NON-TECHNICAL SUMMARY

Environmental and Social Impact Assessment for the Renewstable Barbados Hybrid Solar Power Plant with Hydrogen Storage

PDD No. 1735/10/2021D

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1.0 INTRODUCTION

Renewstable (Barbados) Inc. (RSB), a project company owned by Rubis Caribbean and HDF Energy, is proposing to construct and operate a baseload hybrid solar photovoltaic (PV) energy facility with battery and hydrogen storage at Harrow Plantation in the Parish of Saint Philip, Barbados (the Project). The Project will deliver non-intermittent, carbon-free, and renewable electrical power to the national grid and will also accommodate large-scale Blackbelly sheep farming facility within the solar power plant and surrounding green areas. The Project will generate approximately 56,000 megawatt-hours per year of solar power with hydrogen storage, thereby providing non-intermittent renewable power to the equivalent of approximately 16,000 residents annually (based on an average electricity consumption of 3,480 kilowatt-hours per person per year). The electricity generated by the Project will be purchased by Barbados Light & Power Company at an agreed rate through a power purchase agreement for 25 years following the commissioning of the power plant.

With the release of the Barbados National Energy Policy 2019–2030 (Government of Barbados 2019a), the Government of Barbados officially announced its intention for the island to achieve 100% renewable energy and carbon neutral transformational goals by 2030. As a baseload clean asset, the Project will contribute towards Barbados achieving its renewable energy and carbon neutrality targets.

2.0 DESCRIPTION OF PROJECT

The energy facility components of the Project will consist of a solar PV power plant and associated battery and hydrogen energy storage systems. These components will be controlled and optimized via an integrated Energy Management System. The Project will convert sunlight into electricity via the solar PV power plant. A capped and consistent level of output from the power plant will be directed to the national power grid, while the remainder will be used to split water molecules into hydrogen and oxygen via an electrolyser system. The resultant hydrogen will be stored as compressed gas. Fuel cells will then be used to produce electricity whenever needed from the stored hydrogen gas, thereby enabling the delivery of stable power to the national grid. The power plant will occupy a plot totalling 73.6 ha; approximately 59.1 ha of that area will be comprised of an array of 96,154 solar panels, equipped with PV cells, which will be ground-mounted in a fixed-tilt, south-oriented configuration. This configuration has been selected because it is well adapted for sheep grazing beneath the solar arrays and is efficient for energy generation while limiting land use requirements.

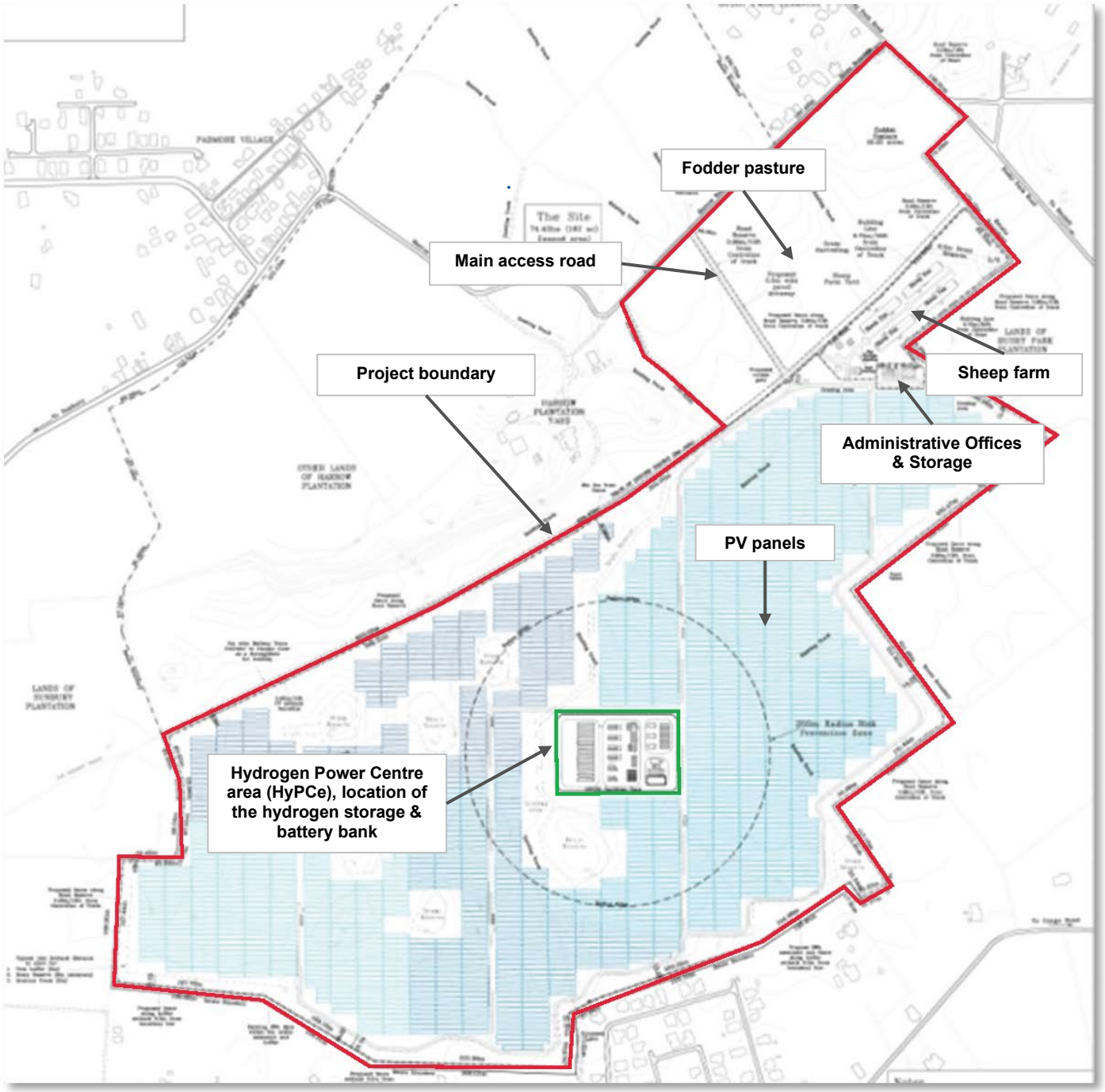

Figure 1. Site Plan - Renewstable Barbados

Where other solar PV approaches provide intermittent power with little or no storage, the Project offers a baseload solution that combines solar power with hydrogen and lithium battery technologies.

The Project will be designed to accommodate at least 1,830 Blackbelly sheep. On-site agricultural facilities will include sheep pens, a barn for hay storage, a feed silo, water storage tanks, a designated waste skip area on a concrete pad, and a farm building/staff facility, all of which will occupy a total area of approximately 2.3 ha. The sheep will be allowed to graze between and beneath the solar panels of the power plant within a solar grazing area that is approximately 57.4 ha in size. Another area of land – approximately 10 ha – shall be dedicated to agricultural activities: grazing and/or fodder pasture.

3.0 DESCRIPTION OF ENVIRONMENT

The Project will be located at Harrow Plantation which is situated on the south-eastern end of Barbados. Generally, the site for development is gently sloping from the East to the West. It is located within the Coral Region of Barbados which is characterized by a shallow topsoil followed by limestone rock of significant depth. Soils at the surface are made up primarily of the Saint Philip Plain Association soils (over 900mm in thickness) and with some soils from the Grey Brown Association (less than 450mm in thickness). These soils are mostly clay in nature and have a slow to moderate permeability. The limestone rock layer below these soils is approximately 30-55 m in depth. Groundwater beneath the site flows at the interface between the limestone layer and the underlying Oceanics layer (i.e., streamwater) in a southern direction. Lands to the north of the Project Site have higher elevations than lands at the Project site while lands to the south are at lower elevations. As a result, runoff flows from the north to the Project Site. Additionally, the site forms a rainwater catchment where runoff is generated when rain falls.

A baseline noise assessment found existing pre-construction ambient noise levels at most locations to be below the World Health Organisation (WHO) Guideline threshold for outdoor residential areas. Where ambient sound levels slightly exceeded WHO Guidelines, higher readings were due to constant vehicular traffic from a nearby main road and wind passing through nearby sugar cane. A baseline ecological assessment was also conducted and defined three main habitat types within the site: cleared agricultural land, grassy areas, and sugarcane fields. The species of flora and fauna found in the site are common in Barbados and are not considered rare or endangered.

Land at Harrow Plantation has traditionally been rural in character and dominated by agricultural use. The site is situated on agricultural land that is currently used for sugarcane farming augmented by rotational crops, with the immediate and expanded surroundings predominantly residential and agricultural in use. The Harrow Plantation Yard is located immediately adjacent to the site while a small community is located adjacent and north of the proposed sheep grazing area, and a larger community is situated along much of the southern boundary.

4.0 IMPACT ASSESSMENT METHODOLOGY

This ESIA addresses the environmental and social effects by firstly identifying Valued Components (VCs) of the physical and social environments that have the potential to be impacted by the Project and that are of value or interest because they have been identified to be of concern by regulatory agencies, the Developer, resource managers, scientists, key stakeholders, and/or the general public. These VCs were selected, their scopes defined and the rationale for their selection explained in Section 6.2 of the main ESIA. Spatial and temporal boundaries were defined and provided a meaningful and manageable focus for the assessment as they defined the areas within and the time periods during which the VCs are likely to interact with the project.

The interactions between Project activities and the VCs were thereafter identified, and potential environmental and social impacts assessed for each VC during every phase (pre-construction, construction, and operation phases) of the Project (with impact pathway described for each impact). Environmental impacts were analysed based on scientific knowledge, assessment tools such as quantitative modelling (where needed), and professional judgement. Technically and economically feasible mitigation measures were, thereafter, recommended to eliminate, reduce, or control adverse environmental impacts, to address public concerns, and to optimize beneficial effects.

5.0 SUMMARY OF ENVIRONMENTAL IMPACTS AND MITIGATION

5.1 Atmospheric and Acoustic Environment

Potential Impacts: Adverse changes in air quality, greenhouse gas emissions and in the acoustic environment are possible during the construction, operations and maintenance, and decommissioning phases. These are mostly due to emissions and noise from the use of vehicles, machinery and equipment during all project phases (concentrated during construction), ground-disturbing activities during construction and decommissioning, and noise emissions from the electrical components and the 1,830 sheep that will be reared at the Blackbelly sheep farm during operations. Conversely, a positive change in air quality and greenhouse gas emissions is also possible during the operations and maintenance phase, due to the generation of power from two non-polluting and carbon-free sources – the sun and hydrogen.

Mitigation: A full list of mitigation measures can be found in Section 8.2.2. Recommendations include the appropriate selection, maintenance, inspection and outfitting (with sound attenuation devices) of project vehicles, heavy equipment, and machinery; the scheduling of activities between 7:00 and 17:00 on weekdays and 8:00 and 14:00 on Saturdays, with no work on Sundays; and acoustical barriers or walled enclosures near loud sources during construction, if feasible. Tree screens/enclosures around site boundaries, road watering, speed limits on site and the paving/revegetation of cleared areas are also recommended to control dust emissions.

Residual Impacts: The residual impacts of the Project on air quality, greenhouse gas emissions and the acoustic environment are predicted to be insignificant.

5.2 Surface water and groundwater resources

Potential Impacts: Adverse changes in surface water and groundwater quantity/quality are possible during the construction, operations and maintenance, and decommissioning phases of the Project.

Mitigation: A full list of mitigation measures can be found in Section 8.3.2. Recommendations include the maintenance of existing drainage systems within the Project Site, where possible; planting and maintenance of grassed surfaces; the design of a drainage system that includes catchment basins, drainpipes and suckwells, drains from roadways and paved areas within the Project Site to limit stormflows from the site; a proposed 9-m wide drainage reserve along the southern boundary; a vegetated buffer strip at the downstream site boundary; silt screens/hay bales/boulder barrier where necessary to prevent erosion and retain topsoil and; the routine inspection of septic tanks and soakaways.

Residual Impacts: The residual environmental impacts of the Project on surface water and groundwater resources are predicted to be insignificant.

5.3 Flora and fauna

Potential Impacts: Adverse changes in flora and fauna habitat, flora health/survival, and fauna habitat quantity/quality/use and mortality risk are possible during the construction, operations and maintenance, and decommissioning phases of the Project.

Mitigation: A full list of mitigation measures can be found in Section 8.4.2 of the ESIA document. Recommendations include the clearing of the areas required for construction only; revegetation of cleared areas, where possible; the use of vegetation screens to reduce sensory disturbance to fauna; limited use of artificial lighting; the use of native plants for landscaping and the secure storage, frequent removal and proper disposal of wastes in an environmentally acceptable manner.

Residual Impacts: The residual impacts of routine Project activities on flora and fauna (i.e., residual Project-related changes in flora / flora habitat; flora health / survival; fauna habitat quantity / quality / use; and fauna mortality risk) are predicted to be insignificant.

5.4 Visual environment

Potential Impacts: Adverse changes in visual landscape/aesthetics and lighting conditions are possible during the construction, operation and maintenance, and decommissioning phases of the Project. An adverse project-related change in reflection conditions – glint and glare – is also possible during the operation and maintenance phase of the Project.

A Project-specific Visual Impact Assessment and Glint and Glare Study were conducted and can be found in appendices G and H of the ESIA report, respectively. For the Glint and Glare Study, glare modelling software – Solar Glare Hazard Analysis Tool (SGHAT) – was used to estimate glare at eleven observation points and four route receptors (i.e., public roadways). Five different panel configurations were modelled and detailed results, as well as methodology and recommendations, are provided in the Study.

Mitigation: A full list of mitigation measures can be found in Section 8.5.2 of the main ESIA. Recommendations include the planting of thick vegetation/tree screens in areas where visual impacts are to be expected; limited use of artificial lighting; the use of specific solar panels to minimize solar glare and an adaptive management approach if complaints regarding glint and glare are received from local residents or surrounding land users. This adaptive management approach includes the establishment of additional or taller vegetation/tree screens and/or additional opaque privacy screens to further shield or obscure offending panels so that they cannot be seen.

Residual Impacts: The residual environmental impacts of the Project on the visual environment (i.e., residual Project-related adverse changes in visual landscape / aesthetics, reflection conditions (i.e., glint and glare), and lighting conditions) are predicted to be insignificant.

5.5 Agriculture and other land uses

Potential Impacts: Adverse changes in the quantity/quality of agricultural land and in other (non-agricultural) land use are possible during the construction, operation and maintenance, and decommissioning phases of the Project.

Mitigation: A full list of mitigation measures can be found in Section 8.6.2 of the ESIA. Recommendations include sediment, dust control, and noise management strategies to reduce potential sensory/nuisance

impacts to nearby land users, residents, businesses, and other off-site receptors; timing project activities to avoid undue nuisance to off-site receptors, and the use of thick vegetation/tree screens.

Residual Impacts: The residual impacts of the Project on agriculture and other land uses (i.e., a residual Project-related adverse change in the quantity / quality of agricultural land, a residual Project-related positive change in the quantity / quality of agricultural land, and a residual Project-related changes in other [non-agricultural] land use) are predicted to be insignificant.

5.6 Accidents, Malfunctions, Emergencies & Disasters

Potential project-related accidents, malfunctions, emergencies, and disasters include:

- During the construction phase, spills or leaks of petroleum products, hydraulic fluids, lubricants, or coolants
- During project operation and maintenance, spills or leaks of petroleum products, hydraulic fluids, lubricants, coolants, or the potassium hydroxide (KOH) solution; release of flammable vapours from battery modules within the battery energy storage system (BESS); and release of hydrogen gas (H_2) from the hydrogen energy storage system (HESS)
- During the decommissioning phase, spills or leaks of petroleum products, hydraulic fluids, lubricants, or coolants

Potential Impacts: An accident, malfunction, emergency, or disaster resulting in the release of hazardous materials to the environment could result in the contamination of soil and/or water resources, and adverse changes to the quality and use of terrestrial habitat within the project development area. The loss of containment (LOC) of hydrogen from the hydrogen energy storage system (hydrogen fuel tanks) during the operations and maintenance phase of the development could result in the potential for fires or explosions if the gas is ignited. Flammable vapours could also be realised from battery modules used for storing energy

A Project-specific Quantitative Risk Assessment (QRA) was conducted to examine the potential consequences in the event of an accidental release of flammable vapours from the BESS or an accidental LOC of hydrogen gas from the HESS during the operation and maintenance phase of the Project. The full QRA report, including detailed methods and results, is provided in Appendix D of the ESIA report.

Mitigation: A full list of mitigation measures related to the storage, handling, use, and end-of-life disposal/recycling of hazardous materials and for spill prevention, control and response can be found in Table 3.3 (Section 3.7.2) of the ESIA. Additional detail on KOH spill mitigation and emergency response can be found in the attached ESIA Addendum dated 28 October 2022.

With respect to hydrogen and battery energy storage systems, it is recommended that:

1. Systems are centralised within the development at greatest distance from the nearest receptors.
2. The batteries be individually sealed and separated, and cells be capable of withstanding temperatures up to 50^{o}C.
3. Fire detection systems and a ventilation system be installed to enable the safe evacuation of gases.
4. Hydrogen fuel cells and related equipment be housed in containerised enclosures that are constantly ventilated, and all equipment be monitored using hydrogen detectors and ventilation switch detectors.

The Developer proposes that the BESS and HESS, as well as related utilities and auxiliary systems, be centralized and contained within a secured and fenced hydrogen power centre (HyPCe) area that will be located near the middle of the Project development area (PDA). The HyPCe area will be specifically designed to mitigate the risks associated with the energy storage equipment (Section 3.2.1.2 of the main ESIA report), for the protection of Project personnel and the surrounding community. This includes the design of the BESS and HESS in accordance with applicable international standards, and a setback radius of more than 200 m between the HyPCe area fenceline and the PDA site boundary

Residual Impacts: The residual adverse impacts of a potential accidental spill or leak of petroleum products, hydraulic fluids, lubricants, KOH solution, or transformer oil on VC specific criteria could be significant for the Surface Water and Groundwater Resources VC and the Agriculture and Other Land Uses VC but are predicted to be not significant for the remaining biophysical/ecological and anthropogenic VCs.

5.7 Climate Change

Potential Impacts: The Project is susceptible to potential adverse impacts associated with climate-related and other natural hazards, such as tropical storms and hurricanes, droughts and floods, earthquakes, volcanic eruptions, tsunamis, and wildfires. Potential sea level rise, however, is not anticipated to adversely affect the Project over its lifetime.

Mitigation: The potential impacts of climate and natural disasters on the Project will be considered and incorporated into the planning and design of Project components and the scheduling of Project activities. This includes the construction of resilient ground-mounted solar PV systems, the incorporation of safety features in the design of BESS and HESS in the event of climate-related or other disaster, water reuse and rainwater harvesting to minimize the effect of drought, and the establishment of drainage reserves for runoff management in the event of flood conditions.

Residual Impacts: With application of the design considerations and proposed mitigation, climate change and natural disasters are not anticipated to result in substantial delays to the Project schedule, damage to Project components, or disruption to Project activities that could compromise the long-term technical or economic viability of the Project.

6.0 SUMMARY OF SOCIAL IMPACTS AND MITIGATION MEASURES

6.1 Construction Phase

Potential Impacts: Positive impacts associated with the Project during the construction phase include the creation of up to 150 construction-related jobs over two years; capacity-building and skills development for local workers; increased technological capacity of local businesses; support for local suppliers in the construction and renewable energy sectors; increased retail business, primarily food related from construction workers; and business for accommodation and car rental companies.

Potential negative impacts associated with the construction phase of the Project include noise and vibrations from construction vehicles and equipment; impaired air quality from dust and other emissions from construction vehicles and equipment; reduced visual amenity due to construction activity; damage to roads from construction vehicles and equipment; health and safety risks to on-site workers communities and the general public; an influx of temporary workers which may affect social dynamics; perceptions of

inequitable labour conditions; delays to construction if any archaeological and cultural heritage features are found within the PDA, and accidental spill or leak.

6.2 Operational Phase

Potential Impacts

Positive impacts associated with the Project during the operational phase include the generation of clean, renewable energy; employment at the energy facility and sheep farm; and improvement in national agricultural productive capacity.

Potential negative impacts associated with the operational phase of the Project include the reduced visual amenity due to the presence of Project components and perceived negative aesthetic impacts; potential health and safety impacts on workers and adjacent communities in the event of an accident, from the inappropriate use of machinery or from the improper handling of chemicals or flammable substances; decreased water pressure due to Project-related water usage; odours from the sheep farm; a change in property values, and accidents (non-routine) events from hazardous products.

Mitigation Measures

Positive Impacts: To enhance employment benefits of the Project, it is recommended that the hiring process be transparent and designed so that eligible locals can apply for and have a fair chance of acquiring work at the Project and that consideration be given to employment opportunities being made available to some of the unemployed residents of neighbouring areas.

Negative Impacts: It is recommended that concerns about the potential change to the aesthetics of the area be addressed through a carefully planned and implemented public awareness campaign to address the typical concerns raised about the construction of solar facilities on the scale of the Project.

To reduce negative impacts on neighbouring residents, it is recommended that action be taken to reduce and mitigate potentially adverse effects from the construction of the Project. It is also recommended that the Project be compliant with the legal and statutory labour requirements, to safeguard community and worker safety and health. Construction should therefore be based on an approved construction management plan that includes measures to reduce the impacts of noise, dust, vibration, wastes, and traffic. Operational health and safety plans should be developed and approved, detailing appropriate operating procedures and safety provisions based on the type of machinery and materials being used, and contractors should be required to operate in compliance with these plans. In addition, contractors should be required to provide gender sensitization training to address critical on-the-job issues and facilitate positive interactions between workers and the surrounding residents.

It is further recommended that provisions be made to ensure safety at the Project areas; these include 24-hour security at access points; appropriate lighting; clearly visible signage; open and unobstructed passageways; safe storage of hazardous products; and the development of an emergency and disaster management plan.

Public service announcements should be provided so that commercial operators, residents, and the public are updated on and given appropriate advance notice of the construction activities, especially those, such as construction activities planned outside of typical work hours.

7.0 Cumulative Impact Assessment (CIA) and Mitigation

The CIA identifies other past, present, and likely (i.e., certain or reasonably foreseeable) future developments surrounding the Project site whose residual environmental impacts could interact

cumulatively with the residual environmental impacts of the Project and assesses the significance of those potential cumulative impacts on the physical and social environments.

Eleven developments in the area surrounding the project were identified; of these, the status of seven are undetermined while the remaining four have been approved. The main potential cumulative impacts could arise from the interactions between the residual impacts of the Project and the residual impacts of the other developments around the Project site within the atmospheric and acoustic environment, surface water and groundwater resources, flora and fauna, visual environment, agriculture and other land use, and the social environment.

Mitigation measures to reduce or eliminate potential Project-related impacts are summarised in the sections above. It is assumed that each of the other developments of interest around the Project Site will be carried out in accordance with the requirements of the Physical Development Plan (PDP) for Barbados and other relevant plans, policies, and legislation pertaining to land use and environmental / social considerations, including requirements related to the assessment of potential environmental, social, and/or agricultural impacts associated with each respective development. If complaints are received from community members, surrounding land users, or other stakeholders regarding perceived Project-related residual impacts or the Project's perceived contribution to cumulative impacts, it is recommended that the Developer work with affected stakeholders to address their concerns through the grievance redress mechanism – developed and described in the ESIA.

8.0 Conclusion and Recommendations

The Developer is proposing to construct and operate a hybrid solar PV energy facility with battery hydrogen energy storage at Harrow Plantation in the Parish of Saint Philip, Barbados. The Project will deliver non-intermittent, carbon-free, and renewable electrical power to the national grid and will also accommodate a large-scale Blackbelly sheep farming facility within the solar power plant and surrounding green areas. With the release of the Barbados National Energy Policy, the Government of Barbados officially announced its intention for the island to achieve 100% renewable energy and carbon neutral transformational goals by 2030. As a baseload clean asset, the Project will help Barbados achieve its renewable energy and carbon neutrality targets without contributing additional intermittency to the national grid.

This ESIA has been prepared to support the Developer's application to Barbados' Planning and Development Department for Planning Permission to proceed with the Project. The assessment predicts that for routine Project activities during construction, operation and/or decommissioning, residual adverse effects (following consideration of proposed mitigation measures) are negligible to moderate in magnitude, reversible and not significant, with a high degree of confidence. With application of mitigation, the potential cumulative environmental impacts of the Project in combination with other planned developments are predicted to be low to moderate in magnitude, reversible and not significant, with a moderate degree of confidence.