Terms of reference

Consulting services for the feasibility studies of an Ocean Thermal Energy Conversion system (OTEC) in The Bahamas

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LIST OF ABBREVIATIONS

AACE	American Association of Cost Engineering
AECID	Agencia Española de Cooperación Internacional para el Desarrollo
AFD	Agence Française de Développement
BOOT	Build, Own, Operate, Transfer (PPP model)
BPL	Bahamas Power & Light
CAPEX	Capital Expenditure
CCCCC	Caribbean Community Climate Change Centre
CITES	Convention of International Trade of Endangered Species
CTD	Conductivity-Temperature-Depth
DSCR	Debt Service Coverage Ratio
EEZ	Economic Exclusive Zone
EF	Expertise France
EIB	European Investment Bank
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
E&S	Environmental and Social
EU	European Union
EUR (or €)	Euro
FEED	Front End Engineering Design
FIAP	Program Implementation Agency of Spain
GGIA	Global Gateway Investment Agenda
LAC	Latin America and the Caribbean
GBPC	Grand Bahamas Power Company
GIS	Geographic Information System
GIZ	German Cooperation Agency
IMO	International Maritime Organisation
IRR	Internal Rate of Return
IUCN	International Union for Conservation of Nature
KOM	Kick-Off Meeting
kW	Kilowatt
MW	Megawatt
NELHA	Natural Energy Laboratory of Hawaii Authority
NOAA	National Oceanic and Atmospheric Administration
NPV	Net Present Value
OESL	Ocean Energy Systems Limited
OPEX	Operational Expenditure
OTEC	Ocean Thermal Energy Conversion
PPA	Power Purchase Agreement
PPP	Public-Private Partnership
PUE	Power Usage Effectiveness
RT	Refrigeration Ton
SDC	Seawater District Cooling
SDG	Sustainable Development Goals
SIDS	Small Island Developing State
SPV	Special Purpose Vehicle
SWRO	Seawater Reverse Osmosis
ToR(s)	Terms of Reference
UN	United Nations
UNDP	United Nations Development Program
UN-ECLAC	United Nations Economic Commission for Latin America and the Caribbean
USD (or $)	United States Dollar
WSC	Water and Sewerage Corporation

1. GENERAL INFORMATION

Key Features

Assignment name	Consulting services for the feasibility studies of an Ocean Thermal Energy Conversion system (OTEC) in The Bahamas
Beneficiary	Prime Minister's Office of The Bahamas
Country	The Bahamas
Total estimated number of months	13 months

In the present document, the term **"Consultant"** refers to the entity or consortium contracted to perform the pre-feasibility study whose scope of work is detailed in this document. Where structured as a consortium, the Consultant comprises (i) a "**Lead Consultant"** (consortium leader) responsible for overall project management, coordination, and delivery of all outputs and (ii) "**Sub-contractors" or "Co-contractors"** providing specialised expertise for specific study activities.

The Consultant may also be referred to as the **"Service Provider"** in the present document or other contractual documents.

General Requirements

As per the definition and details of the consulting activities outlined in this document, the overall OTEC feasibility study aims at carrying out a total of 5 activities:

- Activity 1: Site characterization and validation
- Activity 2: Technical feasibility
- Activity 3: Financial and Economic Analysis
- Activity 4: Legal and Regulatory Framework
- Activity 5: Environmental and Social Impact Assessment

This procurement **only covers Activities 1, 2 and 3** of the overall OTEC feasibility study. The contract is structured as a framework agreement with five phases. For more details about the contractual framework and articulation of the scope of services between Expertise France and the Service Provider, please refer to document *1. Tender rules* and *2. Service supply contract* of the tender package.

The Consultant must submit a bid covering all five phases. Pricing shall be presented phase by phase according to the *Financial Offer* template (Excel format) provided in the tender package. For Phase 2, the Consultant shall provide a maximum conditional price reflecting their proposed scope of complementary oceanographic measurements, to be confirmed following completion of Phase 1 (cf. section 4.1.4 for detailed scope of work).

Activity	Phase	Title	Activation Condition	Key Output
1	**Phase 1**	Site Characterization and Validation	Contract signature (T0)	Site Characterization and Validation Report

2	**Phase 2**	Marine Resource Evaluation	Completion of Phase 1 + Notice to proceed	Oceanographic Measurement Report (if applicable)
	Phase 3	Project Preliminary Design	Completion of Phase 2 (or waiver) + Notice to proceed	Preliminary Design Report + Multi-use synergies assessment (Data center, SWAC, SWRO, etc.)
	Phase 4	Grid-Connection Pre-Feasibility Study	Completion of Phase 2 (or waiver) + Notice to proceed	Grid-Connection Pre-Feasibility Report
3	**Phase 5**	Economic and Financial Analysis	Completion of Phase 3 and 4 + Notice to proceed	CAPEX, OPEX and Business Case report(s) (incl. cost-benefit analysis), Business Model

Environmental and social safeguards expertise and legal expertise must be integrated into the site selection process (Activity 1 / Phase 1). The Consultant shall include at least one E&S specialist and one legal expert within the cross-disciplinary working group (cf. section 6.2) contributing to site assessment and selection to ensure early identification of potential environmental, social, and legal risks that could affect site viability. These experts shall participate in the desktop analysis, field mission (at least the E&S expert), and site validation workshop(s) to provide preliminary screening of E&S and legal constraints, even if the comprehensive legal analysis (Activity 4) and detailed ESIA (Activity 5) are not covered by this procurement.

The price quoted by the Consultant based on the present Terms of Reference shall follow the Financial Offer form annexed to the ToR.

2. CONTEXT AND JUSTIFICATION OF THE NEED

2.1. Expertise France

Expertise France (EF) is a public agency and the inter-ministerial actor in international technical cooperation, subsidiary of the Agence Française de Développement Group (AFD Group). As the second largest agency in Europe, it designs and implements projects that sustainably strengthen public policies in developing and emerging countries (Governance, security, climate, health, education, etc.). It operates in key areas of development and contributes alongside its partners to the implementation of the Sustainable Development Goals (SDGs).

For more information: www.expertisefrance.fr

2.2. The Euroclima programme

2.2.1. Euroclima programme overview

Euroclima is the European Union's (EU) flagship cooperation program on environmental sustainability and climate change in Latin America and the Caribbean (LAC). It aims to contribute to the LAC region's

green transition, through efforts to mitigate and adapt to climate change and to protect and conserve biological diversity. Two main outcomes are expected:

- The enabling environment for a green transition (integrated policies, legal frameworks, sector plans and financial instruments) will be strengthened, in line with climate, biodiversity and circular economy objectives.
- Transformative approaches in key areas for the green transition will be developed, demonstrated and scaled up through the mobilization of public and private funding.

Euroclima contributes to the implementation of the Global Gateway Investment Agenda in the region. Global Gateway is the EU's offer to bridge the infrastructure investment gap by using public financing to leverage private capital and investment for projects that contribute to the green and digital twin transition. In the Caribbean region, Euroclima is funded by the European Commission, for a 5-year period, and is implemented by EU Member States agencies or MSAs (AECID, Expertise France, FIAP, GIZ) and the UN (ECLAC, UNDP, UN Environment). The program forms part of the regional Team Europe Initiatives "Latin America and Caribbean Green Transition" and "A Partnership for a Caribbean Green Deal".

Through Euroclima, the EU has initiated Country Dialogues to enhance its role in defining cooperation priorities. The Country Dialogue is conducted with the key institutions for climate action in each country, which allows for the alignment of the program's strategies with nationally established priorities to ensure cohesion and synergies with other activities. In consultation and coordination with the country and under the leadership of the National Focal Point (NFP), the program supports the design of the Dialogue process on a case-by-case basis.

For more information: https://www.euroclima.org/

2.2.2. The Euroclima program in The Bahamas

In the context of the EU-CELAC Summit held in July 2023 in Brussels, the EU committed to renewing the bi-regional partnership. The EU-CELAC Summit Declaration 2023 recognized the EU-LAC Global Gateway Investment Agenda (GGIA) as a potential contribution to address the investment gaps between the EU and LAC. The GGIA aims to mobilize private and public funds for sustainable development in various sectors, highlighting projects with potential for EU investments, especially in climate-related sectors. Additionally, the EU's global approach includes "complementary measures" such as regulatory improvements and investments in human capital development. In this context, Euroclima is ideally positioned to facilitate the implementation of the shared priorities in the summit declaration in climate-related sectors as prioritized by the countries.

In The Bahamas, the GGIA focuses on the Climate and Energy sector through the modernization of the archipelago's energy system.

The Bahamas is currently part of two regional focus areas:

- Transport: Improve maritime connectivity in the Caribbean to foster regional integration, economic growth and food security.

- Climate and Energy: Turn Sargassum algae from a threat to an economic opportunity (e.g. biofuel, water purification, agriculture).

The EU focuses its support to The Bahamas on the adoption of climate-resilient renewable energy infrastructures and on strengthening the policy and regulatory frameworks to foster the integration of renewable energies (solar power technologies, marine energies, etc.).

2.3. Background of the action

2.3.1. Energy and Climate context of The Bahamas

The Commonwealth of The Bahamas is a Small Island Developing State (SIDS) comprising over 700 islands and cays spread across approximately 100,000 square miles of the Atlantic Ocean. With a population of approximately 400,000 inhabitants and a GDP of approximately USD 16 billion, The Bahamas ranks as the fifth wealthiest country in the Caribbean region[1].

Like many Caribbean SIDS, The Bahamas faces significant energy challenges that directly impact its economic development, climate resilience, and energy security. The country's energy sector is characterized by[2]:

- Heavy dependence on imported fossil fuels: more than 90% of electricity generation relies on diesel and heavy fuel oil, exposing the country to volatile international oil prices and supply disruptions.
- High electricity costs: electricity tariffs in The Bahamas are among the highest in the region, significantly impacting household budgets, business competitiveness, and overall economic development.
- Fragmented grid infrastructure: The archipelagic geography results in multiple isolated electricity grids across the Family Islands, each with its own generation and distribution challenges.
- Water-energy nexus: More than 50% of potable water in the Family Islands is produced through energy-intensive Seawater Reverse Osmosis (SWRO) desalination plants, creating a critical interdependency between energy and water security.

The Bahamas has committed to ambitious climate and energy targets aligned with international frameworks, including the Paris Agreement and the United Nations Sustainable Development Goals (SDGs). The Bahamas National Energy Policy (2013-2033) sets forth four strategic goals:

- Energy conservation and efficiency;
- modern, safe, reliable, and affordable energy infrastructure;
- establishing The Bahamas as a world leader in sustainable energy in an environmentally sensitive manner; and
- dynamic governance and public-private partnerships.

2.3.2. Ocean Thermal Energy Conversion (OTEC): Technology Overview

[1] Source: The World Bank group data base, 2024
[2] Source : The Bahamas National Energy Policy (2013-2033)

Ocean Thermal Energy Conversion (OTEC) is a renewable energy technology that harnesses the natural temperature difference between warm surface seawater and cold deep seawater to generate electricity. Unlike intermittent renewable energy sources such as solar and wind, OTEC can provide baseload electricity 24 hours a day, 7 days a week.

OTEC operates on a thermodynamic principle similar to conventional heat engines, but with much smaller temperature differences. The technology requires a minimum temperature gradient of approximately 20°C between surface water (typically 25-28°C in tropical regions) and deep water at approximately 1,000 meters depth (typically 4-7°C). This thermal gradient drives a heat engine, typically using a Rankine cycle with a working fluid such as ammonia, to produce mechanical energy that drives an electrical generator.

There are two main OTEC system configurations:

- Closed-Cycle OTEC (CC-OTEC): Uses working fluid with a low boiling point (typically ammonia) in a closed loop. Warm surface water vaporizes the working fluid, which drives a turbine. Cold deep water then condenses the vapor back into liquid form to repeat the cycle.
- Open-Cycle OTEC (OC-OTEC): Uses seawater itself as the working fluid. Warm surface water is flash evaporated under vacuum conditions, and the resulting steam drives a low-pressure turbine. Cold deep water condenses the steam, producing freshwater as a valuable co-product in addition to electricity.

Beyond electricity generation, OTEC systems offer significant multi-use applications that enhance project economics and sustainability:

- Freshwater production: Open-cycle OTEC directly produces high-quality desalinated water, while closed-cycle systems can be coupled with desalination units.
- Seawater Air Conditioning (SWAC): Cold deep seawater can provide energy-efficient district cooling for buildings, hotels, and industrial facilities, reducing air conditioning energy consumption up to 90%.
- Data center cooling: The availability of cold seawater makes OTEC installations ideal co-location sites for high-performance computing and data centers, which require significant cooling capacity.
- Aquaculture and agriculture: Nutrient-rich deep ocean water can support enhanced fish farming, algae cultivation, and cold agriculture.

OTEC technology has been successfully demonstrated at pilot scale in several locations worldwide, including:

- Hawaii, United States: The Natural Energy Laboratory of Hawaii Authority (NELHA) operates a 105 kW grid-connected OTEC plant (operational since 2015) and hosts the longest-operating cold-water pipeline (1,837 meters length, 1 meter diameter, operating for 37 years at 600 meters depth).
- Kumejima, Japan: A 100 kW demonstration plant operational since 2013, with plans for expansion to 1 MW.
- PLOTEC project, a pan-European consortium that is designing an Ocean Thermal Energy Conversion (OTEC) platform capable of withstanding the extreme weather effects of the tropical area of the ocean, with a viable cost model, validated by a scaled demonstration of a structure.

- São Tomé and Príncipe: A 1.5 MW floating OTEC platform under development with support from UNIDO and the Green Climate Fund (since 2023).
- Republic of Korea: K-OTEC1000 floating platform demonstrations (since 2019).
- Ongoing initiatives led by the OTEC department of the University of Malaysia.

2.3.3. OTEC Potential in The Bahamas

The Bahamas presents exceptional conditions for OTEC development due to its geographic location in tropical waters, proximity to deep ocean trenches, and critical energy-water nexus challenges[3]. Several technical assessments and pilot initiatives have established the foundation for advancing OTEC technology in the country.

2.3.3.A. Caribbean Community Climate Change Centre (CCCCC) Studies

Between 2022 and 2023, the Caribbean Community Climate Change Centre (CCCCC), with support from the European Union through the Global Climate Change Alliance (GCCA+) program, commissioned Witteveen+Bos Consultants to conduct an evaluation of OTEC potential in The Bahamas. This study included:

- Energy efficiency audit of existing SWRO facilities operated by Veolia on behalf of the Water and Sewerage Corporation (WSC) in the Family Islands
- Assessment of OTEC technology paired with SWRO plants at three priority locations: Lower Bogue (North Eleuthera), Naval Base (Central Eleuthera), and Cockburn Town (San Salvador)
- Conceptual design specifications for OTEC systems ranging from 60 kW to 500 kW capacity
- Cost-benefit analysis comparing OTEC with alternative renewable energy options (solar power, wind turbines, battery storage)

The Witteveen+Bos study (February 2023) concluded that:

- OTEC for electricity generation alone is not yet cost-competitive with mature renewable energy alternatives in the Bahamas context;
- Multi-use OTEC systems combining electricity generation with freshwater production and/or seawater district cooling significantly improve economic feasibility;
- Open-Cycle OTEC in Lower Bogue, producing both electricity (500 kW) and freshwater (40% additional capacity beyond current SWRO), demonstrated the most favorable business case with an LCOE approximately 40% lower than Closed-Cycle OTEC without co-products;
- OTEC deployment in Naval Base, Central Eleuthera shows also potential synergies and opportunities;
- Seawater District Cooling (SDC) in San Salvador showed promising economic metrics;
- Critical uncertainty: All technical and economic analyses assumed that cold water (<7°C) is accessible at approximately 1,000 meters depth via vertical boreholes. This assumption remained unvalidated at the time of the study and needed to be assessed through a proper thermal gradient measurement campaign.

2.3.3.B. Temperature and Salinity Measurement Campaign (NOAA, 2023)

[3] *Source: The Bahamas National Energy Policy (2013-2033)*

In 2023, the National Oceanic and Atmospheric Administration (NOAA) conducted a temperature and salinity measurement campaign in the Atlantic Ocean east of Eleuthera. The campaign was carried out between August and November 2023 using a Seaglider 668 autonomous underwater vehicle, collecting continuous profiles from the surface down to 900 meters depth.

The dataset confirms the existence of a substantial thermal gradient in the water column off Eleuthera, providing encouraging preliminary evidence of the area's potential for OTEC deployment. However, these data require critical review by an entity with demonstrated expertise in OTEC project implementation, in order to assess in particular whether the measurements are representative of year-round conditions, given that the campaign was conducted over a four-month window during the second half of the year, and whether they are spatially extrapolable to the pre-selected project site at the Naval Base, Central Eleuthera, which may present specific bathymetric and hydrodynamic conditions that differ from the measurement locations.

2.3.3.C. OTEC Diagnostic Note by Ocean Energy Systems Limited (OESL)

In November 2025, Martin G. Brown of Ocean Energy Systems Limited (OESL), commissioned by Expertise France under the EUROCLIMA+ Bahamas Country Action Plan, completed a comprehensive OTEC Pre-Feasibility Assessment and Diagnostic Note.

This assessment provided critical insights and identified key technical gaps requiring resolution before OTEC implementation in The Bahamas. Key findings from the OESL diagnostic note include:

- The Bahamas possesses strong fundamentals for OTEC: stable governance, technical capacity (University of The Bahamas), existing infrastructure (submarine cables, ports), and proximity to deep cold water;
- Proven deep seawater access: The Baha Mar resort successfully operates a seawater district cooling system using 20°C water from approximately 300 meters depth via vertical boreholes;
- Consolidated Water operates large-diameter boreholes for SWRO;
- Infrastructure approach uncertainty: Previous studies assumed vertical boreholes to 1,000m depth, but this approach is unproven at the scale and depth required for OTEC. Alternative approach: marine pipelines (proven technology);
- Recommended pathway: Establish a "Caribbean Marine Renewable Energy Centre" like NELHA (Hawaii), Kumejima (Japan), or EMEC (Scotland), where government funds expensive seawater infrastructure and private sector develops commercial applications; and
- Multi-product approach essential: OTEC projects in The Bahamas must integrate electricity generation with freshwater production, seawater air conditioning, and potentially data center cooling to achieve economic viability.

2.3.3.D. North Eleuthera Deep Supply Well Project

In parallel with the broader OTEC assessments, the EU and Expertise France initiated a pilot project in North Eleuthera to drill a deep supply well supporting both SWRO desalination and OTEC temperature gradient validation.

A tender was launched in 2024 to execute the drilling and measurement campaign. However, the procurement process proved unsuccessful due to the significant cost differential between shallow drilling adequate for SWRO applications (approximately 450 ft i.e. 137m depth) and the deep drilling required to validate OTEC feasibility at approximately 1,000m depth. The substantial budgetary gap

between available resources and the technical requirements for accessing cold water at OTEC-relevant depths ultimately prevented contract award.

This experience underscores the importance of ensuring technical scope alignment with OTEC validation requirements and realistic budget allocation for deep water access infrastructure studies, whether through offshore marine pipelines or onshore drilling approaches.

2.4. Justification and Rationale for the Feasibility Study

The cumulative evidence from the CCCCC/Witteveen+Bos study, NOAA oceanographic measurement campaign and OESL diagnostic note, and North Eleuthera pilot project tentative highlights both the significant potential and critical knowledge gaps surrounding OTEC deployment in The Bahamas. While the country possesses favorable natural conditions and existing technical capacity, several fundamental questions must be answered through rigorous feasibility analysis before commercial-scale investment can be justified.

The following critical gaps and uncertainties necessitate a comprehensive feasibility study:

2.4.1. Site validation for a first-of-a-kind project

- Optimal site selection: As a first-of-a-kind OTEC demonstration project in The Bahamas, site selection must prioritize **value capture optimization** to maximize economic viability. The selected site should demonstrate strong revenue potential from multiple applications including, but not limited to:
    - proximity to energy-intensive activities
    - access to submarine fiber optic cable infrastructure enabling data center co-location opportunities; and
    - favorable bathymetric conditions with deep water (1,000m) near shore minimizing cold water pipe length and construction costs.
- Site selection shall balance technical feasibility with commercial opportunity to ensure the demonstration project can achieve financial sustainability through diversified revenue streams.

⇨ **Following the results of previous studies and due to the local economic context and opportunities offered, the government of the Bahamas has decided to focus on the site of Naval Base in Central Eleuthera which already host a large SWRO facility. The relevance of the selected site shall be validated by the Service Provider through a detailed analysis (cf. section 4.1.3 for detailed scope of work).**

2.4.2. Technical validation gaps

- Temperature gradient validation: the water temperature and salinity measurement campaign led by NOAA from August to November 2023 in the Atlantic ocean (east coast of Central Eleuthera) is a precious and unique source of empirical data proving the existence of sufficient temperature gradient to deploy an OTEC**. However, this data shall be analyzed critically by the Service Provider and might need to be completed by other oceanographic measurement to ensure the viability of an efficient OTEC project in Naval Base or in another relevant site of Eleuthera (cf. section 4.1.4 for detailed scope of work).**

- Site-specific conditions: Bathymetric, geophysical, oceanographic, and geological conditions at candidate sites require detailed characterization
- Climate change impacts: Analysis needed on how ocean warming trends may affect thermal gradient availability and OTEC performance over project lifetime (25-30 years)

2.4.3. Integration and Multi-Use Optimization

- SWRO integration: Detailed engineering required to optimize OTEC-SWRO coupling at existing or planned desalination facilities
- SWAC feasibility: Site-specific analysis of seawater district cooling demand and technical integration pathways
- Data center potential: Assessment of co-location opportunities with high-performance computing facilities requiring significant cooling capacity
- Grid integration: Electrical interconnection requirements (national grid or local grid if direct sale of electricity to private client such as resorts, industrials, etc.) grid stability analysis, and regulatory compliance pathways for independent power producers

⇨ **The pre-selected Naval Base site offers strong potential for data center deployment, owing to its proximity to North American internet interconnection nodes and to the possibility of integrating a SWRO desalination component, given the presence of an existing plant in the vicinity (cf. section 4.1.5 for detailed scope of work).**

2.4.4. Economic and Financial Viability

- Cost structure analysis: Detailed capital expenditure (CAPEX) and operational expenditure (OPEX) estimates for OTEC systems in the Bahamas context, including local vs. imported cost components
- Revenue optimization: Multi-product revenue streams (electricity sales, freshwater production, cooling services) and their integration into financial models
- Financing mechanisms: Assessment of public financing, private investment, concessional climate finance (e.g., Green Climate Fund), and blended finance structures
- Business models: Comparative analysis of government-owned/operated model versus public-private partnership (PPP) structures, including risk allocation and return expectations

2.4.5. Legal, Regulatory, and Institutional Framework

- Land tenure and marine resource rights: Legal framework for securing terrestrial sites, seabed access rights, and subsurface resource utilization
- Regulatory barriers: Current legislation does not grant independent power producers' access to the electricity grid; policy reforms required
- Permitting pathways: Environmental clearance procedures, construction permits, grid interconnection approvals, and operational licensing
- Public-private partnership models: Viable contractual structures (e.g., Build-Own-Operate-Transfer, Power Purchase Agreements) considering Bahamas legal framework

2.4.6. Environmental and Social Considerations

- Marine environmental impacts: Effects of cold-water discharge, intake entrainment/impingement of marine organisms, changes in local water chemistry and temperature
- Construction impacts: Temporary disruption from drilling, pipeline installation, or offshore platform deployment
- Social acceptance: Stakeholder engagement requirements, community benefits, and public acceptance pathways
- Compliance requirements: Alignment with international safeguard standards (IFC Performance Standards, Equator Principles, EU Environmental & Social Standards)

2.5. Key Stakeholders

The key stakeholders of the assignment are The Office of the Prime Minister of The Bahamas (final client), Expertise France (program implementation) and the Delegation of the European Union (funder).

Other important public stakeholders to consider and consult through this assignment includes:

- Ministry of the Environment and Natural Resources
- Water and Sewage Corporation
- Ministry of Works and Family Islands Affairs
- Bahamas Power and Light

3. OBJECTIVES AND DESIRED RESULTS

3.1. General objective

The overall objective of this assignment is to conduct a comprehensive technical pre-feasibility study for the development of OTEC technology in The Bahamas, with possible integration of synergistic applications. This assignment constitutes the first phase of the global feasibility study and aims at solving the critical gaps and uncertainties listed in the sections 2.4.1 to 2.4.3.

This first phase of the pre-feasibility study shall provide the Government of The Bahamas, EUROCLIMA+ program stakeholders, development partners, and potential investors with evidence-based analysis to support informed decision-making regarding OTEC deployment as a pathway toward energy security, climate resilience, and sustainable development.

3.2. Specific objectives

This assignment shall achieve the following specific objectives:

- **Objective 1: Site Validation and Characterization**
  Characterize and confirm relevance of the preselected site of Naval Base (Central Eleuthera) for OTEC development in The Bahamas through exhaustive evaluation of oceanographic, technical, environmental, economic, and social criteria.

- **Objective 2: Technical Feasibility Validation**

- Review the existing studies and empirical measurement of thermal gradients at the selected site, including comprehensive assessment of seawater temperature profiles, sustainable flow rates, seasonal variations, and climate change projections.
- Propose and implement additional oceanographic measurement campaign(s) if relevant to confirm OTEC deployment at Naval Base site.
- Ensure optimized OTEC dimensioning for local grid integration or potential electricity off takers in Eleuthera
- Develop preliminary engineering designs for OTEC facilities integrated with complementary applications (SWRO, SWAC, data centers) and grid connection infrastructure.
- Provide preliminary CAPEX and OPEX estimation and range of the proposed design(s) to be used for activity 3 (Economic and Financial analysis).

- **Objective 3: Economic and Financial Viability**
- Cost structure analysis: Detailed capital expenditure (CAPEX) and operational expenditure (OPEX) calculations for the designed OTEC system(s) produced during Activity 2, including local vs. imported cost components
- Implement viable financing models and an assessment of investment viability (net present value, internal rate of return, payback period, cost-benefit ratio, etc.)
- Present financial risks and mitigation strategies, cash flow projections, budget forecasts, and recommendations regarding incentive measures or support mechanisms
- Analyze different scenarios and test sensitivities, as well as ensuring compliance with international standards.
- Provide guidance for project implementation and financing.

3.3. Anticipated results

The feasibility study shall deliver the following expected results:

Result 1: Selected Site Characterized and Validated

- Desktop analysis report of Naval Base site against technical, environmental, economic, and social criteria based on existing documentation and studies
- Field mission report documenting site visits, stakeholder consultations, and preliminary site assessments
- Site selection characterization and justification report presenting the rationale for the selected site with endorsement from Government of The Bahamas authorities, available information and other preliminary assessments carried out during the field mission (bathymetric surveys, geophysical investigations, oceanographic conditions, infrastructure assessment, etc.)

Result 2: Technical Feasibility Validated Through Empirical Data

- Comprehensive empirical data package including thermal gradient measurement report and other relevant data collected through onsite and oceanographic measurement campaign(s) ensuring robustness of the assumptions used for OTEC preliminary design (bathymetry, sustainable flow rate, etc.)
- Climate change impact analysis projecting thermal gradient availability over the project lifetime (25-30 years) considering ocean warming trends

- Synergies integration studies providing pre-feasibility assessments for SWRO desalination, SWAC district cooling, and data center cooling applications
- OTEC conceptual design specifications including system configuration (closed-cycle vs. open-cycle), capacity sizing (based on a selected scenario regarding potential integration with SWRO, SWAC and data center opportunities), preliminary equipment specifications, and performance projections
- Preliminary infrastructure design specifications covering OTEC facilities, submarine cables, cold water intake systems (pipelines), onshore electrical infrastructure (transformers, substations, SCADA systems), and related civil works
- Grid connection study analyzing electrical interconnection requirements, grid stability impacts, power quality considerations, and compliance with Bahamas Power & Light (BPL) technical standards
- Preliminary (1) capital expenditure (CAPEX) estimates and (2) operational expenditure (OPEX) estimates as basis for detailed economic and financial analysis of Activity 3

Result 3: Financial Viability and Guidance Assessed Under Alternative Business Models

- Detailed CAPEX and OPEX calculation and range based on preliminary work carried out in Activity 2
- Multi-product revenue analysis projecting income streams from electricity sales (based on avoided cost of diesel generation or negotiated PPA tariffs), freshwater production (valued at current SWRO water tariffs), seawater air conditioning services (valued at energy savings relative to conventional cooling), and data center cooling services (if applicable)
- Public ownership scenario financial model assuming government financing, ownership, and operation of OTEC assets, including fiscal implications, government budget impacts, and economic rate of return calculations
- Public-Private Partnership (PPP) scenario financial model analyzing Build-Own-Operate-Transfer (BOOT) arrangements, Power Purchase Agreement (PPA) structures, risk allocation between public and private parties, required returns to attract private investment, and government financial obligations
- Financing mechanisms assessment evaluating potential sources including government budget allocation, development finance institutions, commercial financing, concessional climate finance (e.g., Green Climate Fund, Climate Investment Funds), blended finance structures, and grant co-financing opportunities
- Sensitivity analysis and cost-benefit analysis examining project financial performance under varying assumptions including fuel price escalation, discount rates, OTEC capacity factors, multi-product utilisation rates, and capital cost variations
- Investment decision framework providing recommendations on the most appropriate business model, financing structure, and implementation pathway based on financial, institutional, and risk considerations

Final Deliverable: Technical Pre-feasibility Study Report

The culmination of this assignment shall be the delivery of a detailed report and a data room including all empirical measurements in the adapted format that enables the Government of The Bahamas and its partners to proceed with confidence toward OTEC project development. This comprehensive package shall integrate all study outputs into a cohesive decision-making framework, including:

- Executive Summary: A concise, non-technical summary suitable for senior decision-makers, highlighting key findings, recommended site, technology configuration, high-level estimated costs and benefits, high-level environmental safeguards, and recommended implementation pathway.
- Site Characterization and Validation Report including, but not limited to, technical, environmental, economic, and social conditions of the site and technical gap analysis
- Marine Resource Evaluation Report presenting all relevant data used to formulate assumptions for the technical design of the project
- Technical Feasibility Report including preliminary OTEC engineering design, synergies integration, grid connection analysis and validation, grid infrastructure requirements for OTEC integration and preliminary CAPEX/OPEX estimates.
- Financial and Economic Analysis Deliverables including business case report(s) and financial model

This package shall provide all necessary information and documentation for the Government of The Bahamas to make an informed go/no-go decision on moving to the second phase of the feasibility study including (1) detailed legal framework assessment and (2) ESIA implementation.

4. DESCRIPTION OF THE ASSIGNMENT

4.1. Scope of Work and Phase Structure

4.1.1. Kick-off Meeting (KOM)

The assignment shall commence with a kick-off meeting to be held remotely via videoconference **within two weeks of contract signature**. The kick-off meeting shall bring together:

- The Consultant and key members of the consulting team (Team Leader, technical specialists, subcontractor representatives, c.f. section 6.1)
- Expertise France project management team and advisors
- Representatives of the Government of The Bahamas (Prime Minister's Office, relevant ministries and agencies)
- Other relevant stakeholders as identified by Expertise France and the Government of The Bahamas

The objectives of the kick-off meeting are to:

- Confirm mutual understanding of the Terms of Reference, study objectives, expected results, and deliverables
- Present the Consultant's proposed methodology, work plan, and team composition
- Clarify roles and responsibilities of all parties
- Establish communication protocols, reporting arrangements, and coordination mechanisms

- Agree on the schedule for key milestones, deliverables, and stakeholder consultations
- Identify key stakeholders for engagement during the study
- Discuss data availability, access to information, and logistical arrangements
- Address any questions or clarifications regarding the assignment

The Consultant shall prepare and distribute meeting materials (agenda, presentation) **at least five working days prior to the kick-off meeting**.

Deliverable 0.1: Kick-off Meeting Minutes
The Consultant shall deliver an exhaustive kick-off meeting minute detailing all considerations discussed during the meeting and clear next steps within one (1) week following the kick-off meeting.

4.1.2. Inception Report

Within two weeks following the kick-off meeting, the Consultant shall submit an inception report which refines and details the proposed approach for executing the feasibility study (hereafter the "**Inception Report**"). The Inception Report serves as a critical planning document that demonstrates the Consultant's understanding of the assignment and provides a roadmap for implementation.

Content requirements

The Inception Report shall largely leveraged on the technical offer composed by the Consultant during the tender phase and will include the following elements:

1. Executive Summary: Concise overview of the Consultant's understanding of the assignment, proposed approach, and key deliverables.

2. Understanding of the Assignment: Demonstration of comprehensive understanding of: (i) The Bahamas energy and water context; (ii) OTEC technology and its potential application in The Bahamas; (iii) Previous studies and their findings (CCCCC/Witteveen+Bos, NOAA, OESL diagnostic note, North Eleuthera, etc.); (iv) Key challenges and knowledge gaps to be addressed; (v) Study objectives and expected results as defined in these Terms of Reference.

3. Team Composition and Expertise: Detailed presentation of the consulting team including: (i) Organisational structure and reporting lines; (ii) CVs and roles/responsibilities of all key personnel (Team Leader, OTEC technical specialist, ESIA specialist, legal/regulatory specialist, financial specialist, etc.); (iii) Identification of co-contractors and their specific scope of work for each activity (if applicable); (iv) Confirmation that team composition meets qualification requirements specified in Section 6 of these Terms of Reference; (v) Work allocation and level of effort (person-days) by team member and by activity.

4. Detailed Methodology: Comprehensive description of proposed methodology for each phase. The methodology section shall clearly identify any proposed deviations or enhancements from the indicative methodologies described in these Terms of Reference, with full justification.

5. Work Plan and Timeline: Detailed work plan showing: (i) Sequencing and scheduling of activities and tasks; (ii) Critical path and key dependencies; (iii) Milestones and decision points; (iv) Deliverable submission schedule aligned with Section 4.3 of these Terms of Reference; (v)

Stakeholder consultation and validation workshops timeline; (vi) Field mission schedule; (vii) Quality control and review processes.

6. Stakeholder Engagement Strategy: Comprehensive strategy for engaging Government of The Bahamas authorities, local communities, civil society, private sector, and other relevant stakeholders throughout the study, including: (i) Stakeholder mapping and analysis; (ii) Consultation methods and timing; (iii) Information disclosure and feedback mechanisms; (iv) Workshop and validation session plans.

7. Data Requirements and Sources: Identification of: (i) Required data for the feasibility study; (ii) Data sources (government agencies, utilities, private operators, international databases); (iii) Data gaps and strategies to address them; (iv) Data quality assurance protocols.

8. Risk Assessment and Mitigation: Analysis of potential risks to successful study implementation (technical, logistical, institutional, political) and proposed mitigation measures.

9. Quality Assurance Framework: Description of internal quality control processes, peer review mechanisms, and validation procedures to ensure deliverable quality.

Review and validation process

The Inception Report shall be submitted to Expertise France for review and comments. Expertise France, in coordination with the Government of The Bahamas, will provide consolidated comments **within two weeks of receipt**. The Consultant shall address all comments and submit a revised Inception Report **within one week of receiving comments**.

Approval of the Inception Report by Expertise France is a prerequisite for proceeding with the implementation of study activities. The approved Inception Report serves as the reference document for monitoring progress and evaluating deliverables throughout the assignment.

Deliverable 0.2: Inception Report

4.1.3. Phase 1: Site Characterization and Validation

Duration: 2 months

Phase 1 constitutes the foundational activity of the feasibility study. Its purpose is to compile and critically assess all available information pertaining to the Naval Base site at Central Eleuthera, to conduct a site visit, and to produce a comprehensive characterization of the site in view of its suitability to host a first OTEC installation. The conclusions of Phase 1 may directly affect the design of the Phase 2 measurement campaign (if any) and inform the preliminary design work under Phases 3 and 4.

The Naval Base site has been designated as the priority site by the Government of The Bahamas. This phase does not require the Service Provider to conduct a comparative multi-site analysis; rather, it focuses on producing a rigorous, evidence-based characterization and validation assessment for this specific location.

Task 1.1: Data Collection and Analysis of Existing Information

The Consultant shall conduct comprehensive collection and analysis of existing documentation, data, and studies relevant to OTEC development in The Bahamas with focus on Naval Base site. The exact limits and coordinates of Naval Base site considered are available in annex of the Energy Audit Report carried out by Witteveen+Bos during the CCCCC preliminary study.

The Consultant shall review and synthesize relevant information for Naval Base preselected site from the non-exhaustive following sources:

- Previous OTEC studies and notes: CCCCC/Witteveen+Bos Energy Audit Report (February 2023), OESL OTEC Pre-Feasibility Assessment and Diagnostic Note (November 2025), North Eleuthera Deep Supply Well Project documents (2024)
- Oceanographic data: Bathymetric charts, ocean temperature databases (e.g. NOAA, World Ocean Atlas), ocean current data, seasonal variation patterns, extreme weather and hurricane records
- Energy sector data: Electricity demand profiles in Eleuthera and proximity to Naval Base site, current generation capacity and fuel consumption, electricity tariffs, grid infrastructure maps, Bahamas Power & Light and Grand Bahama Power Company technical specifications
- Water sector data: SWRO plant locations, capacities, and operational data from Water and Sewerage Corporation, water demand projections, water tariff structures
- Infrastructure data: Submarine cable network (BDSNi and others), port facilities, airports, road networks, existing coastal and marine infrastructure
- Land and marine tenure data: Government-owned coastal land inventory, marine protected areas, existing marine resource concessions, zoning regulations
- Socio-economic data: Population distribution, economic activities by island, tourism infrastructure, industrial facilities, community development plans
- Environmental baseline data: Marine ecosystems, coral reefs, fisheries, protected species, water quality data, coastal zone management plans
- Policy and regulatory framework: Bahamas National Energy Policy (2013-2033), environmental regulations, maritime laws, land use policies

The Consultant shall also consider planning interviews with relevant stakeholders for local knowledge sharing and restitute the conclusion of their interviews in the deliverable detailed below. A list of relevant stakeholders will be shared following the kick-off meeting and will include active and former consultants (Witteveen+Bos, etc.), local universities, SWRO operators in Naval Base/Eleuthera, etc. These interviews shall be carried out remotely during this phase with view of planning relevant physical meetings, onsite hearings and infrastructure visits (cf. task 1.2)

Deliverable 1.1:

Data Collection and Analysis Report documenting all collected information, data quality assessment, identified data gaps, meetings minutes with relevant stakeholders and preliminary observations relevant to site selection. The report shall include maps, tables, and figures synthesizing key information.

Task 1.2: Field Mission, Onsite Hearing and Data Collection

Following existing data collection, key stakeholders interviews and analysis, the Consultant shall conduct a **field mission to The Bahamas** to visit the pre-selected site of Naval Base and conduct stakeholder consultations and preliminary onsite data collection.

The field mission shall provide ground-truthing of desktop analysis findings and enable direct engagement with government authorities, local communities, and other stakeholders.

Field Mission Activities:

- Site visits: Physical inspection of the site including coastal areas, potential infrastructure locations, access routes, and surrounding land uses. Documentation through photographs, GPS coordinates, and field notes.
- Preliminary site surveys and data collection: Basic bathymetric verification (if feasible), visual assessment of marine conditions, observation of currents and wave patterns, identification of sensitive environmental features, data collection relevant for completion of phases 2, 3 and 4 (including potential upside of SWRO, SWAC and/or data center implementation).
- Stakeholder consultations: Meetings with government ministries and agencies (Prime Minister's Office, Ministry of Energy and Transport, Ministry of Environment and Housing, Bahamas Power & Light, Water and Sewerage Corporation, etc.), local government authorities, community leaders, civil society organizations, private sector actors (hotels, utilities, potential partners), and affected or interested communities.
- Infrastructure assessment: Site visits to one or two existing SWRO plants in Eleuthera, electrical substations, ports, and other relevant infrastructure that may integrate with OTEC development.
- Data validation: Verification and update (if reasonably feasible) of information collected during Task 1.1, identification of additional data sources, and clarification of regulatory requirements with competent authorities.
- Field mission final workshop: Facilitation of a stakeholder workshop to present findings, discuss evaluation and preliminary findings, gather feedback, and build consensus toward next steps.

Should the Consultant, in the course of the desktop review or site visit, identify any critical issue, whether technical (unfavorable seabed conditions, insufficient thermal gradient, pipeline routing constraints, etc.), legal (land tenure disputes, conflicting use rights, etc.) or environmental and social (proximity to sensitive habitats or protected areas, etc.), that would render the Naval Base site manifestly unviable for an OTEC installation, the Consultant shall notify Expertise France without delay.

Expertise France will then convene a steering meeting with the Consultant and the Bahamian counterpart to assess the situation and determine whether to redirect the remaining scope of Tasks 1.2 and 1.3 towards one or both of the alternative sites previously evaluated in the Witteveen+Bos (2023) prefeasibility study for the CCCCC, namely Lower Bogue and Cockburn Town. Any such redirection shall be formalized by written instruction from Expertise France and shall not affect the overall contractual timeline or budget without prior written agreement of both parties.

Deliverable 1.2:

- 1.2a. Field Mission Report including:
  - Documentation of site visits, stakeholder meetings, and field observations with photographic evidence and GPS data.
  - Stakeholder Consultation Report: Summary of consultations conducted, feedback received, key concerns identified, and stakeholder positions documented.
- 1.2b. PowerPoint presentation for the field mission final workshop.

Task 1.3: Site Characterization and Validation

On the basis of the desktop review, field mission findings and stakeholder engagement, the Consultant shall produce a reasoned opinion note either validating the Naval Base site for an OTEC installation or, should the evidence so warrant, recommending against its selection, with full justification in either case.

The reasoned opinion note shall be submitted to Expertise France and the Government of The Bahamas for validation and approval.

In case of favorable opinion, the note shall demonstrate that Naval Base site:

- Offers favorable technical conditions for OTEC development (thermal gradient availability, bathymetry, grid access)
- Presents manageable legal framework with feasible mitigation measures (preliminary assessment)
- Presents manageable environmental and social risks with feasible mitigation measures (preliminary assessment)
- Provides opportunities for multi-use applications (SWRO, SWAC, data centers) to enhance economic viability
- Benefits from government and community support
- Aligns with national energy and development priorities
- Presents a viable pathway for securing land tenure and regulatory approvals

In particular, the following criteria shall be considered (non-exhaustive list, the Consultant shall produce its own criteria list based on internal knowledge and experience):

Technical Criteria:

- Bathymetric conditions: Water depth profile, distance to 1,000-meter depth contour, seabed slope and geology
- Thermal gradient potential: Expected temperature difference based on oceanographic databases and proximity to documented cold water upwelling zones
- Accessibility: Proximity to shore (for onshore OTEC or marine pipeline installation), seafloor conditions for anchoring (for floating OTEC)

- Grid connection feasibility: Distance to existing electrical infrastructure, grid capacity and stability
- Synergies potential: Proximity to existing or planned SWRO facilities, cooling and electricity demand centers (hotels, data centers, industrial facilities)
- Infrastructure availability: Access to ports, construction staging areas, maintenance facilities

Legal Criteria:

- Property of affected project sites: current use of the land, ownership status, etc.
- Rights on sea use, potential restricted areas (military, fisheries, etc.)
- Potential compensation to third-party during project construction and operation (preliminary, based on observations during field visit)
- Path to land securing (preliminary, based on interview with relevant stakeholders of the government or local legal expert)

Environmental and Social Criteria:

- Environmental sensitivity: Presence of marine protected areas, coral reefs, critical habitats, endangered species
- Coastal zone conflicts: Overlap with fishing grounds, shipping lanes, tourism zones, aquaculture areas
- Community proximity: Distance to populated areas, potential impacts on livelihoods and traditional uses
- Cultural heritage: Presence of archaeological or culturally significant sites
- Natural hazard exposure: Hurricane risk, coastal erosion, sea level rise vulnerability

Economic and Institutional Criteria:

- Land tenure: Government ownership status, availability for project allocation
- Demand centers: Electricity and water demand magnitude, growth projections
- Development costs: Estimated capital expenditure based on site-specific conditions
- Economic multipliers: Potential for local employment, supply chain development
- Institutional support: Local government interest, community support, alignment with development plans

Deliverable 1.3:

The Service Provider shall produce a Site Characterization and Validation Report consolidating the outputs of Tasks 1.1 to 1.3. This report shall:

- Present a structured inventory of all data sources reviewed, with a critical assessment of their quality, relevance and limitations.
- Provide a comprehensive characterization of the Naval Base site against the technical, legal, environmental/social and economic/institutional criteria described above.
- Identify data gaps and their potential implications for subsequent study phases.

- Provide a clear, documented validation (or, if warranted, a reasoned qualification) of the Naval Base site as the selected location for an OTEC feasibility study, with explicit justification and technical rationale.
- Set out recommended priorities and parameters for the Phase 2 oceanographic measurement campaign, if deemed necessary.

4.1.4. Phase 2: Marine Resource Evaluation

Duration: 2 to 4 months

Task 2.1: Marine Resource Assessment Campaign

The purpose of Phase 2 is to confirm or supplement, through targeted oceanographic measurement, the marine thermal resource data available for the east coast of Eleuthera, to the extent strictly necessary to validate the site's viability for OTEC and to provide the data inputs required for the preliminary engineering design under Phase 3.

This phase is conditional and shall be activated by Expertise France only if the conclusions of Phase 1 identify specific, material data gaps in the available oceanographic dataset that cannot be resolved through existing data sources and that are deemed essential to validate site viability or to correctly execute the Phase 3 preliminary design. If existing data are assessed as sufficient, Phase 2 may not be activated, and Phases 3 and 4 shall proceed directly based on the Phase 1 conclusions[4].

The Service Provider shall note that substantial oceanographic data is already available for the Eleuthera area, in particular:

- NOAA sea glider temperature-depth profiles (2023), covering 0 to 900 m depth along the East coast of Central Eleuthera, which will be provided to all Tenderers as part of the procurement data package;
- The Witteveen+Bos (2023) OTEC prefeasibility study for The Bahamas (CCCCC), which contains oceanographic analysis relevant to the Eleuthera context.

As part of their technical offer, Tenderers shall propose a detailed scope of complementary oceanographic measurements, prepared on the following basis:

- (1) A critical review of the documentation provided in the annexes to these Terms of Reference (NOAA 2023 data, Witteveen+Bos study, Naval Base site data package);
- (2) The Tenderer's own research into publicly available or commercially purchasable oceanographic datasets for the Eleuthera area, including data held by international oceanographic institutions and agencies (e.g. NOAA, CMEMS/Copernicus, GEBCO, national hydrographic offices). Tenderers are expected to have conducted this research prior to submitting their offer and to demonstrate, in their technical offer, that all reasonably accessible existing data sources have been considered;
- A conservative assumption that no additional oceanographic data beyond those identified under (1) and (2) will be discovered or made available during the execution of Phase 1. The proposed measurement campaign shall therefore be designed to be self-sufficient in

[4] *See 1. Tender rules and 2. Service supply contract of tender package for more details about phases contractual activation.*

addressing identified data gaps, without reliance on data that may or may not emerge during the course of the study.

Tenderers shall therefore propose, price and justify a targeted measurement campaign that is strictly limited to addressing residual data gaps that cannot be resolved from existing sources, and that is proportionate to the study budget and operational constraints in The Bahamas.

Payment arrangements for Phase 2 shall be as follows, depending on the delivery model proposed by the Service Provider:

- Where the oceanographic measurement campaign is entirely subcontracted to a specialist local or international survey firm: payment shall be made on the basis of the subcontractor's invoices, up to the agreed contractual ceiling. The technical and financial offer of the proposed subcontractor must be included in full in the Tenderer's overall bid submission;
- Where the campaign is executed directly by the consortium's own project team but involves travel and accommodation costs, the charter of a vessel, the rental of measurement equipment or the procurement of any other specialized instrumentation: the logistics and vessel or equipment charter costs shall be reimbursed against presentation of original invoices, and the technical services component shall be remunerated as a lump sum. The technical and financial offer must clearly distinguish between (i) rechargeable costs (vessel charter, equipment rental, mobilisation) and (ii) internal project team costs (personnel and own equipment), with each component budgeted separately and transparently (cf. tender Financial Offer form).

In all cases, the amount attributed to Phase 2 under the contract shall be defined as a maximum contractual ceiling, which shall not be exceeded without prior written authorization from Expertise France. Payment shall be made in accordance with the terms and conditions set out in the Service Supply Contract (refer to the tender package for full contractual provisions).

For budget reasons, large-scale dedicated research vessels shall be excluded from proposed options. Proposed methodologies shall prioritize cost-efficient approaches utilizing locally chartered vessels with mobilized sensors. Applicable measurement types may include, but are not limited to:

- CTD (Conductivity, Temperature, Depth) casts to characterize the thermal profile at target depths;
- Supplementary bathymetric survey along the proposed cold water pipeline corridor, if existing data are insufficient for preliminary routing design;
- Deployment of a moored thermistor chain or similar sensor for short-duration time-series data collection, if seasonal variability cannot be adequately characterized from existing data.

The Tenderer shall further identify and discuss the limitations of the proposed methodology with respect to the reliability and representativeness of the data to be collected, **and shall provide, on an indicative basis, a brief description of the comprehensive marine resource assessment campaign that would ideally be conducted in the absence of budget constraints.**

The Service Provider shall detail the proposed measurement methodology in its technical offer, including the rationale for each measurement type, proposed instrumentation, mobilization plan, health and safety provisions, and quality assurance protocol.

If, and only if, the data adequacy assessment carried out in Phase 1 concludes that complementary measurements detailed in the Service Provider technical proposal are necessary, the Service Provider shall execute the targeted oceanographic campaign.

CRITICAL REQUIREMENT - Full Consultant Responsibility:

The selected Consultant shall be **entirely and exclusively responsible** for:

- Design and engineering of the oceanographic measurement system appropriate for the selected site conditions
- Procurement, installation, and commissioning of all equipment, sensors, moorings, vessels, and supporting infrastructure
- All logistical arrangements including vessel charter, equipment transportation, permits and authorizations, and insurance
- Operation and maintenance of the measurement system throughout the monitoring period
- Data collection, quality control, processing, and analysis
- Decommissioning and removal of all equipment at the conclusion of measurements
- Compliance with all safety, environmental, and regulatory requirements
- All costs associated with the above activities

Deliverables 2.1: Marine Resource Evaluation Report
The Service Provider shall produce a Marine Resource Evaluation Report comprising:

- A synthesis and critical assessment of all available oceanographic data;
- a full campaign report including methodology, raw data, processed results, and quality assurance documentation;
- A validated characterization of the thermal resource at the Naval Base site, including estimated OTEC gross power potential as a function of depth and flow rate assumptions;
- Confirmed bathymetric parameters for cold water pipeline preliminary design;

  A statement of data adequacy confirming that the resource characterization is sufficient for the purposes of the Phase 3 preliminary design.

4.1.5. Phase 3: Project Preliminary Design

Duration: 4 to 6 months

Task 3.1: Multi-Use Synergies Preliminary Assessment

Previous studies and concept notes (CCCCC/Witteveen+Bos, OESL) have demonstrated that OTEC electricity generation alone is unlikely to be economically competitive with conventional power sources in The Bahamas. However, multi-use applications leveraging OTEC by-products significantly improve economic viability. The Consultant shall conduct preliminary studies of synergistic applications that can be integrated with OTEC to optimize overall project economics.

The Consultant **may** evaluate the following synergy opportunities:

1. Data Center:

- Opportunity assessment: Potential for attracting data center development leveraging OTEC electricity (renewable, baseload) and cold seawater cooling

- Data center requirements: Power capacity (MW), cooling capacity, reliability, connectivity (submarine fiber optic cables[5])
- Cooling system preliminary design: Direct seawater cooling, indirect cooling via heat exchangers, hybrid cooling approaches, backup cooling systems
- Energy efficiency: Power Usage Effectiveness (PUE) targets, comparison with global data centers
- Preliminary market analysis: Caribbean data center market, competitive positioning, potential customers (cloud providers, content delivery, regional services), colocation vs. hyperscale models
- Enabling factors: Bahamas regulatory environment for data centers, tax incentives, data sovereignty considerations, disaster resilience (hurricane protection)

2. <u>Seawater Air Conditioning (SWAC) / District Cooling:</u>

- Cooling demand assessment: government or public facilities, hospitals within feasible distance of OTEC site
- Technical integration: Deep cold seawater distribution via insulated pipeline network, heat exchangers at customer buildings, return seawater or discharge
- Energy savings: reduction in conventional air conditioning electricity consumption, demand reduction impacts on grid
- System design: Preliminary SWAC network layout, pipeline sizing (supply and return), pump stations, customer substations, thermal energy meters
- Capacity sizing: Cooling capacity (MW thermal or Refrigeration Tons), number of buildings served, load profiles
- Successful precedents: Baha Mar district cooling system (20°C at c. 300m depth via boreholes), international SWAC projects (Hawaii, Tahiti, etc.)
- Customer agreements: Preliminary considerations in relation to off-take commitments, service level agreements, tariff structures

3. <u>Seawater Reverse Osmosis (SWRO) Integration:</u>

- Demand assessment: Freshwater demand at the selected site, existing SWRO capacity, projected demand growth, Water and Sewerage Corporation development plans
- Technical integration: Use of OTEC cold seawater for SWRO feed (pre-cooled, low biofouling), energy supply from OTEC for SWRO operation, co-location opportunities
- Capacity sizing: Optimal SWRO capacity to integrate with OTEC, modular expansion potential
- Technology selection: SWRO membrane technology, energy recovery devices, pre-treatment requirements (simplified due to cold seawater quality)
- Water quality: Produced water quality standards, blending requirements, distribution integration

5 BDSNi network in Bahamas

- Economic analysis: Capital costs, operating costs, water production costs (USD/m^3), revenue potential, comparison with conventional SWRO
- Institutional arrangements: Preliminary considerations in relation to project integration with Water and Sewerage Corporation, water off-take agreements, tariff structures

4. <u>Other Potential Synergies[6]:</u>

- Aquaculture: Cold, nutrient-rich deep seawater for fish farming (lobster, finfish)
- Mineral extraction: Lithium, uranium, and other minerals dissolved in seawater
- Hydrogen production: Electrolysis using OTEC electricity for green hydrogen (potential for maritime fuel)
- CO_2 absorption: Deep Ocean water for carbon capture/carbon market applications

The Consultant shall develop integrated scenarios combining multiple synergies and optimize overall system configuration:

- Scenario development: Multiple configurations (e.g. OTEC+SWRO, OTEC+SWAC, OTEC+SWRO+SWAC, OTEC+Data Center+SWAC, etc.)
- Resource allocation: Optimal distribution of electricity, cold seawater, and other resources among applications
- Infrastructure sharing: Shared components (cold water pipe, seawater intake/discharge, power systems) to reduce costs
- Phasing strategy: Optimal sequencing of development (e.g. OTEC+SWRO first, SWAC added later)
- Risk diversification: Multiple revenue streams reducing project risk

<u>Deliverable 3.1:</u>

Multi-Use Synergies Study Report presenting:
- Data center co-location preliminary assessment: Opportunity assessment, technical requirements, market analysis, enabling factors analysis
- Seawater Air Conditioning (SWAC) preliminary assessment: Cooling demand assessment, distribution network design, energy savings analysis, economic viability, customer agreements framework
- Seawater Reverse Osmosis (SWRO) preliminary assessment: Demand assessment, technical integration, capacity sizing, institutional arrangements, etc.
- Other synergies: High-level assessment of aquaculture, mineral extraction, hydrogen production, and other opportunities
- Integrated multi-use scenarios: Comparative analysis of alternative configurations, resource allocation optimization, infrastructure sharing opportunities, phasing strategies

[6] The Consultant shall prioritise SWRO, SWAC, and data center synergies as these offer the most significant near-term economic potential. Other synergies may be evaluated at a high level for future consideration.

- Technical recommendations: Optimal multi-use configuration for detailed financial analysis in a complementary feasibility analysis phase (excluded from the scope of work of this assignment)

Important note:
The assessment of multi-use synergies constitutes a secondary output of the pre-feasibility study scope defined in this document. The core objectives of the study remain the validation of a suitable site for a first OTEC installation in The Bahamas, the acquisition of a comprehensive oceanographic dataset for the selected site, and the achievement of stakeholder consensus on a preliminary OTEC system design. At this stage of project development, the key deliverables of Task 3.1 shall be (1) the identification and confirmation of potential synergistic applications envisaged on site, together with an estimation of their respective scale and demand profiles and (2) the definition of the optimal OTEC system sizing and configuration required to accommodate those applications.

Accordingly, the price submitted for Task 3.1 under Phase 3 shall not exceed €30,000 inclusive of all taxes.

Task 3.2: OTEC Technology Selection and Conceptual Design

Based on preliminary thermal gradient data and site characteristics, the Consultant shall develop conceptual engineering designs for OTEC systems suitable for deployment at the selected site. The design work shall evaluate technology options, determine optimal system configuration and capacity, and provide preliminary technical specifications for key components.

Technology Selection Analysis:

The Consultant shall evaluate and compare the following OTEC technology options:

- Closed-Cycle OTEC (CC-OTEC)
- Open-Cycle OTEC (OC-OTEC)
- Hybrid OTEC: Combining CC-OTEC for power generation with separate desalination unit.

The selection of the technology shall consider thermal gradient characteristics, multi-use objectives (electricity vs. electricity + SWAC), capital and operational costs, technical risk and maturity, local operation and maintenance capacity, and market availability of equipment and expertise.

Capacity Sizing:

The Consultant shall determine optimal OTEC plant capacity considering:

- Available thermal resources (based on measured temperature gradient and cold-water flow rates)
- Electricity demand at the selected site and potential for grid integration
- Freshwater demand if OC-OTEC or hybrid configuration selected
- SWAC (seawater air conditioning) demand from nearby facilities
- Data center cooling demand if co-location opportunity exists
- Economies of scale vs. resource constraints
- Phased development potential (initial capacity with expansion capability)

The Consultant may propose in its offer to evaluate **2 or 3 capacity scenarios** (e.g. 500 kW, 1 MW, 2+ MW) and recommend optimal size with justification.

Conceptual Engineering Design:

For the recommended OTEC configuration and capacity, the Consultant shall develop conceptual design including:

- Process flow diagram: Complete thermodynamic cycle with major equipment, piping, and instrumentation
- Heat exchanger specifications: Evaporator and condenser sizing, surface area, materials (titanium, aluminum, enhanced surfaces), biofouling control provisions
- Turbine-generator specifications: Type (axial, radial), capacity, efficiency, speed, cooling requirements
- Working fluid system: Ammonia inventory, storage, handling, and safety systems (for CC-OTEC)
- Seawater intake systems: Warm water intake (surface or near-surface) and cold-water intake (depth c. 1,000m) including flow rates, pipe diameters, materials, intake structures, screens
- Seawater discharge system: Mixed discharge or separate warm/cold discharges, diffuser design, environmental considerations
- Platform configuration: Land-based, nearshore, or floating platform including structural concept, mooring system (if floating), hurricane resistance
- Auxiliary systems: Pumps, valves, instrumentation and control, electrical systems, safety systems, cooling water for auxiliary equipment
- Performance projections: Gross power output, parasitic power consumption (pumps, auxiliaries), net power output, capacity factor, thermal efficiency, annual energy production

Infrastructure Requirements Identification:

In line with the work carried out for the site characterization phase, the Consultant shall identify infrastructure required to support OTEC operation:

- Cold water pipe (CWP): Material options (HDPE, steel, composite), diameter, wall thickness, length, installation methodology (bottom-resting, suspended, or floating), connection to platform, maintenance access
- Onshore facilities: Power conditioning equipment, switchgear, grid interconnection, control room, maintenance workshop, spare parts storage, access roads
- Marine facilities: Berthing for service vessels, equipment staging areas, navigation aids
- Construction logistics: Laydown areas, heavy-lift equipment access, transportation routes for large components (barge, heavy-haul trucking)

Supporting Infrastructure Preliminary Design:

If the construction of supporting infrastructures are deemed necessary for the implementation of the project, the Consultant shall develop preliminary designs for all infrastructure required to support OTEC

- Access infrastructure: Roads, causeways, bridges, parking areas
- Marine facilities: Berthing for construction and service vessels, barge landing, material offloading areas
- Utilities: Freshwater supply, sanitary systems, telecommunications, security and lighting
- Environmental protection: Spill containment, waste management, stormwater management, erosion control
- Safety systems: Fire protection, emergency response equipment, personnel safety systems, hurricane shelters (if personnel on site)

Deliverables 3.2:

OTEC and Supporting Infrastructure Conceptual Design Report presenting:

- Technology selection analysis and recommendation with comparative evaluation matrix
- Capacity sizing analysis with evaluation of multiple scenarios and recommendation
- Conceptual engineering design: process flow diagrams, equipment specifications, performance calculations, platform configuration drawings
- Cold water pipe design: sizing calculations, material selection, installation methodology
- Infrastructure requirements: layouts, preliminary dimensions, construction considerations
- High-level capital cost estimate based on conceptual design and the Service Provider ongoing OTEC projects (if applicable)
- Preliminary operations and maintenance requirements and cost estimates
- Technology risk assessment and mitigation strategies
- Comparison with international OTEC benchmarks (Hawaii NELHA, Kumejima, São Tomé, etc.)
- Recommendations for detailed engineering phase

4.1.6. Phase 4: Grid Connection Pre-feasibility Assessment

Duration: 2 months

Task 4.1: Grid Connection and Power Integration Studies

The Consultant shall conduct preliminary studies of grid connection requirements, interconnection feasibility, and power integration for the proposed OTEC facility. This task addresses the technical and regulatory requirements for connecting OTEC generation to The Bahamas electrical grid and evaluates impacts on grid stability and power quality.

Grid Characterization:

The Consultant shall characterize the electrical grid at the selected site including:

- Existing grid infrastructure: Nearest substations, transmission/distribution lines, voltage levels, available capacity
- Grid operator: Bahamas Power & Light (New Providence, Eleuthera, Abaco, other Family Islands) technical standards, interconnection procedures, grid codes
- Load characteristics: Demand profiles (hourly, daily, seasonal), peak demand, minimum demand, load growth projections
- Existing generation: Generation mix (diesel, solar, wind), installed capacity, typical dispatch patterns, reserve margins
- Grid stability: Frequency regulation capability, voltage regulation, power factor requirements, short-circuit capacity
- Power quality: Harmonics, flicker, voltage variations, acceptable limits per utility standards

OTEC Integration Analysis:

The Consultant shall analyze technical requirements and impacts of integrating OTEC baseload generation:

- Interconnection design: Voltage level (medium or high voltage), transformer requirements, switchgear and protection systems, connection point location
- Baseload contribution: Displacement of diesel generation, fuel savings, emissions reductions, capacity credit
- Grid stability impacts: Frequency response, voltage support, inertia contribution, reserve requirements, islanding capability
- Power quality: Harmonic analysis, flicker assessment, voltage regulation, power factor correction requirements
- Protection and control: Relay protection schemes, synchronization requirements, anti-islanding protection, SCADA integration, remote monitoring and control
- Grid code compliance: Conformity with Bahamas utility technical requirements and international standards (IEEE, IEC)

Deliverables 4.1:

Grid Connection and Power Integration Study Report presenting:

- Grid characterization: Infrastructure maps, technical specifications, operational characteristics
- Interconnection design: Single-line diagrams, equipment specifications, connection point, voltage level
- Integration analysis: OTEC contribution to grid, stability impacts, power quality assessment
- Protection and control schemes: Relay coordination, SCADA integration, operational procedures
- Interconnection cost estimates: Transmission line, transformer, switchgear, protection equipment, engineering and installation
- Grid code compliance certification strategy

4.1.7. Phase 5: Economic and Financial Analysis

Duration: 3 months

The objective of Phase 5 is to conduct comprehensive economic and financial analysis of the proposed OTEC project under alternative business models and financing structures. The analysis shall provide Government of The Bahamas and potential investors with robust financial projections to support informed investment decision-making.

Task 5.1: Capital and Operating Cost Calculation

The Consultant shall develop detailed capital expenditure (CAPEX) and operating expenditure (OPEX) estimates for the OTEC project based on the technical design(s) developed in phase 3.

Capital Expenditure (CAPEX) Breakdown:

The CAPEX estimate shall include all costs from project approval through commissioning. The Consultant will propose the relevant granularity/level of details for the CAPEX estimation based on the OTEC design(s). CAPEX calculation would typically include:

1. **OTEC Plant and Equipment:**
- Heat exchangers (evaporator and condenser): Procurement, shipping, insurance
- Turbine-generator package: Procurement, shipping, installation
- Seawater pumps (warm water intake, cold water intake, discharge): Equipment, motors, drives
- Working fluid system (for CC-OTEC): Ammonia or other working fluid, storage tanks, piping, safety systems
- Cold water pipe (CWP): Benchmarked price and/or Material costs (HDPE, steel, composite), fabrication, transportation to site
- Warm and cold-water intake structures: Screens, filters, civil works
- Discharge system: Piping, diffuser, outfall structure
- Platform or building structure: Structural steel or concrete, foundation, hurricane-resistant design
- Electrical equipment: Transformers, switchgear, protection relays, cables, backup power systems
- Instrumentation and control: SCADA system, sensors, control panels, communications
- Auxiliary systems: Cooling systems, compressed air, fire protection, potable water

2. **Synergistic Applications (if integrated / high-level CAPEX estimation and range):**
- SWRO plant
- SWAC/SDC distribution network
- Data center facilities

3. **Grid Connection Infrastructure:**
- Transmission/distribution line: Conductor, poles/towers, right-of-way
- Grid interconnection substation: Transformers, switchgear, protection equipment
- Metering and communications: Revenue meters, telemetry systems

4. **Marine and Civil Works:**
- Cold water pipe installation: Marine construction equipment, vessels, installation labour
- Platform installation (if floating): Mooring system, anchors, installation
- Site preparation and earthworks: Grading, excavation, fill
- Access roads and infrastructure: Roads, causeways, laydown areas
- Marine facilities: Berthing, material offloading facilities

5. **Engineering, Procurement, and Construction Management:**
- Detailed engineering design: FEED studies, final engineering drawings, specifications
- Project management: Owner's engineer, construction supervision, quality assurance
- Procurement services: Tendering, contract management, expediting, inspections
- Construction management: Site management, safety coordination, schedule control
- Commissioning and start-up: Performance testing, operator training, warranty management

6. **Development and Pre-Construction Costs:**
- Feasibility studies: Cost of this current study and any additional studies
- Environmental and social studies: ESIA and monitoring programs
- Legal and permitting: Legal fees, permit application fees, land/seabed lease costs
- Financial advisory: Financial modelling, due diligence, financing arrangement fees
- Land acquisition or lease: Purchase price or capitalised lease payments for project period

7. **Contingencies and Escalation:**
- Physical contingency: 10-15% of construction costs for unforeseen conditions, design changes
- Price escalation: Inflation allowance from estimate base date to construction mid-point
- Force majeure reserve: Hurricane damage contingency (given Bahamas exposure)

8. **Financing Costs During Construction (IDC):**
- Interest during construction: Interest on debt drawn during construction period
- Financing fees and charges: Loan commitment fees, legal fees, arrangement fees
- Working capital reserve: Initial operating funds

Operating Expenditure (OPEX) Breakdown:

The OPEX estimate shall include all costs for normal operation and maintenance over project lifetime. The Consultant will propose the relevant granularity/level of details for the OPEX estimation based on the OTEC design(s). OPEX calculation would typically include:

1. **Fixed Operating Costs:**
- Personnel: Salaries, benefits and trainings of operators, maintenance technicians, engineers, administrative staff, security
- Insurance: Property insurance, liability insurance, business interruption
- Land and seabed lease payments: Annual rent (if lease rather than ownership)
- Property taxes and licenses: Annual business licenses, regulatory fees
- Management and administration: Office costs, utilities, communications, supplies

2. **Variable Operating Costs:**
- Electricity consumption: Parasitic power for pumps, auxiliary equipment (if not self-supplied)

- Chemicals and consumables: Biofouling control chemicals (if used), working fluid makeup (ammonia), lubricants, spare parts inventory
- Water consumption: Potable water for facilities
- Waste disposal: Hazardous and non-hazardous waste management

3. **Maintenance Costs:**

- Routine maintenance: Preventive maintenance schedules, inspections, filter replacements, cleaning
- Periodic maintenance: Major equipment overhauls, heat exchanger tube cleaning, cold water pipe inspection and maintenance
- Corrective maintenance: Unscheduled repairs, equipment failures
- Spare parts: Critical spare parts inventory replenishment

4. **Environmental and Social Costs:**

- Environmental monitoring: Water quality, marine ecology
- Community programs: Community benefit sharing, grievance mechanism operation
- Environmental compliance: Reporting, audits, certification renewals

5. **Major Overhauls and Replacements:**

- Capital replacement schedule over 25-30 year project life: Heat exchanger refurbishment, turbine overhaul, pump replacements, instrumentation upgrades, cold water pipe repairs

6. **Synergistic Applications (if integrated / high-level OPEX estimation and range):**

- SWRO plant
- SWAC/SDC distribution network
- Data center facilities

Local vs. Imported Cost Components:

The estimate shall clearly distinguish:

- Imported components: OTEC equipment, specialised marine equipment, requiring international procurement and foreign currency
- Local components: Civil works, local labour, some construction materials, potentially available in Bahamas or Caribbean
- Foreign exchange exposure: Identification of USD/other currency exposure for risk management and financing planning

Cost Estimation Methodology:

The Consultant shall use a relevant methodology for cost estimation which may include (if relevant):

- Internal Consultant knowledge used for CAPEX and OPEX preliminary estimation in phase 3 deliverables
- Benchmark projects: Costs from OTEC demonstration projects (PLOTEC, Hawaii NELHA, Kumejima, São Tomé) adjusted for Bahamas context, capacity, and inflation
- Local cost data: Labor rates, construction costs, logistics costs specific to The Bahamas obtained from local contractors and suppliers

- Engineering estimates: Equipment and material quantities from technical design × unit costs from cost databases or recent projects
- Vendor quotations: For major equipment (heat exchangers, turbine-generator), assess latest budgetary quotations carried out for recent projects from qualified suppliers
- Contingency allowances: Applied per industry standards (AACE International) based on project definition level and risk

Deliverable 5.1:

Capital and Operating Cost Estimate Report presenting:

- CAPEX estimate: Detailed breakdown by major category and subcategory, unit quantities, unit costs, extended costs, total project CAPEX
- OPEX estimate: Annual operating costs by category (fixed, variable, maintenance, environmental), total annual OPEX, lifecycle cost projections
- Cost estimate basis: Methodology, data sources, quotations, benchmarks, assumptions, base date, currency
- Local content analysis: Percentage of costs procurable locally vs. imported, foreign exchange requirements
- Cost comparison: CAPEX and OPEX per kW capacity, comparison with international OTEC benchmarks
- Accuracy and contingency: Estimate accuracy level (+/- 20%), contingency allowances, risk factors
- Sensitivity factors: Key cost drivers, cost reduction opportunities, value engineering potential
- Cost estimate summary: One-page executive summary suitable for decision-makers

Task 5.2: Financial Modelling Under Alternative Business Models

The Consultant shall develop a detailed financial model for the OTEC project under two main business model scenarios: (1) Public Ownership and Operation by Government of The Bahamas, and (2) Public-Private Partnership (PPP) under Build-Own-Operate-Transfer (BOOT) structure with Power Purchase Agreement (PPA). The financial models should provide comprehensive cash flow projections, profitability metrics, and investment decision frameworks.

Scenario 1: Public Ownership Model

Under this scenario, the Government of The Bahamas (or a government entity such as Bahamas Power & Light or a new OTEC Corporation) finances, constructs, owns, and operates the OTEC project.

Financial Model Components:

- Financing structure: Government budget allocation, sovereign borrowing (bilateral, multilateral lenders such as AFD, EIB, etc.), concessional climate finance (Green Climate Fund, Climate Investment Funds), grants (EU, bilateral donors), blended finance combinations
- OTEC-related Revenue: Electricity sales to retail customers at Bahamas Power and Lights tariffs

- Multi-use-related Revenue: the model shall include ability to compute water sales to WSC or retail customers, SWAC sales to government facilities and commercial customers, data center revenues (if applicable)
- Costs: Debt service (principal and interest), OPEX as estimated in Task 3.1, depreciation (for accounting), taxes (minimal under government ownership)
- Cash flow projections: Annual cash flows over 25-30 year project life
- Economic indicators: Internal Rate of Return (IRR), Net Present Value (NPV) using social discount rate, Benefit-Cost Ratio, economic benefits (fuel savings, emissions reductions, energy security, water security, employment)
- Fiscal analysis: Government fiscal impact - revenues from project operation, cost savings from displaced diesel imports and fuel subsidies, tax revenues (if applicable), net fiscal benefit/cost to government budget
- Affordability analysis: Electricity and water tariffs under public ownership, comparison with current tariffs, consumer savings, affordability for low-income households, subsidy requirements (if any)
- Government obligations: Upfront equity contribution, guarantees or letters of credit for lenders, ongoing subsidies (if revenues are insufficient to cover costs), asset ownership and depreciation

Scenario 2: Public-Private Partnership (PPP) - BOOT Model

Under this scenario, a private developer (Special Purpose Vehicle) finances, constructs, owns, and operates the OTEC project for a concession period (typically 25-30 years), after which assets transfer to Government. Government commits to purchasing electricity/water through long-term off-take agreements.

Financial Model Components:

- Financing structure: Equity (20-40% of CAPEX from project sponsors/investors), Senior debt (60-80% of CAPEX from commercial banks, DFIs, export credit agencies), subordinated debt or mezzanine finance (if needed), construction financing then refinancing at operation
- Revenue: Power Purchase Agreement (PPA) payments from BPL or GBPC for electricity (capacity payments and energy payments), Water Purchase Agreement payments from WSC for desalinated water, SWAC contracts with commercial customers, data center colocation revenues
- Costs: Debt service (principal and interest on senior and subordinated debt), OPEX, corporate income tax (if applicable, typically 0% or reduced rate for renewable energy in Bahamas), insurance, reserve accounts (debt service reserve, maintenance reserve)
- Cash flow projections: during construction period (drawdowns), cash available for distribution, equity distributions (dividends to sponsors after debt service and reserves)
- Financial returns: DSCR (Debt Service Coverage Ratio, minimum 1.5x typically required by lenders for this kind of project), Project IRR, Equity IRR, NPV to equity, payback period
- Risk allocation: Construction risks (cost overruns, delays, performance, etc.), operational risks (availability, performance, penalties, etc.), revenue risks (demand, pricing, etc.), political risks (regulatory changes, etc.), force majeure (hurricanes, acts of God, etc.)

- Government obligations: PPA execution and payment commitment (bankable off-take agreement), Land and seabed rights transfer for concession period, Regulatory approvals and permits facilitation, Potential partial guarantees, minimum revenue guarantees, or viability gap funding, Political risk coverage
- Tariff determination: PPA tariff must be sufficient to (1) cover OPEX, service debt, provide acceptable equity returns, maintain required DSCR and reserve levels. Tariff structure could be made of two components (1) capacity charge (fixed, $/MW/month) and (2) energy charge (variable, $/MWh). Escalation mechanisms should be considered such as inflation indexation, fuel price pass-through (if applicable), foreign exchange adjustment

Sensitivity Analysis of Business Models:

The Consultant shall conduct comprehensive sensitivity and risk analysis to test robustness of financial projections under varying assumptions and develop a clear investment decision framework for Government of The Bahamas.

The Consultant shall test sensitivity of financial returns (IRR, NPV, DSCR) to variations in key parameters such as capital costs, operating costs, capacity factor of OTEC, electricity tariff, fresh water production and tariff, SWAC demand, construction schedule, financing terms, foreign exchange rates, etc.

Comparative Analysis of Business Models:

The Consultant shall compare the two scenarios across multiple dimensions:

- Financial viability assessing which scenario achieves better financial returns (EIRR for public, IRR for PPP)
- Fiscal impact: Net cost or benefit to government budget under each scenario
- Risk allocation: Which party bears which risks under each model, implications for government exposure
- Affordability: End-user tariffs under each scenario, consumer impact
- Implementation timeline: Speed of project development under each model
- Financing availability: Likelihood of securing required financing under current market conditions
- Regulatory barriers: Impact of IPP grid access prohibition on PPP scenario, reform requirements
- Development impact: Job creation, technology transfer, capacity building, local content
- Flexibility: Ability to expand or modify project over time
- Political economy: Alignment with government preferences and political context

Financial Model Specifications:

The financial models shall be developed in Microsoft Excel with:

- Transparent structure: Clear input sheets (assumptions), calculation sheets (annual cash flows), output sheets (summary results and charts)

- Flexibility: Ability to modify key assumptions including integration of multi-use application inputs (SWRO, SWAC, SDC, etc.) and instantly see impact on results
- Scenario analysis capability: Easy switching between scenarios and sensitivity cases
- Documentation: Cell comments explaining calculations, assumption basis, data sources
- Error checking: Formula audits, balance checks, logical consistency tests
- Professional presentation: Charts, graphs, dashboard summaries suitable for presentation to decision-makers and investors

Deliverable 5.2:

Financial Model and Business Case Report presenting:

- Public Ownership Scenario: Financing structure, revenue and cost projections, annual cash flows (25-30 years), IRR/NPV/BCR, fiscal impact analysis, electricity/water tariff implications, government obligations and risks
- PPP/BOOT Scenario: Financing structure (equity/debt split), PPA and other revenue contracts, annual project and equity cash flows, Project IRR and Equity IRR, DSCR profile, required PPA tariff, risk allocation matrix, government obligations and guarantees
- Sensitivity Analysis: impact on economic and financial metrics of the projects for both public ownership and PPP/BOOT models with presentation of base, worst and best case scenarios
- Comparative analysis: Side-by-side comparison of scenarios across financial, fiscal, risk, affordability, and implementation dimensions, strengths and weaknesses of each approach
- Recommendation: Preferred business model with clear justification based on analysis, conditions or reforms needed for recommended model success
- Financial model files: Excel models for both scenarios, fully functional and documented, suitable for Government and investor due diligence
- Investment decision framework: Clear criteria and process for Government to make go/no-go decision

4.2. Indicative Timeline of the Assignment

The following table summarizes the indicative timeline of the assignment:

Activity / Task	Duration	End Date
START-UP		
Kick-off Meeting (videoconference)	-	T0 (15 August 2026)
Inception Report (drafting + review)	2 weeks	T0 + 2 weeks (30 August 2026)
PHASE 1: SITE CHARACTERIZATION AND VALIDATION	**2 months**	**T0 + 2 months = T1 (15 Oct. 2026)**
Task 1.1: Data Collection and Analysis	1 month	T0 + 1 month
Task 1.2: Field Mission and Data Collection	5 days	T0 + 1.5 months
Task 1.3: Site Characterization and Validation	1 month	T0 + 2 months = T1
PHASE 2: MARINE RESOURCE EVALUATION	**2 to 4 months**	**T1 + 3 months = T2 (15 Jan. 2026)**
PHASE 3: PROJECT PRELIMINARY DESIGN	**4 to 6 months**	**T2 + 5 months = T3 (15 June 2027)**
Task 3.1: Multi-Use Synergies Preliminary Assessment	2 months	T2 + 2 months

Task 3.2: OTEC Selection and Conceptual Design	4 months	T2 + 5 months
PHASE 4: GRID CONNECTION PRE-FEASIBILITY ASSESSMENT*	**2 months**	**T2 + 5 months = T3 (15 June 2027)**
PHASE 5: ECONOMIC & FINANCIAL ANALYSIS	**3 months**	**T3 + 3 months (15 Sept. 2027)**
Task 5.1: Capital and Operating Cost Calculation	1 month	T3 + 1 month
Task 5.2: Financial Modelling Under Alternative Business Models	4 months	T3 + 3 months
FINAL DELIVERY		**T0 + 13 months (15 Sept. 2027)**

**It is expected that phase 4 can start in parallel of the OTEC conceptual design finalization.*

The Consultant will include an adjusted work schedule in its proposal. Especially, it is important to note that:

- The timeline presented above is indicative and may be challenged by the Consultant based on their experience on similar assignments and specificities of the selected site/oceanographic measurement campaign proposed
- Optimization of the time to deliver the expected reports will be appreciated

4.3. Summary of Anticipated Deliverables

Task	Deliverable	Expected Format
Kick-off meeting	Kick-off meeting minutes Report	Word + PDF
Start-up	Inception Report	Word + PDF
Task 1.1	Deliverable 1.1: Data Collection and Analysis Report	Word + PDF
Task 1.2	Deliverable 1.2a: Field Mission Report	Word + PDF
Task 1.2	Deliverable 1.2b: PowerPoint presentation	PPT
Task 1.3	Deliverable 1.3: Site Characterization and Validation Report	Word + PDF
Task 2.1	Deliverable 2.1: Marine Resource Evaluation Report	Word + PDF + Data files (NetCDF, CSV)
Task 3.1	Deliverable 3.1: Multi-Use Synergies Study Report	Word + PDF
Task 3.2	Deliverable 3.2: OTEC and Supporting Infrastructure Conceptual Design Report	Word + PDF + CAD drawings (if applicable)
Task 4.1	Deliverable 4.1: Grid Connection and Power Integration Study Report	Word + PDF + Software files
Task 5.1	Deliverable 5.1: Capital and Operating Costs Estimate Report	Word + PDF
Task 5.2	Deliverable 5.2a: Business Case Report	Word + PDF
Task 5.2	Deliverable 5.2b: Financial Model	Excel File
Transversal	Interim Report	Word + PDF
Transversal	Meeting Minutes	Word + PDF
All activities	Final Deliverable including Executive Summary of the study and Power Point for final workshop to the stakeholders	Word + PDF + PPT

All reports shall be submitted in draft version for review by Expertise France and the relevant stakeholders, with final version due two weeks after receipt of comments.
The deliverables and supporting information (eg. Questionnaire, surveys) must be sent in a digital format and independently on the agreed delivery date. The Consultant shall provide all deliverables in accordance with the agreed schedule.

Please note:

- Validation of deliverables cannot be prejudged by the Consultant: it necessarily takes the form of a written approval (e-mail) by the Euroclima project officer when the deliverables are deemed satisfactory.
- Both the Euroclima team, in consultation with the national technical focal point, and the contractor will do their best to ensure that the deliverables are validated as quickly as possible.
- Electronic copies shall be prepared in editable format (Word, Excel, CAD) and non-editable PDF format.
- GIS data shall be shared in standard formats (Shapefile, GeoJSON, or similar)
- Raw oceanographic data shall be shared in standard formats (NetCDF, CSV with metadata)

4.4. Coordination and contacts

Focal Point Designation and Kick-off Meeting

The Service Provider shall designate a single contact person for project implementation purposes.

The Euroclima National Focal Point shall be copied in key coordination emails, and shall be kept informed by the service provider of progress made and difficulties encountered, as necessary. The Euroclima National Focal Point for this assignment is Anthony DICANOT, Euroclima Caribbean Project Officer (email: anthony.dicanot@expertisefrance.fr).

Anne-Laure DUBILLY, Euroclima Caribbean Programme coordinator, will be copied in all exchanges (email: anne-laure.dubilly@expertisefrance.fr).

A kick-off meeting shall be held at the latest 15 days after the contract award has been notified (see section 4.1.1. The meeting will gather relevant representatives of the Government of The Bahamas, Expertise France and its designated experts and the Consultant consortium (including subcontractors if any).

Close collaboration must take place with all relevant stakeholders from assignment preparation right up to completion. Furthermore, regular exchanges must take place on assignment progress and any difficulties that may be encountered.

Any change of contacts will be notified by the relevant party to the others.

Obligation to Report Project Viability Issues

The Consultant shall immediately notify Expertise France, in writing and within ten (10) calendar days of any findings, circumstances, or developments emerging during the study that materially call into question the viability of the proposed OTEC project. Such circumstances include but are not limited to critical environmental or social impacts that cannot be adequately mitigated; technical barriers (including inadequate thermal gradient, site-specific engineering constraints, or insurmountable infrastructure challenges); prohibitive financial costs or unviable economic returns under all assessed scenarios; or insurmountable legal or regulatory barriers that prevent project authorization or operation.

Upon receiving such notification, Expertise France, in coordination with the Government of The Bahamas and relevant project partners, shall conduct its own independent assessment of the reported

issue(s) and their implications for project viability. Following this assessment, Expertise France reserves the right to request modifications to the study scope, including but not limited to evaluation of alternative sites, adjustment of project configuration or capacity, reassessment of business models, or re-prioritisation of study activities. Any such scope modifications shall be subject to mutual agreement between Expertise France and the Consultant, and may result in adjustments to the study timeline, deliverables, and budget as appropriate.

The Consultant shall continue with the originally agreed scope of work until written confirmation of scope modifications is received from Expertise France. This provision is intended to enable adaptive management of the feasibility study and avoid unnecessary expenditure of resources on demonstrably non-viable project configurations.

5. PLACE, DURATION AND TERMS OF PERFORMANCE

Place of the assignment: the works will be conducted at the Consultant office, Nassau and Eleuthera island in The Bahamas in accordance with the activities detailed in the present document. The service provider is expected to provide detailed planning for field missions as part of the technical proposal, including number, purpose and duration.

Implementation period: 15 August 2026 to 15 September 2027

Effective duration of the assignment: 13 months

The Service Provider will provide a detailed workplan in its technical proposal, based on the provisional program. Any changes made to the provisional program shall be properly justified.

6. REQUIRED EXPERTISE AND PROFILE

6.1. Consortium Structure and Team Composition

The Consultant shall provide a multidisciplinary team of experts with the required skills and experience to successfully conduct this complex feasibility study. Given the specialized and multifaceted nature of OTEC development encompassing marine renewable energy technology, oceanographic measurements, legal, environmental and social preliminary considerations, the Consultant is expected to combine specialized expertise in all relevant domains.

If the Consultant is composed of different entities (consortium), the consortium structure may comprise:

Lead Consultant (Consortium Leader):

- The Lead Consultant shall demonstrate strong technical expertise in marine renewable energy with specific focus on Ocean Thermal Energy Conversion (OTEC) technology and proven competence in addressing Small Island Developing States (SIDS) energy challenges.

- The Lead Consultant is responsible for overall project management, coordination of all consortium members, quality assurance, stakeholder liaison, etc.
- The Lead Consultant shall provide, at minimum, the following key personnel:

1. **Project Manager (senior profile):** Overall responsibility for study execution, team coordination, client relationship management, deliverable quality control, and strategic guidance. Minimum 15 years of experience in managing complex energy infrastructure feasibility studies, with demonstrated experience in island contexts and/or developing countries.
2. **Administrative Support:** Logistics coordination, visa arrangements, travel planning, meeting organisation, document management, and administrative follow-up.

Specialised Co-Contractors:

Unless the Lead Consultant has internal expertise in the relevant domains, the Lead Consultant is encouraged to engage the following specialised expertise, each bringing domain-specific expertise:

1. **Lead Technical Engineer (OTEC specialist):** Responsible for Activity 2 (Technical Studies) coordination and technical content across all activities. Minimum 10 years of experience in OTEC or related ocean energy technologies, with hands-on experience in feasibility studies and conceptual design.
2. **Technical Support Team:** At least two middle and/or junior engineers supporting the Lead Technical Engineer in technical analyses, modeling, design work, and report preparation.
3. **Oceanographic Measurement Specialist** (if expertise is not encompassed within previously listed personnel): at least one specialist of oceanographic measurement campaigns and data analyst specialized for OTEC deployment.
4. **Financial and Economic Specialist** (if expertise is not encompassed within previously listed personnel): at least one specialist of financial and economic analysis with strong background in OTEC budgeting and/or power project/infrastructure business modelling.
5. **Legal and Regulatory Specialist** (if expertise is not encompassed within previously listed personnel): at least one specialist of local law and regulations with expertise in Infrastructure projects development in the Bahamas preferably in Eleuthera and/or in the energy sector.
6. **Environmental and Social Impact Assessment (ESIA) Specialist** (if expertise is not encompassed within previously listed personnel): at least one specialist of environmental and social considerations for this kind of project with experience in the Caribbean and/or in marine projects.

Local stakeholder(s):

The Consultant shall consider local specialist(s) implication with preferably knowledge about infrastructure project implementation in the Bahamas. Especially, the following institutions have in-depth knowledge of the project initiative, local context of Eleuthera island and historical background[7]:

- University of Bahamas (top priority)
- Bahamas Technical and Vocational Institute
- Cape Eleuthera Institute
- UNESCO (Inter Governmental Hydrological Program)

[7] *These institutions were identified by Witteveen+Bos during the study carried out in 2023.*

6.2. Coordination and Integration Across Disciplines

Given the interdisciplinary nature of this assignment, effective coordination among consortium members is critical. The following provisions apply:

Focal Point:

The Project Manager previously designated shall be responsible for the good coordination of the assignment.

Cross-Disciplinary Working Group:

A multidisciplinary working group comprising the senior focal points of the Lead Consultant and co-contractors shall be established for:

- Site selection process (Phase 1)
- Monthly progress monitoring meetings: Regular participation (see Section 7) to ensure alignment across activities, identify interdependencies, resolve technical issues, and maintain study coherence.

The Lead Consultant is responsible for facilitating this working group, ensuring information flow among sub-contractors, and synthesizing inputs into coherent, integrated study outputs.

All team members must have a good command of written and spoken English, as all deliverables, presentations, stakeholder consultations, and communications shall be conducted in English.

6.3. Required Qualifications and Submission Requirements

Qualifications:

- Bidders shall demonstrate relevant corporate experience and references for similar OTEC, ocean energy, or complex island energy infrastructure feasibility studies.
- Team members shall possess relevant academic qualifications (minimum bachelor's degree in engineering, environmental science, law, economics, or related fields; advanced degrees preferred for senior positions) and professional certifications as applicable.
- Experience in island contexts, developing countries, and projects funded by international donors (AFD, EU, World Bank, bilateral agencies) will be positively appreciated.

Gender Balance:

A gender balance in the composition of the team will be positively appreciated. Bidders are encouraged to include women in senior expert and leadership positions within the consortium.

Additional Profiles:

Bidders are strongly encouraged to include additional specialized expert profiles beyond the suggested composition to strengthen the team's technical capabilities. In particular, Data center and/or SWAC (Seawater Air Conditioning) specialist(s) are recommended for the implementation of task 3.1 (Multi-

Use Synergies Assessment), given the importance of these synergistic applications to overall project economic viability.

Quality Control and Consistency:

Provisions ensuring high-performance quality control and consistency across all study activities and deliverables will be positively assessed. Bidders shall describe their internal quality assurance processes, peer review mechanisms, and coordination protocols in the technical proposal.

Submission Requirements:

In complement to the documents required in the *Tender Rules* document, the technical proposal shall include:

- Detailed team composition: Organisational chart showing Lead Consultant, all sub-contractors, and key personnel with roles and responsibilities clearly defined.
- CVs of all team members: Including academic qualifications, professional experience, relevant project references, and language proficiency.
- Time allocation: Person-days of intervention for each team member by activity/task, demonstrating appropriate level of effort.
- Sub-contractor pricing: Detailed breakdown of costs for each sub-contractor in accordance with the Financial Offer template provided in annex (Excel format).

Team Stability Requirement:

The Consultant must adhere to the team composition as specified in the accepted proposal and may not make any changes to key personnel without prior written approval from Expertise France. Any proposed substitution must be justified, and the replacement personnel must possess equivalent or superior qualifications and experience.

7. MONITORING AND REPORTING

To ensure effective oversight, coordination, and timely identification of issues throughout the study execution, the Lead Consultant shall organize and facilitate monthly progress monitoring meetings with all relevant stakeholders, commencing from the kick-off meeting and continuing through final deliverable submission.

Meeting Participants:

Monthly meetings shall include:

- Lead Consultant: Project Manager and relevant technical staff
- Senior expert focal points from all co-contractors
- Expertise France: Project management team
- Government of The Bahamas: Designated representatives from Prime Minister's Office and relevant ministries/agencies
- Other stakeholders as appropriate based on agenda topics

Meeting Objectives:

Monthly meetings serve to:

- Review progress on all activities and tasks relative to the approved work plan and schedule
- Present preliminary findings, technical analyses, and draft deliverables for discussion and feedback
- Identify technical challenges, risks, or deviations from expected results (including any issues affecting project viability)
- Coordinate across disciplines and resolve interdependencies among activities
- Plan upcoming field missions, stakeholder consultations, or data collection campaigns
- Align on deliverable review timelines and comment incorporation processes
- Ensure quality and consistency across consortium outputs (if applicable)

Meeting Organization:

The Lead Consultant is responsible for:

- Scheduling: Proposing meeting dates with adequate advance notice (minimum 2 weeks), accommodating participant availability, and confirming attendance
- Agenda preparation: Distributing a detailed agenda at least 5 working days prior to each meeting, highlighting key discussion topics and decisions required
- Presentation materials: Preparing clear, concise presentations summarising progress, findings, and issues for discussion
- Meeting facilitation: Chairing the meeting in a structured, time-efficient manner, ensuring all participants have opportunity to contribute
- Action item tracking: Maintaining a log of action items, responsible parties, and deadlines arising from meetings

Meeting Minutes:

The Lead Consultant shall produce comprehensive minutes of each monthly meeting documenting:

- Participants present
- Key discussion points and decisions made
- Action items with assigned responsibilities and deadlines
- Any risks, issues, or concerns raised and proposed mitigation measures
- Agreements on next steps and upcoming milestones

Meeting minutes shall be shared with all participants within 7 calendar days following each meeting. Participants may provide comments or corrections within 5 working days, after which the minutes shall be considered final.

Meeting Format:

Meetings may be conducted in-person (when feasible, particularly during field mission periods) or via videoconference, at the discretion of Expertise France based on meeting content and efficiency considerations.

Interim Report:

Beyond monthly meetings, the Consultant shall provide Interim progress reports composed of brief written progress updates (3 pages maximum) submitted at mid-point of each major activity, highlighting achievements, challenges, and upcoming work.

8. PRACTICAL INFORMATION

1. Language of assignment: English
2. All travels shall be borne by the service provider and be included as part of the financial proposal. Experts remain solely responsible for organizing their own travel, accommodation, transport, insurance, communication and internet costs.
3. The Government of The Bahamas will arrange the following during field missions: meeting room and internet while at the Government building.
4. The Government of The Bahamas shall facilitate meetings with the stakeholders when deemed appropriate.
5. The Government of The Bahamas shall assist with necessary documentation for entry and work in The Bahamas.
6. During the implementation of the assignment, the visibility of the European Union as donor of the Euroclima Programme must be ensured, in accordance with the Euroclima Programme's rules on communication and visibility, which take into account the European Union's requirements for communication and visibility: https://international-partnerships.ec.europa.eu/knowledge-hub/communicating-and-raising-eu-visibility-guidance-external-actions_en. All reports and deliverables must include the emblem of the European Union (with the words "Financed by the European Union"), the logos of the Euroclima Programme and Expertise France, as well as the following "standard" disclaimer: “This publication has been produced with the financial support of the European Union. The contents are the sole responsibility of <name of author/partner> and do not necessarily reflect the views of the European Union"
7. The financial offer and all costs associated with the assignment shall be presented in Euro.