



US Virgin Islands Bulk Energy Storage Feasibility Study Proposal October 05, 2015

Island Energy Innovations LLC (IEI) proposes to develop a bulk energy storage component of the integrated energy resource plan (IRP) currently being developed for the Territory. The bulk energy storage component will update and build upon a report¹ prepared by IEI and Gridflex Services in 2014 and will focus on pumped hydro storage (PHS) and other commercially-proven, economically viable energy storage technologies as well as dynamic demand-side management as a means of syncing load demand with variable supply, thus minimizing curtailment and reducing energy storage requirements.

The purpose of the IEI project is to develop and support recommendations on bulk energy storage to be integrated into or supplement the USVI Integrated (energy) Resource Plan, is consistent with USVI Energy Production Action Plan, the USVI Energy Roadmap Analysis, EDIN's USVI Energy Challenge, and the USVI 60% by 2025 goal: *The USVI will lead the Caribbean to a clean energy future. We will lead by example and reduce our fossil fuel imports by 60% from business as usual by 2025.*²

A. Scope of Work

The project scope of work will include seven action items:

1. Update the IEI/Gridflex renewable energy + storage pre-feasibility report
2. Add an alternatives analysis comparing PHS with other energy storage technologies
3. Further assess potential integration of firm renewable energy
4. Add a preliminary grid integration assessment
5. Add a preliminary environmental assessment
6. Add an information gap analysis
7. Make preliminary recommendations

A.1. Update the IEI/Gridflex Services October 2014 report

The current project will build upon and update the IEI / Gridflex 2014 USVI renewable energy + storage pre-feasibility report. The update will incorporate new data and calculations reflecting economic changes resulting from oil price changes both in the fossil fuel (fuel oil, LNG, LPG) market and in the renewable energy (especially wind, solar and battery) markets.

A.2. Energy storage technology alternatives analysis

The IEI/Gridflex 2014 report found PHS to be the preferred alternative for bulk energy storage in the St. Croix and St. Thomas/St. John grids, Ongoing changes in the performance and economics of battery technology warrant a second look at that conclusion. An alternatives analysis comparing PHS with other prospective bulk energy technologies (including but not limited to solid state and flow batteries) will be included in the updated report.

¹ A Renewable Energy + Storage Base for the US Virgin Islands: Pre-feasibility Report, Island Energy Innovations and Gridflex Services, October 2014

² Governor John P. de Jongh, Jr., statement during the signing of the Energy Development in Island Nations (EDIN) Memorandum of Understanding between the USVI, DOE and DOI, February 16, 2010

In addition to energy storage technologies, the IEI report will include a discussion of variable loads (such as RO desalination) that may reduce renewable energy curtailment and levelize electricity supply / demand disparities, thereby reducing energy storage requirements.

A.3. Dispatchable renewable energy assessment

In our October 2014 USVI pre-feasibility report, IEI and Gridflex suggested the potential for the territory to achieve a 90% renewable energy portfolio by 2020 through integrating a mix of dispatchable and non-baseload domestic renewable energy resources, with grid penetration of variable wind and solar resources optimized through grid stability and bulk energy storage. According to our modeling, a 90% domestic renewable energy portfolio appears to be achievable with biomass plus waste-to-energy (WtE) providing a firm base of 16-29% of baseload energy supply, on top of which is layered less firm wind and solar resources plus energy storage.

In the proposed study, IEI will also assess dynamic demand-side management as a means of syncing load demand with variable supply from wind and solar, thus minimizing curtailment and reducing energy storage requirements. Reverse osmosis desalination is an excellent example of a high-load demand that, with adequate freshwater storage capacity, may be scheduled to utilize curtailed energy to meet public and private-sector potable water needs.

A.4. Preliminary grid integration assessment

In order to provide a fatal flaw analysis as well as a complete evaluation and feasibility of bulk energy storage technologies, a detailed background of the existing utility grid is required. This includes generation as well as the transmission and distribution facilities. This assessment would include, but not be limited to:

- Existing power generators, including any renewable and distributed generation sources;
- MTBF data for generating sources, efficiency, and any planned retirement dates;
- Hourly load data as well as seasonal cycling;
- Feeder information such as layout, transmission voltage, wire size and voltage drop, and available fault current;
- Utility grid integration requirements such as frequency & voltage regulation, reactive power and droop response, and any fault ride through parameters;
- Grid integration agreements; and
- Current plans for smart grid integration and/or ancillary services.

A.5. Preliminary environmental assessment

Detailed environmental impact assessments will be required for any proposed renewable energy initiatives, such as onshore and offshore wind farms, solar arrays, and PHS or battery storage. Environmental, sociocultural and archaeological impact studies will be required. The proposed IEI report will provide a general discussion comparing the potentially significant environmental, social and archaeological impacts of energy storage technologies addressed in the report.

A.6. Information gap analysis

IEI understands that certain information critical to determining optimal capacity, recharge/discharge frequency, siting and other design characteristics for alternative energy storage technologies (for example,



feeder capacity, feeder hourly demand, transmission loss, available fault current and avoided cost studies) will be provided in the Integrated Resource Plan currently being prepared by Black & Veatch. These data will not be included in IEI's scope of work. However, we also expect there to be information gaps that must be filled in the course of preparing detailed feasibility studies or developing detailed engineering designs.

A.7. Preliminary Recommendations

Preliminary recommendations will be provided by IEI based upon the information gathered and analyzed in the study. Recommendations will include energy storage technologies that deserve further consideration as well as those that appear not to be ready or financially viable or otherwise unsuitable for the USVI at this time. In addition, recommendations will be made for filling information gaps next steps to be taken by various entities for moving the USVI to a predominantly renewable energy future.

B. Project Timeline

The proposed project will be completed within 6 months of signing a contract for its completion. IEI would be available to begin the project by October, 2015, with project completion by April 2016.
