Technical Assistance Closure Report Template

Objective of the technical assistance (TA) Closure Report:

- To communicate publicly in one document a summary of progress made and lessons learned during the TA towards the anticipated impact (sections 1-4).
- To document qualitative and quantitative data collected during TA, for use in donor and UN reporting (Annex 1).

Steps for completing the TA closure report:

1. The lead TA implementer submits the closure report at the end of the technical assistance as a final deliverable. The TA closure report will capture outputs, outcomes and impacts of all activities conducted under the TA. Please copy and summarise relevant material from previous TA outputs/deliverables and the Response Plan, as relevant.
2. A CTCN Manager will review and revise the closure report before final approval by the CTCN Deputy Director.

Important note on public and internal use of the closure report:
Once approved by the CTCN Deputy Director, the TA closure report will be a public document available on the CTCN website www.ctc-n.org. Selected content will be used for targeted communication activities. Annex 2 is for internal use only and will not be publicly available.

Closure Report for CTCN Technical Assistance

1. Basic information

Title of response plan	**The Bahamas power system stability study for the implementation of a higher renewable energy penetration level**
Technical assistance reference number	**2017000019**
Country / countries	**The Bahamas**
NDE organisation	**Ministry of Environment and Natural Resources**
NDE focal point	**Ms. Rochelle Newbold**
NDE contact information	**rochellenewbold@bahamas.gov.bs**
Proponent focal point and organisation	Ms. Rhianna Neely, Ministry of the Environment and Housing, rneelybest@gmail.com
Designer of the response plan	*CTCN*
Implementer(s) of technical assistance	*Energynautics GmbH, Germany* *Graphite Engineering Ltd, The Bahamas (Subcontractor)* *Tabrizi Consulting, Denmark (Subcontractor)*
Beneficiaries	*Bahamas Power and Light Company Limited (BPL), Government Owned Utility Company*
Sector(s) addressed	*Renewable energy*
Technologies supported	*Grid integration for renewables, Solar PV, Batteries*
Implementation start date	*(25/09/2019)*
Implementation end date	*(13/06/2023)*

Total budget for implementation	*USD 369,715*
Description of delivered outputs and products as well as the activities undertaken to achieve them. In doing so, review the log frame of the original response plan and refer to it as appropriate	*The implementers, UNIDO and BPL have worked closely to finalize:* • *Activity 1 - Data collection and analysis for Exuma and Eleuthera. The last deliverable in this activity has been submitted by the PEE in June 2023, shipping the analysis of the latest retrieved data.* • *Activity 2 - Determine critical scenarios for stability study Exuma and Eleuthera. The last deliverable in this activity has been submitted by the implementer in April 2023.* • *Activity 3 - Dynamic model development for Exuma and Eleuthera. The last deliverable in this activity has been submitted by the implementer in June 2023, providing the final model and documentation.* • *Activity 4 - Dynamic Stability Analysis for Exuma and Eleuthera. The last deliverable in this activity has been submitted by the implementer in June 2023, concluding the stability analysis and corresponding result reports.* • *Activity 5 – Monitoring of the Readiness Proposal. The last deliverable in this activity has been submitted by the implementer in July 2023.* • *Activity 6 - The distribution grid study of the SSRG in New Providence. The last deliverable in this activity has been submitted by the implementer in November 2022.* *Key deliverables are:* • *the dynamic simulation models for New Providence (delivered by the PEE in November 2022) and for Eleuthera and Exuma (delivered in June 2023),* • *the stability studies conducted for New Providence (report delivered in November 2022) and for Eleuthera and Exuma (report delivered in June 2023).*
Methodologies applied to produce outputs and products	*Methods applied include:* • *Data questionnaires* • *Power system dynamic modelling and simulation study* • *Distribution feeder hosting capacity analysis* • *Measurement campaign* • *Gender study*
Reference to knowledge resources	*None*

Deviations	*There were several delays in the project implementation due to multiple reasons, including the Covid-19 pandemic, periods with lack of communication from BPL, modelling issues in the dynamic simulation software, and unforeseen challenges in executing the measurement campaign. This impacted the timing and quality of the outputs, so that the last deliverables could be shipped only in June 2023 instead of in 2022 already.* *Due to the same issues the scope of the project was changed in 2022 by contract amendment to no longer encompass stability studies on all 15 inhabited islands but only on New Providence, Eleuthera, and Exuma. A distribution study (Activity 6) was incorporated to compensate for this.*
Anticipated follow-up activities and next steps	*There are no planned follow-up activities by the implementer. Planned follow-up activities by the beneficiary have not been communicated to the implementer.*

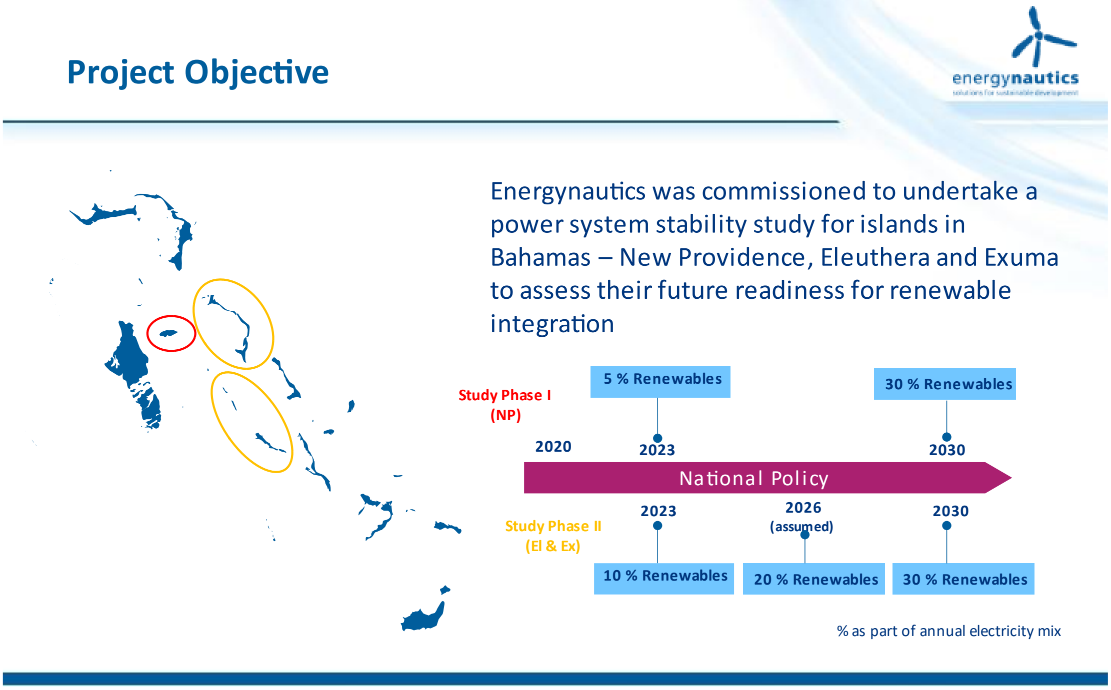
2. Lessons learned

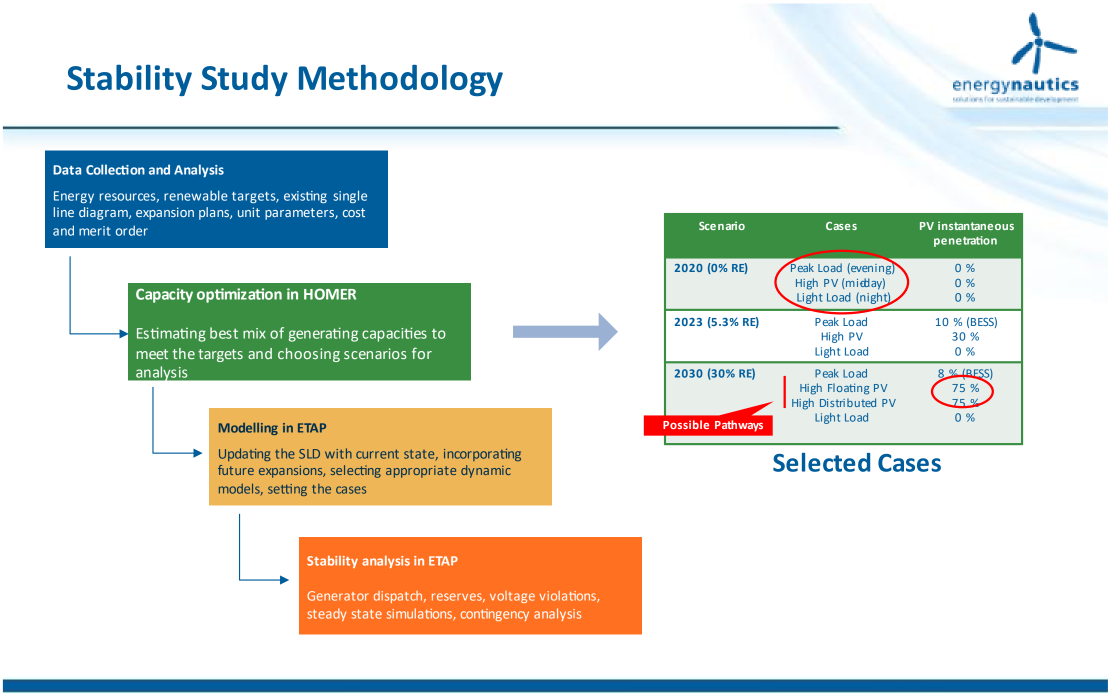
	Lessons learned	**Recommendations**
Lessons learned from the CTCN TA process	*The failure of the measurement campaign is a combination of multiple mistakes: The required effort was estimated too low, people already familiar with the devices were not available to work on the project, preparation of the devices for the conditions on The Bahamas was insufficient, the installation process was error-prone, pre-installation testing was limited, there were no clear go/no-go criteria for issues encountered.* *Availability of satisfactory data for setting up, configuring and validating the needed dynamic models and the respective power system should be assessed before the modelling and simulation work is commissioned.*	*Recommended practice to avoid the mistakes made in the context of the measurement campaign is to incorporate corresponding risk mitigation for these mistakes in the project planning.* *In order to improve the usefulness of the study results for the utility, a stronger collaboration with the latter in preparing the input data and assumptions than could be achieved in this project is recommended. Processes should be established to ensure that this close collaboration is sustained.* *The project plan, in particular the risk management and mitigation plans, should consider the possibility that data of adequate quality for the purpose of the study (and its various sub-studies) cannot be obtained during the duration of the project at all. There should be a corresponding decision deadline early in the project – on the one hand, BPL needs time to collect and provide data, but if the PEE waits too long for BPL to provide the data, it is too late to launch a new data collection effort through the PEE itself.*

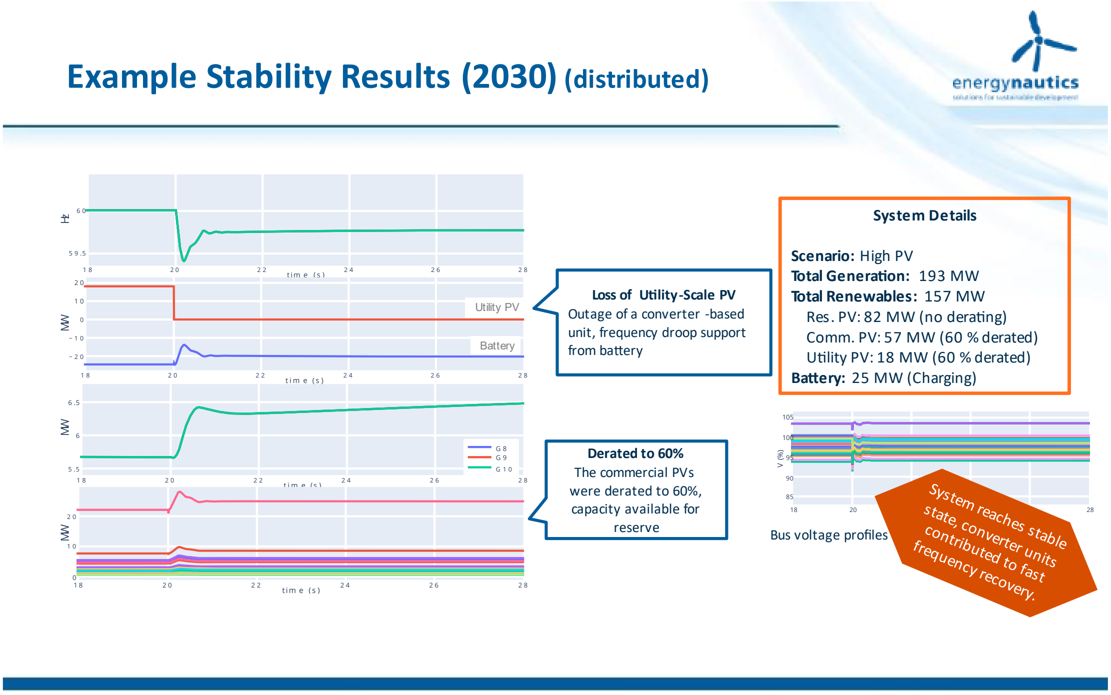
		When embarking on a modelling and simulation exercise in a software environment with which the team has only limited experience, sufficient time and resources must be planned for discovering the limitations of the software and developing solutions.
Lessons learned related to climate technology transfer	*The following describes one of the challenges involved with performing a power system stability study: With each dynamic model being configurable through an extensive parameter set, and incomplete knowledge about the characteristics of generation units not yet existing in the system, it can be hard to distinguish issues caused by an asset in the grid from issues caused by the misconfiguration of its corresponding model. Only the former would be relevant to report as a power system issue where technical countermeasures are needed; the latter can often simply be corrected by changing the model parameters or some other model implementation detail. Detailed knowledge and understanding of each dynamic simulation model is required to be able to make the distinction between the two cases.*	*If a centralized PV integration strategy is favoured over a more distributed strategy with several utility-scale and commercial PV plants and significant residential PV, then multiple connection points should be used in order to avoid the introduction of single points of failure into the system.* *With rising shares of PV on the islands, installation of at least one BESS plant on each island is likely to become advisable.* *The technical connection requirements for new RE generation facilities should follow the state of the art of 'grid-friendly' capabilities available on the market. All new RE generation facilities should be able to ride through disturbances, adjust their power output to counterbalance frequency excursions (at least reduce their power output during overfrequency events), and should be able to respond automatically to temporary generation limits communicated by the system operator. Non-residential PV units should also be able to provide voltage support during undervoltage and overvoltage events.*

3. Illustration of the TA and photos

The following slides illustrate the objective, methodology and results of the stability study.







The following pictures illustrate the impact of the TA:

Figure 1: View from a substation in Exuma, illustration solar PV potential on a sunny day

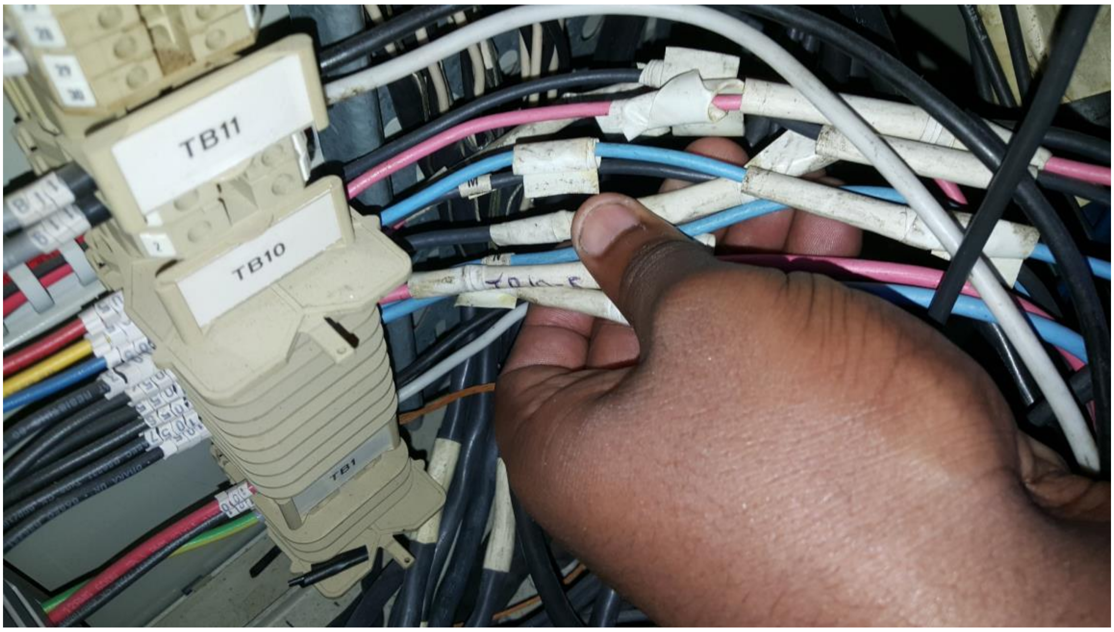


Figure 2: Cabling work in a substation

Figure 3: Engine in a generator station

Figure 4: Small islands with good potential for solar PV application

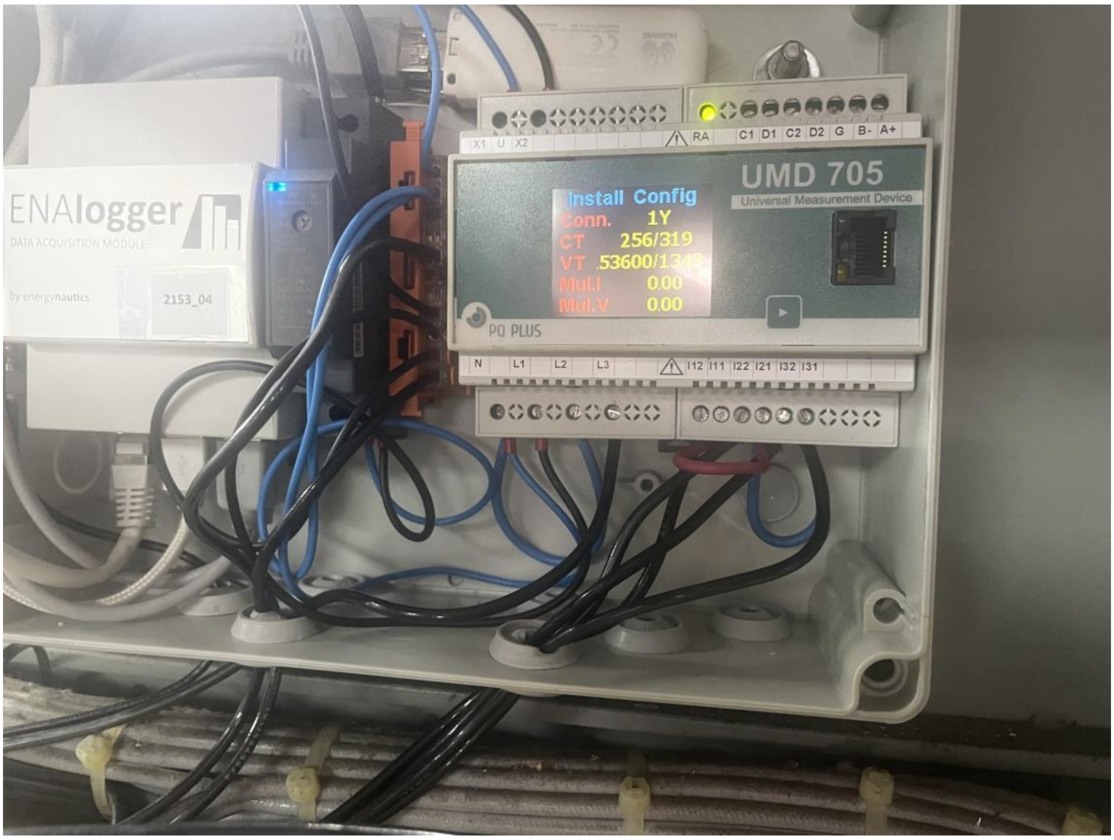


Figure 5: Measurement device installed to record support data for the study

4. Impact Statement

Challenge	*The Bahamas has committed to achieve a minimum of 30% renewables in its energy mix by 2030 and will allow for a 10% Residential Energy Self Generation Programme but faces challenges in increasing the penetration of renewable energy (RE) systems. The addition of significant amounts of renewable energy will require upgrades to the electric grid, and a reliable electricity network with adequate distribution capacity is vital, with an adequate network infrastructure and grid stability.*
CTCN Assistance	*Enhance capacity to transition to renewable energy and energy efficiency:* - *Provide a better understanding of the achievable levels of renewable energy integration* - *Develop capacity to conduct grid stability assessment* - *Develop a comprehensive methodology for the grid stability assessment* - *Provide technological options for grid stability and renewable energy integration*
Anticipated impact	- *Increased energy security* - *Improved system reliability and power quality* - *Energy sustainability and efficiency* *The medium-term impact is an increase in the supply side by accommodating a high penetration of renewable energy (mainly solar PV) that will reduce greenhouse gas emissions, enabling the Bahamas to meet its Nationally Determined Contribution of a minimum reduction of 30% by 2030.*
Co-benefits: Achieved or anticipated co-benefits from the TA	*In the future reduced costs for electricity in comparison to continued reliance on increasingly expensive fossil fuels*

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Gender aspects of the TA	*A gender study has been carried out to support this TA. It was found that the distributed solar PV approach in The Bahamas would likely require additional efforts in terms of enabling more women to engage in the energy production compared to the floating solar model. The areas in which gender mainstreaming were considered particularly relevant include policy and planning, institutional capacity, economic empowerment and monitoring & evaluation.*
Anticipated contribution to NDC	*The project has found that achieving 30% renewables in the electricity mix would be unlikely to cause stability issues assuming the necessary steps are taken:* - *Installation of the necessary amounts of solar PV should be supported by at least one battery storage facility on each island.* - *The installed PV generation and BESS should meet state-of-the-art connection requirements.*

The narrative story	*The vulnerability of the Bahamas to the impacts of climate change is well known given its geographical characteristics (location in the subtropical zone, limited land mass, low relief and dispersion of islands) and resulting environmental vulnerabilities (high temperatures, storm surges, sea level rise, flooding, tropical cyclones, etc.), its heavy dependence on tourism as a revenue source, and the limited human and institutional capacity.* *The Bahamas are therefore aiming to decrease their reliance on carbon-intensive fossil fuels and to enhance their capacity to transition to renewable energy and energy efficiency. The technical assistance highlights that the achievable levels of renewable energy integration are strongly dependent on the implementation strategy of the transition. Locations of new (renewables-based) electricity generation and storage facilities should be chosen with the constraints and opportunities of the existing grid infrastructure in mind, and construction of the new facilities must be accompanied by upgrading, extending, and modernizing the necessary grid equipment. The assistance has contributed tools and models to perform the supporting grid stability assessments and provided corresponding documentation and training.*
Contribution to SDGs A complete list of SDGs and their targets is available here: https://sustainabledevelopment.un.org/partnership/register/	*This TA advances the following SDGs:* - *SDG7 – Affordable and clean energy: In the last years solar PV has become one of the cheapest sources of electricity. By highlighting the integration options of solar PV technology and analyzing their characteristics the Bahamas are better equipped to transition to renewable energies, which thus contributes to achieving affordable access to increasingly clean energy in the future.* - *SDG13 – Climate action: Reducing the carbon dioxide emissions of the electricity generation on the Bahamas contributes to the global efforts toward the same goal.*

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Annex 1 Technical assistance data collection

A. Output and outcome indicators

Indicator Please note indicators below highlighted as **anticipated**	**Quantitative value** *Numerals only; disaggregates must sum to the total*	**Qualitative description** *List the various elements corresponding to the quantitative value as well as timelines and responsible institutions*
Total number of events organized by proponents and implementing partners		
Number of participants in events organized by proponents and implementing partners		
a) Number of men		
b) Number of women		
Number of climate technology RD&D related events		
Number of participants in climate technology RD&D events		
a) Number of men		
b) Number of women		
Number of training organized by proponents and implementing partners	**1**	
Number of participants in trainings organized by proponents and implementing partners	**2**	
a) Number of men	**2**	
b) Number of women	**0**	
Total number of institutions trained		
a) Governmental (national or subnational)		
b) Private sector (bank, corporation, etc.)		
c) Nongovernmental (NGO, University, etc.)	**1**	*BPL*
Percentage of participants reporting satisfaction with CTCN training (from CTCN training feedback form)		*Satisfied= 4+ on 5-pt scale (no feedback forms received)*
Percentage of participants reporting increased knowledge, capacity and/or understanding as a result of CTCN training (from CTCN training feedback form)		*Increased knowledge, capacity and/or understanding= 4+ on 5-pt scale (no feedback forms received)*
a) Percentage of men		
b) Percentage of women		
Total number of deliverables produced during the assistance (excluding mission, progress and internal reports)	*16*	
a) Number of communication materials, including news releases, newsletters, articles, presentations, social media postings, etc.		

b) Number of tools and technical documents strengthened, revised or developed	**16**	• *D1.a Manual on the installation of the measurement devices* • *D1.b Inventory of the power systems in Exuma and Eleuthera* • *D1.c Report comprising the analysis of the measured data for Exuma and Eleuthera* • *D2.ai Study of the system and its operational challenges - New Providence* • *D2.aii Study of the system and its operational challenges - Eleuthera and Exuma* • *D2.b Gender baseline study* • *D3.a Updated dynamic model of New Providence's grids for the year 2030 in ETAP* • *D3.b Dynamic models of Exuma and Eleuthera's grids for the year 2030 in ETAP* • *D3.c Operations manual for the models* • *D3.d Demonstration and training on the simulation models* • *D4.a Upgraded simulation model in ETAP for New Providence* • *D4.b Upgraded simulation models in ETAP for Exuma and Eleuthera* • *D4.c Report on the methodology for grid stability assessment of New Providence* • *D4.d Report on the methodology for grid stability assessment of Exuma and Eleuthera* • *D4.e Recommendations of technological options for grid stability and RE integration* • *D6.a Report on the distribution system analysis for SSRG generation*
c) Number of other information materials strengthened, revised or created (For example training and workshop reports, Power Points, exercise docs etc.)		
Total number of policies, strategies, plans, laws, agreements or regulations supported by the assistance		
a) Adaptation related		
b) Mitigation related		
c) Both adaptation- and mitigation related		

Anticipated number of policies, strategies, plans, laws, agreements or regulations proposed, adopted or implemented as a result of the TA		
a) Adaptation related		
b) Mitigation related		
c) Both adaptation- and mitigation related		
Anticipated number of technologies transferred or deployed as a result of CTCN support	*3*	*Grid integration for renewables, Solar PV, Batteries*
Anticipated number of collaborations facilitated or enabled as a result of technical assistance		
a) Number of South-South collaborations		
b) Number of RD&D collaborations		
c) Number of private sector collaborations		
Number of countries with strengthened National System of Innovation as a result of CTCN support	**1**	*The Bahamas*
Insert any additional indicators here		

B. Core impact indicators

Please fill in the tables for anticipated impacts of the CTCN assistance. Every technical assistance should contribute to at least one of the indicators below. For guidance on how to report on core indicators see the '[M&E Guidance Document for TA Implementers](#)'.

Core indicator 1	**Anticipated metric tons of CO_2 equivalent (CO_2e) emissions reduced or avoided as a result of CTCN TA** *Please add your calculations in word or excel format as an Annex to this Closure Report, where applicable.*	
	Anticipated metric tons of CO_2e reduced or avoided as a result of the TA **on annual basis**	Anticipated metric tons of CO_2e reduced or avoided as a result of the TA **in total**
Quantitative value *(emissions reductions)*	*Total number (numerals only, no rounding or abbreviations)*	*Total number (numerals only, no rounding or abbreviations)*
Unit	tCO_2e	tCO_2e
GHG assessment boundary (project emissions) Identify expected post-TA activities, associated effects and assess boundary for quantification of GHG emission reductions		

Baseline emissions Describe baseline scenario, baseline candidates, emission factors and emissions calculated		
Methodology Explain the method or process of verifying the indicator and how data was gathered		
Assumptions Describe assumptions made during calculation and quantification of GHG reductions		

Core indicator 2	**Anticipated increased economic, health, well-being, infrastructure and built environment, and ecosystems resilience to climate change impacts as a result of technical assistance** *Please provide a* ***qualitative*** *description of the anticipated impacts on the categories below*
Infrastructure and built environment Anticipated increased infrastructure resilience (avoided/mitigated climate induced damages and strengthened physical assets)	In particular the addition of (battery) energy storage to the power systems has potential to support infrastructure resilience to climate impacts, as energy storage can significantly contribute to power system stability and restoration after black-outs.
Ecosystems and biodiversity Anticipated increased ecosystem resilience (areas with increased resistance to climate-induced disturbances and with improved recovery rates)	Ecosystems and biodiversity both benefit from the reduced emission of pollutants achieved through (at least partially) replacing fossil fuels by renewable and sustainable energy sources.
Economic Anticipated increased economic resilience (e.g. less reliance on vulnerable economic sectors or diversification of livelihood)	Increasing adoption of renewable energy based electricity generation will reduce the reliance on imported fossil fuels, which are expected to become increasingly expensive – they must become more expensive because otherwise the required decarbonization of the energy sector will not happen. Reduced reliance on imported fuels therefore contributes to affordability of energy access and makes electricity prices less vulnerable to potential fuel supply shortages and the resulting price peaks.
Health and wellbeing Anticipated increased health and wellbeing of target group (e.g. improved basic health, water and food security)	Basic health, water and food security all depend on reliable energy supply, and therefore benefit from reliable and affordable clean energy. Reducing emissions of pollutants from burning fossil fuels also has health benefits through better air quality.

Core indicator 3	Anticipated number of direct and indirect beneficiaries as a result of the TA	
	Quantitative value	**Means of verification**
Total beneficiaries	*Total number*	
Number of adaptation beneficiaries		*Describe calculation methods and assumptions made*
Number of mitigation beneficiaries		*Describe calculation methods and assumptions made*
Number of adaptation-and mitigation beneficiaries		*Describe calculation methods and assumptions made*

Core indicator 4	Anticipated amount of funding/investment leveraged (USD) as a result of TA (disaggregated by public, private, national, and international sources, as well as between anticipated/confirmed funding)			
	Quantitative value confirmed *in USD*	**Quantitative value anticipated** *in USD*	**Qualitative description** *List the institutions, timelines, and description or title of the investment*	**Methods** *Describe methods used for quantification of funds leveraged*
Total funding	*Total number in USD (numerals only, no rounding or abbreviations)*	*Total number in USD (numerals only, no rounding or abbreviations)*		
Anticipated amount of public funding mobilised from national/domestic sources				
Anticipated amount of public funding mobilised from international/ regional sources				
Anticipated amount of private funding mobilised from national/domestic sources				
Anticipated amount of private funds mobilised from international/regional sources				

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Annex 2 (for internal use – to be filled in by the CTCN)

CTCN evaluation
This section will be completed by the relevant CTCN Technology Manager.

- Evaluation of the timeliness of the TA implementation as measured against the timeline included in the response plan;
- Evaluation of TA quality as defined in the response plan;
- Overall performance of the Implementers;
- Overall engagement of the NDE and Proponent;
- Lessons learned on the CTCN process and steps taken by the CTCN to improve.