processing and desalination.	**Attachment 2: Project Concept / R&D Proposal**

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- Please indicate if this request has been developed with the support of the CTCN Request Incubator.

No. The request has been developed through national-level technical discussions and stakeholder engagement led by the Request Applicant, with relevant national stakeholders and prospective international and regional partners contributing to the development of the R&D concept.

OPTIONAL: Linkages to Green Climate Fund Readiness and Preparatory Support

The CTCN is collaborating with the GCF in order to facilitate access to environmentally sound technologies that address climate change and its effects, including through the provision of readiness and preparatory support delivered directly to countries through their GCF NDA. These actions are in line with the guidance of the GCF Board (Decision B.14/02) and the UNFCCC, particularly paragraphs 4 and 7 of 14/CP.22 and paragraph 4, 7 and 8 of 14/CP.24 that addresses Linkages between the Technology and the Financial Mechanisms[3].

The CTCN is therefore implementing some of its technical assistance using GCF readiness funds accessed via the country's NDA. Any application for GCF support, including the amount of support provided, is subject to the terms and conditions of the GCF and should be developed in conjunction with the NDA.

Please indicate whether this request has been identified as preliminarily eligible by the NDA to be considered for readiness support from the GCF.

☐ Initial engagement: The GCF NDA of the requesting country has been engaged in the design of this request and the NDA will be involved in the further process leading to an official agreement for accessing GCF readiness support.

☐ Advanced engagement (preferred): The GCF NDA of the requesting country has been directly involved in the design of this request and is a co-signer of this request, the signature indicating provisional agreement to use readiness national funds to support the implementation of the technical assistance.

NDA name:

Date:

Signature:

Monitoring and impact of the assistance:

By signing this request, I affirm that processes are in place in the country to monitor and evaluate the technical assistance provided by the CTCN. I understand that these processes will be explicitly identified

[3] Please see:
https://unfccc.int/files/meetings/marrakech_nov_2016/application/pdf/auv_cop22_i8b_tm_fm.pdf

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in the CTCN Response Plan and that they will be used in the country to monitor the implementation of the technical assistance following standard CTCN procedures. This includes the active engagement as NDE together with the key project proponent / beneficiary in regular project steering meetings.

I understand that, after the completion of the requested assistance, I shall support CTCN efforts to measure the success and effects of the support provided, including its short, medium and long-term impacts in the country. This includes the completion of NDE feedback and post-implementation forms.

For the proposed technical assistance, BRIN will coordinate a results framework with the NDE and participating stakeholders, subject to agreement in the CTCN Response Plan. Progress will be reviewed against the 12 anticipated deliverables, the 15-month work plan, agreed acceptance criteria, and the indicator framework in Attachment 1. The framework will report data gaps and assumptions explicitly and will separate outputs completed during technical assistance from projected benefits and impacts to be verified after implementation.

Signature:

NDE name:	Mr. Ary Sudijanto
Date:	17 Oktober 2026
Signature:	

THE COMPLETED FORM SHALL BE SENT TO THE CTCN@UNEP.ORG

The CTCN is available to answer all questions and provide guidance on the application process.

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Attachment 1: Karimunjawa Site and PV-BESS Baseline Data

1. Site and Electricity-System Baseline

Karimunjawa is an isolated island electricity system in Jepara Regency, Central Java, Indonesia. The main island of Karimunjawa is supplied by PLN and has received 24-hour electricity service since 2017 through the PLN-operated **PLTD Legon Bajak**, with an installed capacity of **2 × 2.2 MW (4.4 MW total)**.

The wider Karimunjawa island group also includes smaller islands such as **Parang, Genting, and Nyamuk**, where PLN operates renewable-energy-based electricity systems. In 2024, PLN reported three PLTS units with a combined installed capacity of **182 kWp**, supplying approximately **602 households**. These systems operate off-grid, with PV as the primary electricity supply and diesel generation as backup.

Table 1. Existing Site and Electricity-System Baseline

Parameter	**Baseline information**	**Data status**	**Relevance to R&D**
Country	Indonesia	**Verified**	National context
Province	Central Java	**Verified**	Geographical scope
Regency	Jepara	**Verified**	Administrative location
District	Karimunjawa	**Verified**	Primary project area
Electricity-system type	Isolated island system	**Verified**	Key system characteristic
Main electricity operator	PT PLN (Persero)	**Verified**	Potential system partner
Main island	Karimunjawa	**Verified**	Primary demonstration area
Main diesel generation	PLTD Legon Bajak	**Verified**	Existing DDF target
Diesel capacity	**2 × 2.2 MW = 4.4 MW**	**Verified**	Existing dispatchable capacity
24-hour electricity service	Main Karimunjawa Island	**Verified**	Existing energy-service baseline
Smaller islands	Parang, Genting, Nyamuk	**Verified**	Potential replication
PV capacity – 3 smaller islands	**182 kWp total**	**Verified**	Existing renewable-energy platform
Households served	**602 households**	**Verified**	Community-benefit baseline
Smaller-island configuration	PV primary + diesel backup	**Verified**	Relevant hybrid-system experience
Diesel backup – 3 smaller islands	**230 kW**	**Verified**	Existing backup generation

2. Electricity-Demand Baseline

According to the BPS Jepara electricity statistics provided for this project, electricity sales in **Karimunjawa District in 2021 were 8,649,372 kWh/year**.

This corresponds to:

$$E_{annual} = 8,649,372 \text{ kWh/year}$$

and an annual average-equivalent power of:

$$P_{avg} = \frac{8,649,372}{8,760} = 987.6 \text{ kW}$$

or approximately 0.99 MW average-equivalent electricity consumption

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Table 2. Electricity-Demand Baseline

Parameter	Value	Status	Interpretation
Electricity sales, 2021	**8,649,372 kWh/year**	Available baseline	Annual electricity-sales indicator
Equivalent annual average	**~987.6 kW**	Derived	~0.99 MW average-equivalent consumption
Peak demand	Not available	Data gap	Requires hourly load data
Minimum demand	Not available	Data gap	Requires time-series data
Hourly load profile	Not available	Data gap	Critical for system modelling
Daily load profile	Not available	Data gap	Required
Seasonal load variation	Not available	Data gap	Required
Productive-load profile	Not available	Data gap	Required for cold storage/fish processing

Important technical qualification: the 0.99 MW figure is an **annual average-equivalent electricity consumption**, not the actual instantaneous, maximum or peak load. The proposed CTCN technical assistance should establish the actual load profile through time-series assessment.

3. Existing Renewable-Energy Baseline

The Karimunjawa island group already demonstrates PLN-operated renewable-energy deployment. PLN reported in August 2024 that three PLTS systems with a combined capacity of **182 kWp** were supplying Parang, Genting and Nyamuk. PLN also indicated plans to add further solar capacity to improve electricity reliability.

For the **main Karimunjawa Island**, additional renewable-energy development has also been planned around the existing PLTD Legon Bajak site. A Central Java Government report identified a planned PLTS development near the PLTD Legon Bajak location, with renewable generation intended to complement the existing diesel generation in a hybrid configuration.

Table 3. Renewable-Energy Baseline

Parameter	Value / Information	Status
Existing PV – Parang/Genting/Nyamuk	182 kWp total	Verified existing
Number of PV systems	3 units	Verified existing
Primary supply on smaller islands	PV	Verified
Diesel backup on smaller islands	230 kW	Verified
Existing PV capacity on main Karimunjawa Island	To be confirmed with PLN	Data gap
PV historical generation	Not available	Data gap
Hourly PV generation	Not available	Data gap
PV curtailment	Not available	Data gap
PV-BESS interaction	Not yet validated	Data gap
Future/planned PV development	Identified in planning documents	Planning information

4. BESS Technical Baseline

For the proposed CTCN assessment, the **actual installed PV-BESS specifications at the selected Karimunjawa demonstration site must be confirmed by PLN**.

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At present, the following parameters should therefore be treated as **baseline data requirements rather than assumed values**.

Table 4. PV-BESS Technical Baseline and Data Requirements

Parameter	Existing information	Status	Required action
PV installed capacity	To be confirmed	Data gap	Obtain PLN asset data
PV inverter capacity	To be confirmed	Data gap	Obtain PLN technical specification
BESS rated power	To be confirmed	Data gap	Obtain PLN technical specification
BESS nominal energy capacity	To be confirmed	Data gap	Obtain PLN technical specification
BESS usable energy	To be confirmed	Data gap	Obtain PLN operating data
Battery technology	To be confirmed	Data gap	Obtain equipment specification
BESS SOC profile	Not available	Data gap	Obtain historical EMS data
BESS charge/discharge profile	Not available	Data gap	Obtain time-series data
BESS round-trip efficiency	To be confirmed	Data gap	Manufacturer/operational data
BESS operating strategy	To be confirmed	Data gap	Interview/EMS assessment
PV-BESS EMS/control strategy	To be confirmed	Data gap	System assessment
PV generation time series	Not available	Data gap	Obtain SCADA/EMS data
Load time series	Not available	Data gap	Obtain PLN metering/SCADA data
Excess renewable electricity	Not quantified	Key data gap	Calculate through energy modelling
Curtailment	Not quantified	Key data gap	Obtain operational records

5. Existing Diesel Generator Baseline and Hydrogen Utilization

The existing diesel generator should **not be categorized as an energy source in the renewable-energy integration chain**. Instead, it represents an existing dispatchable generation asset that provides the potential pathway for hydrogen utilization through **Diesel Dual Fuel (DDF)**.

Table 5. Diesel–DDF Baseline

Parameter	Baseline	Status
Diesel plant	PLTD Legon Bajak	Verified
Installed capacity	**4.4 MW**	Verified
Configuration	**2 × 2.2 MW**	Verified
Current fuel	Diesel	Existing system
Hydrogen utilization concept	DDF	Proposed
H_2 injection system	Not installed/assessed	R&D requirement
Allowable H_2 substitution ratio	Not determined	R&D requirement
Engine performance with H_2	Not assessed	R&D requirement
Emissions impact	Not assessed	R&D requirement
Control strategy	Not developed	R&D requirement
Hydrogen safety system	Not developed	R&D requirement

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The proposed technical pathway is therefore:
PV → Community Load → BESS → Excess Renewable Electricity → PEM Electrolyzer → Green H_2 → DDF → Existing Diesel Generator

rather than:
PV → BESS → Electrolyzer → Diesel generator as another energy source.

6. Productive Energy and Community Loads
The technical assistance will also investigate productive electricity demand associated with the fishing community. These loads are important because the objective is not only to produce hydrogen but also to **increase renewable-energy utilization and create local economic value**.

Table 6. Productive-Load Baseline

Productive application	**Existing status**	**Required assessment**
Cold storage	To be confirmed	Electrical load, operating hours, capacity
Ice production	To be confirmed	Power demand, production capacity
Fish processing	Existing/community potential	Equipment and energy demand
Flour production/fish-processing machinery	Proposed	Technology and electricity demand
Desalination	Proposed	Water demand, energy consumption
Other community loads	To be identified	Load survey

7. Integrated Energy Data Architecture
The proposed technical assessment should establish a common time-series dataset:

Data stream	**Required resolution**	**Purpose**
PV generation	5–15 min or hourly	Determine renewable generation profile
Community electricity demand	5–15 min or hourly	Determine actual load
BESS SOC	5–15 min or hourly	Determine available storage
BESS charge/discharge	5–15 min or hourly	Determine storage operation
Diesel output	5–15 min or hourly	Determine diesel dispatch
Diesel fuel consumption	Hourly/daily	Establish baseline emissions/fuel use
Curtailment	5–15 min or hourly	Quantify unused renewable energy
Cold storage load	Hourly	Productive-load integration
Ice-machine load	Hourly	Productive-load integration
Desalination load	Hourly	Water-security integration
Fish-processing load	Hourly	Blue-economy integration
Seasonal variation / representative operating periods	Hourly or finer, across available seasons	Assess seasonal surplus and system constraints

The core calculation will then be:

$$E_{excess}(t) = E_{PV}(t) + E_{BESS,discharge}(t) - E_{load}(t) - E_{BESS,charge}(t)$$

subject to the operational constraints of the isolated system. The resulting **excess-electricity duration curve** will become the basis for electrolyzer sizing.

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8. Key Technical Data Gaps

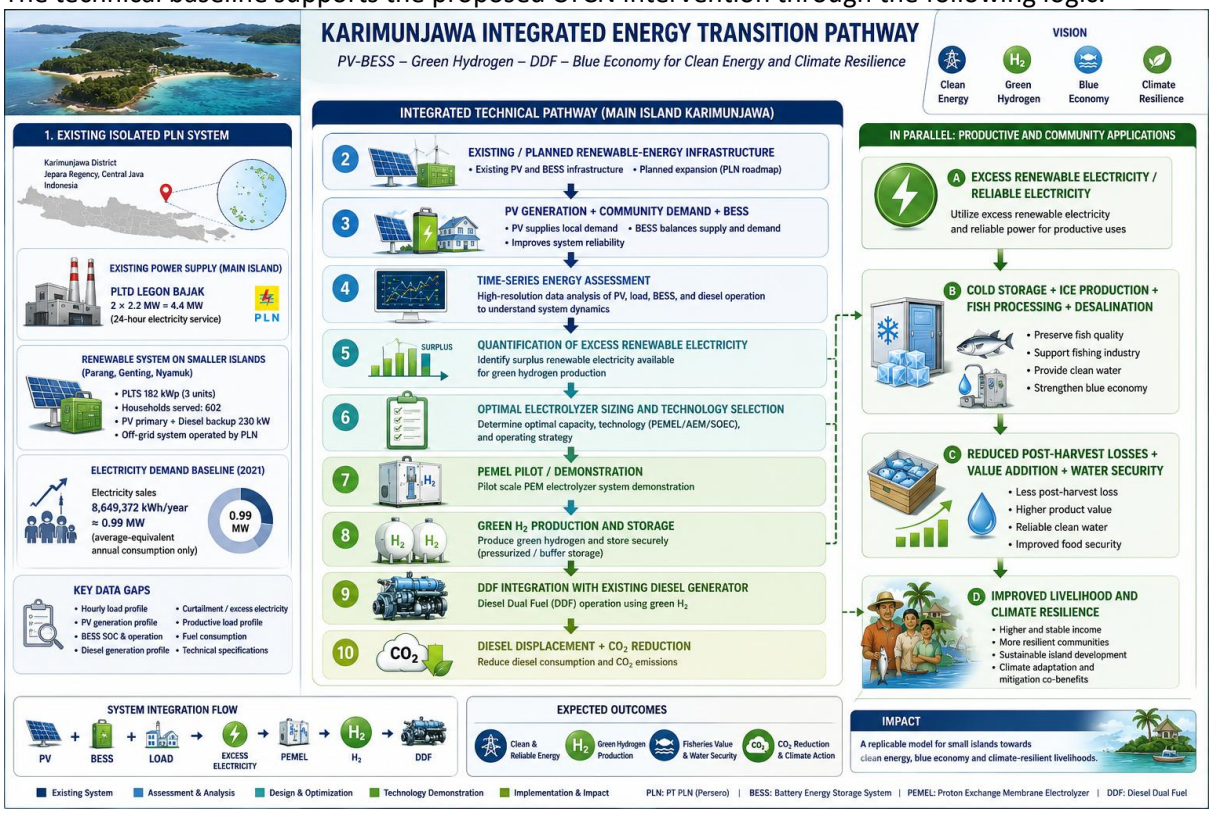
The most important finding from the baseline review is that the annual electricity consumption and installed generation capacity are known, but the time-series operational data needed for optimal system integration are not yet available**.** For decision-making, data will be classified as verified, operator-confirmed, secondary-source, estimated or a data gap. The 182 kWp PV figure refers to Parang, Genting and Nyamuk only and must not be attributed to the main Karimunjawa Island system. Seasonal representativeness and uncertainty will be reported in the energy model.

Table 7. Priority Data Gaps

Priority	Data gap	Why it matters
1	Hourly electricity demand	Determines actual load profile
2	Hourly PV generation	Determines renewable availability
3	BESS SOC and dispatch	Determines storage flexibility
4	PV curtailment/excess electricity	Determines available H_2-production energy
5	Diesel operating profile	Establishes DDF opportunity
6	Diesel fuel consumption	Baseline for CO_2 reduction
7	PV-BESS technical specifications	Determines system constraints
8	Productive-load profile	Determines additional renewable-energy utilization
9	Cold storage/ice demand	Determines fisheries-related energy demand
10	Desalination demand	Determines water-energy nexus
11	Seasonal PV generation and demand variation	Determines whether surplus is persistent or season-specific
12	Engine emissions and performance baseline	Required to assess DDF compatibility, NOx and net emissions
13	Water and fisheries outcome baseline	Required to define measurable adaptation and livelihood indicators

9. Baseline-to-R&D Logic

The technical baseline supports the proposed CTCN intervention through the following logic:



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10. Recommended Baseline Statement for the CTCN Attachment

The Karimunjawa electricity system provides a suitable real-world platform for demonstrating integrated renewable-energy, energy-storage and green-hydrogen technologies. The main island is supplied by the PLN-operated PLTD Legon Bajak with 2 × 2.2 MW installed capacity, while PLN also operates renewable-energy-based systems on Parang, Genting and Nyamuk, with 182 kWp of combined PV capacity serving approximately 602 households. Electricity sales in Karimunjawa District were approximately 8.65 GWh/year in 2021, corresponding to an annual average-equivalent consumption of approximately 0.99 MW. This figure is used only as an initial demand indicator. Detailed hourly electricity demand, PV generation, BESS SOC, diesel dispatch and curtailment/excess-electricity data are not yet available and constitute key technical data gaps.

The proposed technical assistance will therefore establish a time-series integrated energy model to quantify actual excess renewable electricity and determine the optimal electrolyzer capacity and operating strategy. The existing diesel generator will be assessed as a hydrogen-utilization pathway through Diesel Dual Fuel (DDF), rather than as a renewable-energy source. The assessment will also integrate productive electricity applications, including cold storage, ice production, fish processing and desalination. This baseline-to-assessment approach will provide the technical basis for a safe, economically viable and replicable PV-BESS–Green Hydrogen–DDF system for small-island communities.

11. Baseline Validation and Data Governance

The baseline phase will establish a data register identifying each parameter as verified, operator-confirmed, secondary-source, estimated or not available. BRIN will coordinate the protocol with PLN and relevant local authorities. Asset capacity, ownership, operating status, PV/BESS specifications, available EMS/SCADA records, metering data and diesel fuel records will be requested from the responsible data owners. Data access and validation will be subject to stakeholder agreement. The main Karimunjawa site will remain distinct from the 182 kWp combined PV systems reported for Parang, Genting and Nyamuk; these figures will not be used as the main-island PV capacity.

12. Time-Series Surplus-Energy and Electrolyzer Scenario Method

The integrated model will use 5–15-minute data where available, or hourly data where finer resolution is unavailable. It will align PV output, community load, BESS state of charge and charge/discharge, diesel generator dispatch and fuel consumption, curtailment, productive loads, and relevant seasonal variation. Surplus electricity will be calculated only after priority demand, applicable battery constraints, reserve/reliability requirements and operational restrictions are accounted for. Missing time-series data will be documented and addressed through agreed measurement, data collection or sensitivity analysis; annual average-equivalent demand will not be treated as peak load.

The preliminary PEM electrolyzer range of 50–150 kW will be tested through at least three scenarios within or around that range, subject to the verified energy profile and equipment applicability. The scenarios will compare available operating hours, capacity utilization, electricity consumption, estimated hydrogen output, storage and compression requirements, auxiliary loads, flexibility, CAPEX/OPEX and cost of hydrogen. A recommendation will be made only after sensitivity to seasonal resource variation and data uncertainty is assessed. If the surplus is insufficient, the assessment will document that finding and compare alternative uses of the electricity.

13. Comparative Assessment of System Configurations

The following alternatives will be evaluated using a consistent baseline, system boundary, analysis period and documented assumptions: (A) existing system; (B) direct use of renewable electricity for

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priority and productive loads, including cold storage, ice production, fish processing and desalination; (C) additional or optimized BESS; (D) green hydrogen production, storage and use through a technically compatible DDF generator; and (E) a combined configuration where supported by the results. PEMEL, AEM and SOEC will be screened against dynamic operation, scale, efficiency, degradation, balance-of-plant, maintenance and lifecycle cost where technically applicable.

The comparison will cover renewable-energy utilization, pathway efficiency, diesel displacement, net greenhouse-gas emissions, CAPEX, OPEX, energy cost, electrolyzer utilization, service reliability, maintenance, implementation complexity, safety and community benefits. Emissions accounting will state the boundary and factors used and will distinguish direct emissions from relevant upstream/pathway emissions. The preferred option will be selected from evidence; hydrogen-DDF will not be presumed superior to direct electricity use or BESS.

14. Hydrogen-DDF Safety and Environmental Acceptance

The DDF assessment will verify engine and fuel-system compatibility, hydrogen injection and control strategy, feasible substitution range, combustion stability, engine performance and load response. It will evaluate NOx and greenhouse-gas emissions, hydrogen leakage and ignition scenarios, ventilation, detection, isolation and shutdown, storage, hazardous-area requirements where applicable, emergency response, operator competence and relevant Indonesian and international requirements. HAZID/HAZOP and acceptance criteria will be defined at the appropriate design stage. No substitution ratio or emissions benefit will be assumed before engineering verification. Physical testing or pilot implementation will be conditional on a satisfactory safety case, confirmed technical compatibility and necessary approvals.

Environmental review will also consider desalination energy and water requirements, brine management, and responsible handling or valorization of fish-processing residues. Mitigation measures and monitoring needs will be documented as part of the feasibility and implementation roadmap.

15. Monitoring, Evaluation and Success Indicators

The monitoring framework will distinguish deliverables, technical outcomes and impacts. Initial indicators are: (i) baseline-data completeness, measured as the proportion of required parameters verified or documented as gaps; (ii) available surplus electricity, in kWh by time interval and season; (iii) recommended electrolyzer capacity, utilization and estimated hydrogen output; (iv) diesel displaced, in L/year; (v) net greenhouse-gas emissions avoided, in tCO_2e/year; (vi) CAPEX, OPEX, energy cost and cost of hydrogen where applicable; (vii) service continuity using an agreed reliability metric; (viii) fisheries post-harvest loss rate; (ix) clean-water volume, availability and relevant quality compliance; and (x) training participation and competency assessment. Each indicator will include a baseline, unit, data source, verification method and target or acceptance criterion.

Quantitative targets for diesel savings, emissions, water production and fisheries benefits will be established after baseline validation and modelling. Until a pilot is operating, such benefits will be reported as projections with assumptions and uncertainty stated, not as measured outcomes.

16. Work-Package Responsibilities, Budget and Sustainability

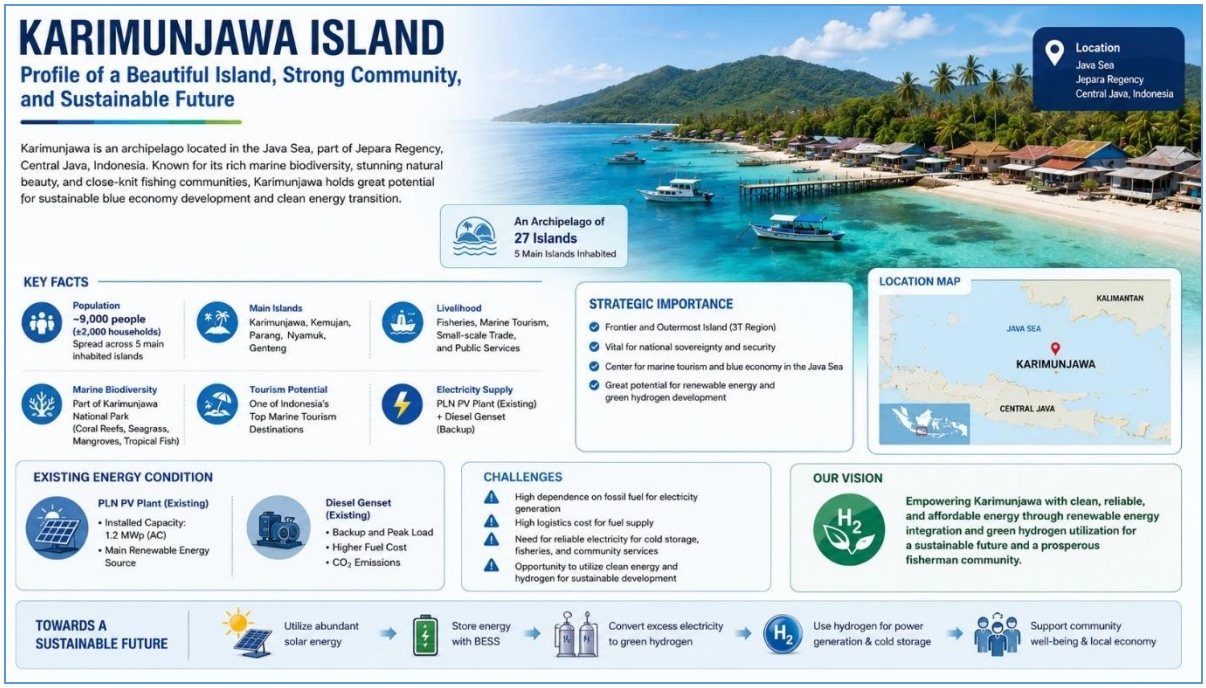
During inception, the participating institutions will agree a responsibility matrix for each work package and deliverable, identifying the lead, contributors, data owner where relevant, reviewer and acceptance authority. Budget estimates will be organized by work package and will document assumptions. CTCN technical-assistance costs will be separated from subsequent capital investment, equipment procurement, construction and recurring O&M costs. Prospective contributions and financing sources will be identified as options until formally confirmed.

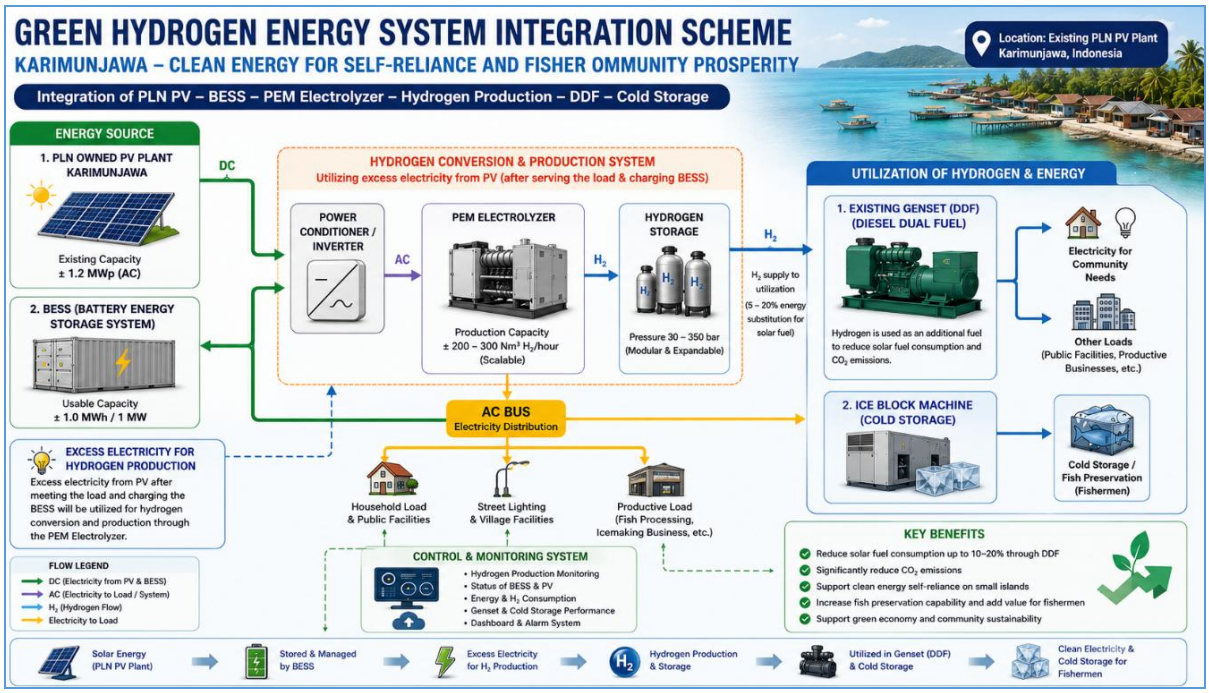
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The post-assistance plan will identify proposed ownership and operating arrangements, routine and major maintenance, safety management, operator training, spare parts, component replacement, service costs, and feasible revenue or funding arrangements for productive uses. Community/cooperative, utility, private-sector or hybrid models may be assessed as appropriate; no role, asset transfer or financing commitment will be assumed without agreement. Each deliverable will have completion evidence and an agreed review/acceptance procedure.

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Attachment 2. Karimunjawa Project Concept / R&D Proposal





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