



REGULATORY
AUTHORITY

Bermuda

**Consultation on the Regulatory
Authority (Renewable Energy Metering
Scheme) General Determination**

Preliminary Report

Preliminary Decision and Order

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1 EXECUTIVE SUMMARY

1. On 2nd March 2017, the Regulatory Authority of Bermuda (the “Authority”) issued an Emergency General Determination (the “EGD”) relating to the former small scale renewable energy ‘net metering’ scheme administered by the Bermuda Electric Light Company Limited (“BELCO”). This intervention followed communication by BELCO of 13 February 2017 to renewable energy (solar photovoltaic, solar thermal, wind, etc.) installation companies, notifying them of its termination of support for new solar PV installs, as well as BELCO’s failure to implement the Energy Commission’s recommendation on ‘net metering’ (as stated in the Energy Commission’s Net Metering Inquiry Response presented to the Minister of Economic Development on 11th October 2016) by 1 January 2017.

2. The Authority has, as per the requirements of the Regulatory Authority Act 2011 (“RAA”), issued an initial Consultation Document on the EGD. It has carefully considered the consultation responses and carried out analysis and assessment on various points raised during the consultation.

3. The Authority has numerous duties and responsibilities in the regulation of electricity, as specified in the Electricity Act 2016 (the “EA”). In particular, there are specific purposes for electricity regulation, as stipulated in section 6 of the EA, which place broad and significant high-level responsibilities on the Authority and create the foundation for its regulation of the electricity sector generally and, in this instance, the continued implementation of the approach set forth in the EGD. This is summarized as follows:

1.1 The avoided cost tariff should remain in place, as it reflects the Authority’s responsibilities under the EA.

4. The EGD and the related implementation of the avoided cost rate of \$0.1736KWh, as well as the related termination of the prior net metering scheme, is appropriate given the Authority’s responsibilities under the EA. In particular, Section 6 (‘Purposes’) states:

- (a) 6(d) to provide sectoral participants and end users with non-discriminatory interconnection to transmission and distribution systems;
- (b) 6(e) to protect the interests of end users with respect to prices and affordability, and the adequacy, reliability and quality of electricity service;
- (c) 6(f) to promote economic efficiency and sustainability in the generation, transmission, distribution and sale of electricity.

5. In addition, Section 36 of the EA states, in relation to Feed-in Tariff setting principles, that:

- (a) the rate shall seek to allow compensation for, at most:
 - (i) the actual cost of generation that BELCO avoids by purchasing power from distributed generation; and
 - (ii) an estimate of any economic benefits from distributed generation.

6. The EGD is entirely consistent with all the above provisions of the EA, because the transitional EGD avoided cost rate:

- (a) Ensures non-discriminatory access to the grid for all BELCO customers with renewable energy installations; and
- (b) Removes cross-subsidies that existed due to the prior net metering scheme, where non-renewable energy BELCO customers were subsidizing BELCO renewable energy customers under the prior net metering rates. This 'cross-subsidy' is the difference between the net metering rate versus the transitional avoided cost rate for all exported electricity.

7. By removing artificial economic returns from renewable energy installations, the EGD promotes economic efficiency.

1.2 The lack of financial data and analysis from the solar installation industry

8. The Authority is concerned that the solar installation industry in Bermuda failed to provide any analysis or data to support its claims as to the financial impact of the EGD. The Authority has carried out its own analysis of the economic and financial aspects of renewable energy installations, in particular solar PV installation, which is explained in Section 7 of this Report and attached as Appendix C.

9. The financial analysis carried out by the Authority has led to the Authority's conclusion that there is a negligible financial impact on the return and payback for renewable energy systems that are installed on the basis of providing self-consumption.

1.3 The question of 'subsidisation' – an issue for Government

10. The Authority notes that many respondents have made comments as to the need for 'subsidisation' and required levels of return on financial investments in renewable energy systems. Some renewable energy companies have explicitly linked subsidies to their business viability. In this regard, the Authority makes the following observations:

- (a) It is not the role of the Authority to devise and implement any subsidy for any particular type of electricity generation or to create subsidies to benefit any particular type of business in Bermuda. Instead, sections 6 of the EA requires the Authority to promote a variety of purposes, including prices and affordability, economic efficiency and energy conservation.
- (b) Furthermore, it is for the Government to make all decisions on whether renewable energy installation companies, and renewable energy systems generally, should be subsidized. Government introduced a limited subsidization regime in September 2009, that was subsequently terminated in 2014. On 26th October 2016, the Minister of Economic Development (the "Minister") requested that BELCO implement the Energy Commission's recommendation on 'net metering', as stated in the Energy Commission's Net Metering Inquiry Response presented to the Minister on 11th October 2016.

1.4 The EGD delivers regulation and associated clarity into an environment where none existed

The Authority is aware that the EGD has been implemented in an environment defined by particular characteristics, including:

- i. A period of Government subsidization of small scale solar PV installs;
- ii. BELCO unilaterally implementing feed-in tariffs and a net metering scheme for small scale renewable energy systems;
- iii. BELCO operating contracts for net metering with a 30-day change of law provision; and
- iv. There was no prior regulator, nor regulation, of feed-in tariffs for small scale renewable energy installation.

It is clear from responses to the consultation that this legacy environment led to a certain level of assumption and expectation that there would be no fundamental changes, for instance, to feed-in tariffs.

The Authority's intervention introduces regulation based on a clear regulatory and legislative framework

The Authority recognizes that the EGD has introduced both regulation and a new feed-in tariff to an environment, including the market for renewable energy installations, where change was not anticipated nor calculated. In this context, the EGD is being represented by certain parties as an 'impact' of a negative nature on the market. The analysis provided in this Preliminary Report shows the opposite. Moreover, the effect of the Authority's intervention is consistent with its statutory responsibilities and delivers the required level of economic efficiency and non-discrimination to the market. This provides both future clarity and, in the context of regulation, predictability as to how regulation will be transacted in this area.

2 INTRODUCTION

11. The purpose of this Preliminary Report, Preliminary Decision and Order is for the Authority to (i) present a summary of the responses to the initial Consultation Document for the Consultation on the Regulatory Authority (Transitional Measures for Bermuda Electric Light Company Limited Solar Net Metering Scheme) Emergency General Determination; (ii) present the Authority's analysis; and (iii) invite comments on the Preliminary Report, Preliminary Decision, the Proposed Order in Appendix A and the Proposed General Determination in Appendix B. At the conclusion of the consultation process, the Authority will enact a General Determination setting forth the renewable energy tariff.

12. The Authority is now the sole body responsible for the regulation of the electricity sector and its overarching responsibilities are to:

- regulate tariffs and the quality of service provision to end users;
- ensure that access to electricity infrastructure by current and prospective generators is transparent, fair, reasonable, and non-discriminatory; and
- investigate and respond to complaints from end users as regards the provision of electricity.

13. The Authority issued the EGD on 2nd March 2017, mandating that BELCO pay a feed-in tariff for electricity produced by renewable energy systems because of the urgent nature of the issue and the potential impact on the economy of Bermuda.

14. The Authority recognises the importance of renewable energy systems which include solar, wind, and tidal generation. In particular, the Authority acknowledges solar PV generating facilities as one of the most important renewable technologies available in Bermuda and that efforts are required by both the Authority, as the regulator, and the Bermuda electricity industry as a whole to ensure that it forms an appreciable component of the Bermuda electricity generation mix in the near future.

15. The Authority further recognises that a degree of uncertainty amongst the Bermuda public in respect of future investment in solar PV has resulted from:

- (a) the closure of the net metering scheme operated by the Bermuda Light Company Limited to new customers; and
- (b) the subsequent issuance of the EGD pursuant to Section 66(2) of the Regulatory Authority Act 2011 concerning the "Transitional Measures for Bermuda Electric Light Company Limited Solar Net Metering Scheme" by the Authority (both as outlined below).

16. Prior to the EGD, BELCO had proposed to grandfather the previous net metering scheme to all PV participants who had begun construction (i.e. submitted their development application to the Dept. of Planning) prior to 26 August 2016, and to develop a new feed-in tariff based on avoided costs. However, BELCO had since that date halted the program to

new participants, pending an inquiry by the Minister of Economic Development. In response to this, the Authority issued the EGD.

17. On 24 March 2017, the Authority issued a Consultation Document inviting interested parties to comment on the proposed transitional solar metering scheme set forth in the EGD.

18. BELCO's original net metering scheme included solar, wind and tidal generation. Therefore, this draft GD applies to all forms of these renewable generation technologies.

3 CONSULTATION PROCEDURE

19. This consultation is being undertaken in accordance with Sections 69 to 73 of the Regulatory Authority Act 2011. The procedure and accompanying timelines (as set out in Section 70 of the RAA), under which this consultation is taking place is set out in this section 3.

20. Written comments should be submitted before 5:00 PM (Bermuda time) on 28 July 2017.

21. The Authority invites comments from members of the public, electricity sectoral participants and sectoral providers, and other interested parties.

22. Responses to this Preliminary Report, Preliminary Decision and Order should be filed electronically in MS Word or Adobe Acrobat format. Parties filing comments should go to the Authority's website, www.rab.bm, follow the link to the Consultations and Response page, and click the "Click here to submit a response" icon which appears at the top of the page. All comments should be clearly marked "**Response to Preliminary Report, Preliminary Decision and Order: Renewable Energy Metering**" and should otherwise comply with Rules 18 and 30 of the Authority's Interim Administrative Rules, which are posted on the Authority's website.

23. The Authority intends to make responses to this Preliminary Report, Preliminary Decision and Order available on its website. If a commenting party's response contains any information that is confidential in nature, a clearly marked "Non-Confidential Version," redacted to delete the confidential information, should be provided together with a complete version that is clearly marked as the "Confidential Version." Redactions should be strictly limited to "confidential information," meaning a trade secret, information whose commercial value would be diminished or destroyed by public disclosure, information whose disclosure would have an adverse effect on the commercial interests of the commenting party, or information that is legally subject to confidential treatment. The "Confidential Version" should highlight the information that has been redacted. Any person claiming confidentiality in respect of the information submitted must provide a full justification for the claim. Requests for confidentiality will be treated in the manner provided for in Rule 30 of the Authority's Interim Administrative Rules.

24. The principal point of contact at the Authority for interested persons for this consultation is Nigel Burgess. He may be contacted by email, referencing "**Comments on Response to Preliminary Report, Preliminary Decision and Order: Renewable Energy Metering**" at renewables@RAB.bm or by mail at:

Nigel Burgess
Regulatory Authority
1st Floor, Craig Appin House
8 Wesley Street
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25. In this Preliminary Report, Preliminary Decision and Order, except insofar as the context otherwise requires, words or expressions shall have the meaning assigned to them by the EA, the RAA and the Interpretation Act 1951.

26. This Preliminary Report, Preliminary Decision and Order is not a binding legal document and does not contain legal, commercial, financial, technical or other advice. The Authority is not bound by this Preliminary Report, Preliminary Decision and Order, nor does it necessarily set out the Authority's final or definitive position on particular matters. To the extent that there might be any inconsistency between the contents of this Preliminary Report, Preliminary Decision and Order and the due exercise by the Authority of its functions and powers, and the carrying out of its duties and the achievement of relevant objectives under law, such contents are without prejudice to the legal position of the Authority.

3.1 Background

27. In 2010, BELCO introduced its own small scale renewable generation scheme which was aimed at incentivizing residential electricity customers to install renewable energy systems at their properties in return for a payment in respect of any excess electricity generated and not consumed by such customers in any calendar month which was sold to BELCO (hereinafter referred to as the "BELCO Scheme" and/or "Scheme").

28. On 15 August 2016, BELCO notified the Energy Commission of the following:

- (a) it was unilaterally closing the BELCO Scheme to new customers who wished to participate in the Scheme;
- (b) it proposed a new feed-in tariff based on an avoided cost methodology for new customers who wished to participate in the BELCO Scheme; and
- (c) it would continue to pay existing BELCO Scheme participants and those persons who had received planning and building control permission for their solar photovoltaic installations as at 15 August 2016 at the original net metering rate of payment.

29. Whilst the Energy Commission was engaged in discussions with BELCO and the Minister in respect of BELCO's decision to close the Scheme, the Electricity Act 2016 came into force on 28 October 2016 and the Energy Commission was consequently terminated; the responsibility for electricity regulation was transferred to the Authority (which included, for the avoidance of doubt, responding to BELCO's decision to close the Scheme). Prior to its termination, the Energy Commission had made a number of recommendations to the Minister regarding BELCO's decision to close the Scheme.

30. The Authority responded to BELCO's decision to close the Scheme to new entrants on 2 March 2017 with the EGD. The EGD stated, amongst other things, that pending the issuance by the Authority of an Administrative Determination on BELCO's proposed changes to the BELCO Scheme, BELCO shall pay to the BELCO Scheme participants in respect of any excess energy generated and not consumed by them in any calendar month and which they sold to BELCO:

- (a) from 15 August 2016 until 31 December, the original net metering rate of payment; and
- (b) from 1 January 2017 until the issuance by the Authority of an Administrative Determination, a rate of \$0.1736 per KWh.

3.2 Procedural History

31. The Authority initiated this consultation by publishing a Consultation Document on 16th March 2017 that invited responses from members of the public, including electricity sectoral participants and sectoral providers, as well as other interested parties.

32. The purpose of the Authority's initial Consultation Document was to consult on the Emergency General Determination.

33. The Consultation Document asked the following questions:

- (i) What is your view of how solar PV has evolved in Bermuda? Please provide views on the uptake of this technology.
- (ii) Looking to the future, how important do you believe solar PV is for Bermuda? If a respondent views solar PV as important please provide your views on what its costs and benefits are, how these should be quantified, and how these should be reflected in the framework for electricity regulation.
- (iii) Should there be capacity limits on solar systems installed on individual customers' premises in Bermuda? Should this be included within a formal licensing framework?
 - (A) If so, who should be responsible for assessing the system sizes and their limits (BELCO, Department of Planning, Authority etc.)
 - (B) Should solar PV system sizing for a customers' premises be limited to the prior 12-month consumption of a residence/business and/or should it be based on forecasted consumption?
- (iv) The Authority has, via the Emergency General Determination, and on a transitional basis, mandated that BELCO should pay for electricity received from solar PV systems on the basis of the Energy Commission recommendations of October 2016 (see the Determination for detail). What are your views on this transitional measure?
- (v) What level and type of cost transparency should be mandated on BELCO to facilitate the determination of an appropriate feed-in tariff for electricity provided by solar PV? In particular:
 - (A) The Authority intends to mandate full accounting separation between BELCO's (i) generating, and (ii) transmission, distribution and retail activities. Please provide your views on specific aspects of BELCO's

operational activities that are relevant to the cost transparency and related determination of the feed-in tariff rate?

- (B) What levels of cost element transparency would you expect within a BELCO feed-in tariff for solar PV?
- (vi) What do you believe should be the economic basis for solar PV in Bermuda, specifically in the context of feed-in tariffs? Alongside any general comments by respondents please provide responses to the following:
 - (A) Should BELCO's solar PV Metering Scheme reflect a cost-benefit methodology or an avoided cost methodology?
 - (B) What cost rate design for solar PV participants is best suited to incentivizing greater utilization of cleaner energy sources and technologies in Bermuda?
 - (C) What other factors should be considered in determining the cost rate design for feed-in tariffs?
- (vii) Should solar PV or other renewable energy programs be incentivized within a specific regulatory framework for renewables in Bermuda?
- (viii) In your view, are there any barriers to solar PV or other forms of renewable generation investment?
 - (A) If so, what are these barriers?
 - (B) How could they be removed to enable further investment?

34. The Consultation Document also invited respondents to raise any other matters that the Authority should consider in developing the electricity licenses.

35. Responses to the Consultation Document were solicited from the public electronically through the Authority's website at www.rab.bm.

36. The response period commenced on 16th March 2017 and concluded on 27th April 2017.

37. The Authority received eighty-three responses from the public, as discussed in section 6 below.

38. The Authority has reviewed the responses to the initial Consultation Document and considered the cost-benefit analysis of switching to the avoided cost rate of \$0.1736 per KWh from the BELCO Scheme methodology (as outlined below); and whether the contractual rights of any of the customers to the subsidised scheme are breached as a result of moving to the avoided cost rate of \$0.1736 KWh.

3.3 Preliminary Decision and Order

The Authority proposes to adopt the Proposed Order set out in Appendix A and enact the Proposed General Determination set out in Appendix B to this Preliminary Report and Preliminary Decision. The Authority invites interested parties to comment on the Authority's conclusions with respect to the responses to the Consultation Document, Preliminary Report, the Proposed Order and the Proposed General Determination.

4 LEGISLATIVE CONTEXT

39. The Authority has the powers to supervise, monitor and regulate the electricity sector in accordance with the purposes of the EA. Such purposes, as set forth in Section 6 of the EA, include:

- (i.) “to promote the use of cleaner energy sources and technologies, including alternative energy sources and renewable energy sources”, Section 6(c); and
- (ii.) “to provide sectoral participants and end-users with non-discriminatory interconnection to transmission and distribution systems”, Section 6(d).

40. The principal functions of the Authority set forth in Section 12 of the RAA include:

- (i.) “to promote and preserve competition”, Section 12(a); and
- (ii.) “to promote the development of the Bermudian economy [and] Bermudian employment”, Section 12 (c).

41. Pursuant to sections 65(2) and 68 of the EA (i) “any matters relating to the electricity sector . . . that are pending before the Minister or the Energy Commission as at the date of commencement of [the EA]” and (ii) “any notice of intention to vary a price or charge given to the Energy Commission and pending before the Minister or the Energy Commission immediately before the commencement date of [the EA] shall be transferred to the Authority for resolution in accordance with the procedures established by the [RAA], subject to any modifications that the Authority may deem appropriate and efficient, depending on the status of each case.”

5 SUMMARY RESPONSES TO THE INITIAL CONSULTATION DOCUMENT

5.1 Response Method

42. The Consultation Document allowed the public to submit responses commenting on the EGD and responding to the consultation questions. Eighty-three written responses were received from the general public.

5.2 Summary of Responses

43. This section provides an overview of the key themes from the responses to the Consultation Document and summarizes some of the main decisions that the Authority has made, taking into consideration the public responses.

44. Not all respondents chose to answer the questions specified in the Consultation Document. Some preferred to provide their views in more general terms and where possible the Authority has included information from these responses in the appropriate section. In addition, some responses addressed some of the questions but not all.

45. Eighty-three parties submitted comments in response to the Consultation Document, twelve of which directly responded to the questions in the Consultation Document. Of those twelve responses, one response was from BELCO, three responses were from solar industry representatives, eight were from scheme participants, and none were from the general public.

46. Of the seventy-one general comments submitted, fifty-three were from scheme participants and eighteen were from the solar industry representatives and workers. In addition to the responses to the consultation questions and general comments received, thirty-nine responses were received and classified as ex parte communication, due to the submission not being received through the official means as described in the Consultation Document.

47. The concerns voiced in the responses generally fall into four categories:

- (a) concerns about the cost reflectivity of the transitional feed-in tariff, and how this tariff may be omitting some avoided costs;
- (b) impact of the transitional arrangement on customers who were either planning to invest, or already have made sunk investments in solar PV installations, based on the EGD's lack of grandfathering provisions;
- (c) concerns of the policy implications of closing the previous solar net metering scheme, and whether this would disrupt environmental policy objectives on the island; and
- (d) concerns about whether the EGD interfered with the scheme participants legal standard contract with BELCO.

6 DISCUSSION OF RESPONSES TO THE INITIAL CONSULTATION DOCUMENT

6.1 Discussion of Responses

48. The first category of responses (paragraph 46 (a)) included concerns about the cost reflectivity of the tariff, primarily focusing on the methodology used to derive the avoided fuel cost. The transitional arrangement's avoided fuel cost component is calculated on a weighted annual average avoided fuel cost basis. Provided that this is periodically updated, this would maintain a cost reflectivity, in particular since the costs of solar PV generation are not variable once the facility is installed. Accordingly, the transitional measures also effectively address the concerns about whether PV producers are being remunerated for the correct fuel costs.

49. The second category of responses (paragraph 46 (b)) include concerns about the impact of the transitional arrangement on both completed and future investments. For consumers who have not yet invested in renewable energy systems, there is no risk of any impact as investments should no longer be made on the basis of a net metering arrangement. For renewable energy system producers with agreements prior to the introduction of the transitional arrangement, it is possible that the transitional arrangement will have a financial impact and this is discussed below. That said, it is the Authority's understanding that at no point was there any policy commitment or 'guaranteed' level of remuneration for renewable energy systems installations.

50. In the third category (paragraph [46 (c)]), many respondents were concerned about the implications of the transitional arrangement for the future of renewables adoption in Bermuda. However, the Authority is required to strike a balance between affordability and other environmental objectives. Therefore, the fact that the transitional arrangements do not actively disincentivise the adoption of renewable energy installations in future, but do prevent overcompensation of existing facilities, ensures that the transitional measures are consistent with a balanced assessment required under the EA. The new transitional arrangement incentivises the efficient level of renewable generation investment, without leading to undue increases in retail tariffs for BELCO's customers.

51. Lastly, the final category of responses (paragraph 46 (d)) claim that the EGD has legally interfered with the standard contract with BELCO. However, the Authority is required to regulate the entire electricity sector in accordance with the EA and the RAA, not any single contract. BELCO's standard contract is subject to applicable laws, including the EA and the RAA, as explicitly set forth in the standard contract.

7 AUTHORITY ANALYSIS

52. Central to the Authority's views on this matter are the requirements set out in the EA.

53. Section 36 of the EA provides that the Authority is required to determine the feed-in tariff methodology in accordance with, amongst other things, the following principle:

(a) The feed-in rate shall allow compensation for, at most, the actual cost of generation that the TD&R Licensee [BELCO] avoids by purchasing power from distributed generators (which, for the avoidance of doubt, includes power from residential solar PV and wind generation providers who are not required to hold a Bulk Generation Licence).

54. Also, section 37 (1)(b) the EA states that within two years from the commencement date of this Part, the Authority shall conduct a feed-in tariff review in accordance with section 36 to establish the approved feed-in tariff.

55. This requirement for a feed-in tariff review is consistent with the National Electricity Sector Policy ('Bermuda's electricity policy'), which states that reformed electricity sector in Bermuda will introduce competition between existing generation facilities, prospective third-party bulk generators (i.e., Independent Power Producers, or IPPs), distributed generators (DGs), and other demand-side resources. In order to ensure that the benefits of such competition are realized, it is necessary for all electricity resources to have access to the electricity network on fair, reasonable, and non-discriminatory terms. In turn, this requires that the feed-in tariff for renewable energy systems reflects the system-wide costs and benefits of this technology – in this case, principally BELCO's avoided costs and avoided network losses.

56. Accordingly, the Authority's current view is that the net metering transitional measures—including the BELCO avoided cost proposed rate of \$0.1736 per kWh for new renewable energy systems going forward—would increase cost reflectivity compared to the previous scheme while still providing an incentive for customers to install renewable energy systems, in particular solar PV.

57. The avoided cost rates are BELCO's avoided costs of fuel, lubricating oil, capital construction, and transmission losses. Items not included in the calculation are capacity payments, spinning reserve and other ancillary services (such as kVar/voltage support, waveform profile, outage management and response), as well as distribution, metering and billing charges. BELCO's project weighted average marginal cost of fuel for 2016 is \$0.1574 per kWh (FAR + \$30/bbl included in the tariff), avoided lubricants of \$0.0059 per kWh, and avoided transmission losses of an additional 1.6% per kWh.

58. The tariff will be recalculated periodically, as determined by the Authority, based on updated lubricating costs, grid losses and the 12-month rolling weighted average of marginal cost of fuel.

59. Upon granting of the TD&R Licence, the Authority will perform an accounting separation study and a comprehensive review of the tariffs to ensure that the tariffs

accurately reflect the system-wide costs and benefits of renewable energy technology according to the methodology, as set out in the EA.

60. Indeed, public comments received so far indicate that the feed-in tariff based on BELCO's avoided costs is greater than the cost of solar PV generation of \$0.10-0.15 per kWh.

61. Furthermore, the transitional measures strike an appropriate balance between the Authority's duty under the EA to regulate the electricity sector in a manner that lowers the overall costs to consumers and the need to promote renewable generation while also ensuring reliable electricity services.

The analysis further explained in Section 7.3 was performed on an adapted form of the System Advisor Model ("SAM") analysis tool, which is a performance and financial model designed to facilitate decision making within the renewable energy industry.¹ The model makes performance predictions and cost of energy estimates for grid-connected power projects based on installation and operating costs and system design parameters (which are specified as inputs to the model). SAM provides analysis of data for various billing and net metering options. The transitional program was not a billing option, therefore the modification of BELCO net metering scheme's results were used. Electricity export data was extracted for analysis to be performed outside of the SAM program into an Excel based program.

7.1 BELCO's prior Net Metering Scheme would have the impact of increasing retail tariffs if allowed to continue

62. BELCO's previous renewable energy Net Metering Scheme operated on a net export basis – that is, any generation exported to the grid by PV producers, net of total energy consumed (and supplied by BELCO), would be remunerated at the retail tariff rate.

63. The effect of this scheme was that the costs of consumption (i.e. BELCO's average production costs) and the benefits of generation (i.e., BELCO's avoided costs) at a customer's premises were assumed to be equal. However, this is not the case, given that BELCO's fixed costs are largely unavoidable at current levels of renewable energy penetration. These fixed costs relate to BELCO's existing generation plants, its network infrastructure, as well as some of its retailing activities (e.g., maintaining customer records, metering, and billing). Setting a feed-in tariff at a level significantly higher than BELCO's avoided costs would increase the risk of overcompensating existing customers with renewable energy installed and thereby increase the average retail tariff, without any benefit in terms of system reliability. Moreover, this would potentially be inconsistent with both Bermuda's electricity policy and the EA.

64. In the long-term, this has the potential to raise overall consumer bills still further since it increases the risk that future renewable energy investments are inefficient from an electricity system perspective. For example, if customers install larger renewable energy systems under the previous net metering scheme than under the transitional measures, then

the direct costs of the scheme to BELCO would increase and the system-wide net demand (in kWh terms) would decrease. This would increase the total system cost to be recovered through the retail tariff, in which all consumers will have to pay.

65. The transitional measures have the effect of transitioning renewable energy producers to a charging system based on gross demand and export as opposed to net imports or exports. BELCO's avoided cost proposed rate of \$0.1736 per kWh for renewable energy system gross exports would therefore make the overall system of electricity tariffs substantially more cost-reflective, given that exports and imports will be metered, and charged or credited, separately. In turn, the average tariff would be lower than if the previous net metering regime were to continue.

7.2 The Authority's Analysis on Transitional Impacts of the New Scheme

66. The Authority has analysed the financial impact of the transitional arrangements on small scale residential PV installations which overwhelmingly includes the majority of renewable energy systems. The report presenting these results is set forth in Appendix C and a summary of the Authority's analysis is presented below in Table 1: Summary of Results. As illustrated in Table 1, solar PV systems of various sizes were analysed and compared. The annual PV production, total self-consumed energy, and total exported energy were kept constant at each consumption (usage) level, which gave each system at that consumption level the same electricity bill in the absence of a renewable energy system. This allowed for the total value of solar PV production (annual and per kWh), the value of solar PV exports, and the payback period to be compared in the Authority's analysis. Although, BELCO's initial net metering scheme included wind, solar, and tidal generating systems, as solar PV systems occupy over 99% of the total renewable energy systems on the program, analysis was carried out solely on solar PV.

67. The Authority's analysis determined that the financial impact varies depending on the size of the installation, consumption patterns, and consumption levels. The Authority finds that for residential consumers with an average-sized PV installation and average demand, the transitional arrangements are likely to still place these consumers in a net credit position. However, the financial return on investment is expected to be lowered under the transitional arrangement.

68. While there is a positive impact to former Commercial Renewable System Excess Energy Rate ("CRSEER") customers, who have benefited from a better export tariff while remaining on the same program methodology, some former small-scale residential customers are negatively affected. The extent of their exposure to the migration between schemes will vary depending on:

- (a) the size of their PV system,
- (b) overall energy consumption, and
- (c) energy consumption patterns.

69. The analysis performed by the Authority shows that there is no significant variation in the financial return between the original net metering scheme and the Authority's avoided cost scheme when exports to the grid are minimised (i.e. scheme participants with energy production closely matched to their consumption patterns). These participants are the least

affected (if at all). Those most severely impacted are the scheme participants who are excessive net energy exporters.

70. The average PV scheme participant will have limited financial exposure to the move to the transitional program and these participants will continue to be in a net credit position, although their payback period is now increased (however the analysis provided here suggests not disproportionately).

71. The kWh value of solar (via the output of the model used for this analysis) is comparable for both the prior Net Metering scheme and the EGD scheme when electricity exports are minimised. It should be noted that although this value is reduced when exports are increased, the value is above the scheme participant's cost to produce electricity, thus still provides a significant return on the investment.

72. The conclusion of this analysis is that, as an investment, PV systems continue to offer a return on the investment in under half the lifetime of the system. While the EGD has changed the financial rates and methodology, there is still significant value and a rationale to invest in small scale solar systems. This implies that solar installers could attract new solar scheme participants without the prior subsidisation from the majority of BELCO's customer base (as was the case under the prior net metering scheme) or from Government rebate programs. It should be noted that there is also additional value of solar PV production that is not quantified within the EGD. The fuel costs and taxes have no value to the scheme participants when they export electricity, however these costs are included when the energy is self-consumed. This is an added benefit of self-consuming and further adds to the importance of sizing a PV system correctly to get the most value out of the PV system.

7.3 Table 1: Summary of Results

2kW PV System	400kWh/month		700kWh/month		1100kWh/month		1500kWh/month	
	Low Usage		Medium Usage		High Usage		Very High Usage	
	2kW Net	2kW Trans	2kW Net	2kW Trans	2kW Net	2kW Trans	2kW Net	2kW Trans
Annual PV Production (year 1) kWh	3,333		3,333		3,333		3,333	
Total energy self-consumed (kwh)	1,989		2,708		3,146		3,292	
Total exported energy (kwh)	1,343.99		624.54		186.57		41.42	
Percentage of System energy Exported	40%		19%		6%		1%	
Electricity bill without system (year 1)	905		1,844		3,382		4,996	
Total Value of Production	\$ 1,120.55	\$ 902.02	\$ 1,120.55	\$ 1,019.00	\$ 1,120.55	\$ 1,090.22	\$ 1,120.55	\$ 1,113.82
Value of exports	\$ 451.85	\$ 233.32	\$ 209.97	\$ 108.42	\$ 62.72	\$ 32.39	\$ 13.93	\$ 7.19
Net capital cost	\$9,268		\$9,268		\$9,268		\$9,268	
Payback period (years)	8.27	10.27	8.27	9.10	8.27	8.50	8.27	8.32

5kW PV System	400kWh/month		700kWh/month		1100kWh/month		1500kWh/month	
	Low Usage		Average Usage		Above Average Usage		High Usage	
	5kW Net	5kW Trans	5kW Net	5kW Trans	5kW Net	5kW Trans	5kW Net	5kW Trans
Annual PV Production (year 1) kWh	7,499		7,499		7,499		7,499	
Total energy self-consumed (kwh)	2,435		3,762		5,073		5,964	
Total exported energy (kwh)	5,063.61		3,736.58		2,426.14		1,535.48	
Percentage of System energy Exported	68%		50%		32%		20%	
Electricity bill without system (year 1)	905		1,844		3,382		4,996	
Total Value of Production	\$ 2,521.16	\$ 1,697.82	\$ 2,521.16	\$ 1,913.60	\$ 2,521.16	\$ 2,126.67	\$ 2,521.16	\$ 2,271.49
Value of exports	\$ 1,702.39	\$ 879.04	\$ 1,256.24	\$ 648.67	\$ 815.67	\$ 421.18	\$ 516.23	\$ 266.56
Net capital cost	\$20,852		\$20,852		\$20,852		\$20,852	
Payback period (years)	8.27	12.28	8.27	10.90	8.27	9.80	8.27	9.18

10kW PV System	400kWh/month		700kWh/month		1100kWh/month		1500kWh/month	
	Low Usage		Average Usage		Above Average Usage		High Usage	
	10kW Net	10kW Trans	10kW Net	10kW Trans	10kW Net	10kW Trans	10kW Net	10kW Trans
Annual PV Production (year 1) kWh	15,145		15,145		15,145		15,145	
Total energy self-consumed (kwh)	2,668		4,363		6,302		7,929	
Total exported energy (kwh)	12,476.76		10,781.65		8,843.24		7,216.32	
Percentage of System energy Exported	82%		71%		58%		48%	
Electricity bill without system (year 1)	905		1,844		3,382		4,996	
Total Value of Production	\$ 5,091.75	\$ 3,063.03	\$ 5,091.75	\$ 3,338.65	\$ 5,091.75	\$ 3,653.84	\$ 5,091.75	\$ 3,918.38
Value of exports	\$ 4,194.69	\$ 2,165.97	\$ 3,624.79	\$ 1,871.69	\$ 2,973.10	\$ 1,535.19	\$ 2,426.13	\$ 1,252.75
Net capital cost	\$42,129		\$42,129		\$42,129		\$42,129	
Payback period (years)	8.27	13.75	8.27	12.62	8.27	11.53	8.27	10.75

15kW PV System	400kWh/month		700kWh/month		1100kWh/month		1500kWh/month	
	Low Usage		Average Usage		Above Average Usage		High Usage	
	15kW Net	15kW Trans	15kW Net	15kW Trans	15kW Net	15kW Trans	15kW Net	15kW Trans
Annual PV Production (year 1) kWh	22,497		22,497		22,497		22,497	
Total energy self-consumed (kwh)	2,755		4,590		6,796		8,755	
Total exported energy (kwh)	19,741.60		17,907.36		15,701.43		13,742.13	
Percentage of System energy Exported	88%		80%		70%		61%	
Electricity bill without system (year 1)	905		1,844		\$3,382		\$4,996	
Total Value of Production	\$ 7,563.49	\$ 4,353.51	\$ 7,563.49	\$ 4,651.75	\$ 7,563.49	\$ 5,010.44	\$ 7,563.49	\$ 5,329.02
Value of exports	\$ 6,637.13	\$ 3,427.14	\$ 6,020.45	\$ 3,108.72	\$ 5,278.82	\$ 2,725.77	\$ 4,620.10	\$ 2,385.63
Net capital cost	\$62,556		\$62,556		\$62,556		\$62,556	
Payback period (years)	8.27	14.37	8.27	13.45	8.27	12.49	8.27	11.74

7.4 The Transitional Measures Ensure Greater Cost-Reflectivity and Lower Retail Tariffs

73. The improved cost-reflectivity of the transitional measures is in line with the Authority's duties to introduce an appropriate degree of competition into the Bermuda electricity generation market and to ensure non-discriminatory access for generation to the network. This implies that future investments in generation, either by BELCO, Independent Power Producers, or through greater adoption of distributed generation (including solar PV and wind), should all be remunerated in accordance with their benefits and costs to the electricity system. For the reasons already elaborated in this response, the Authority's conclusion is therefore that the transitional measures are consistent with the aims and objective of Bermuda's energy policy and its own duties under the EA.

8 CONCLUSION

74. In furtherance of the proposals set forth above, the Authority proposes to adopt the Proposed Order contained in Appendix A to this Preliminary Report and Preliminary Decision and to make the Proposed General Determination contained in Appendix B.

APPENDIX A



BERMUDA
**REGULATORY
AUTHORITY**

**Proposed Order:
Renewable Energy Metering Scheme**

Proposed Order
Date: 14 July 2017

8.1 The Regulatory Authority, pursuant to Sections 44, 52 and 62 of the Regulatory Authority Act 2011 and Sections 6, 14, 65(2) and 68 of the Electricity Act 2016, hereby:

- (a) Adopts the General Determination attached hereto, setting forth the renewable energy metering scheme;
- (b) Directs the Chief Executive of the Regulatory Authority to forward the General Determination to the Cabinet Secretary; and
- (c) Authorises the General Determination to be effected on the date of its publication in the Royal Gazette.

8.2 So Ordered this day of July 2017

APPENDIX B



BERMUDA
[Regulatory Authority (Renewable Energy Metering Scheme) General Determination]

BR /2017

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1	Citation
2	Interpretation
3	General Purpose
4	Determination
5	Terms and conditions of General Determination
6	Effective Date of General Determination

The Regulatory Authority, in the exercise of the power conferred by section 62 of the Regulatory Authority Act 2011, as read with sections 44 and 52 of that Act and sections 6, 14, 65(2) and 68 of the Electricity Act 2016, makes the following General Determination:

Citation

1 This General Determination may be cited as the [Regulatory Authority (Renewable Energy Metering Scheme) General Determination].

Interpretation

2 In this General Determination, unless the context otherwise requires, terms shall have the meaning given in the Regulatory Authority Act 2011, the Electricity Act 2016, and the Schedule to this General Determination.

General Purpose

3 This General Determination establishes the transitional renewable energy program.

Determination

4 (1) This General Determination is made pursuant to the Consultation entitled "Consultation on the Regulatory Authority (Transitional Measures for Bermuda Electric Light Company Limited Solar Net Metering Scheme) Emergency General Determination" dated 16th March 2017 and the Regulatory Authority's Decision on it.

(2) Taking into account the received responses to the Consultation and for the reasons given in the Decision, the Authority determines that the renewable energy metering scheme set forth in the Schedule is consistent with the purposes of the Electricity Act 2016, including to seek to: (a) ensure the adequacy, safety, sustainability and reliability of electricity supply in Bermuda; (b)

encourage electricity conservation and the efficient use of electricity; (c) promote the use of cleaner energy solutions and technologies; (d) provide sectoral participants and end-users with non-discriminatory interconnection to transmission and distribution systems; (e) protect the interests of end-users with respect to prices and affordability, and the adequacy, reliability and quality of electricity service; and (f) promote economic efficiency and sustainability in the generation, transmission, distribution and sale of electricity.

Terms and conditions of General Determination

5 (1) The Schedule to this General Determination has effect.

(2) The Schedule is also published on the Regulatory Authority's website (www.rab.bm), and is also available for inspection at the offices of the Authority [1st Floor, Craig Appin House, 8 Wesley Street, Hamilton HM 11) during ordinary business hours.

Effective Date of General Determination

6 This General Determination shall become effective on the day it is published in the Official Gazette.



BERMUDA

**REGULATORY
AUTHORITY**

**Schedule to [Regulatory Authority
(Renewable Energy Metering) General
Determination 2017]**

General Determination

Date:

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- 1 Definitions
- 2 Interpretation
- 3 Legislative and Procedural Background
4. Final Determination

This General Determination is made by the Authority pursuant to section 62 of the Regulatory Authority Act 2011 (“RAA”) and establishes the transitional scheme for renewable energy metering tariffs. The adoption and implementation of this tariff is in accordance with sections 6, 14, 65(2) and 68 of the Electricity Act 2016 and the general powers granted to the Authority under section 13 of the RAA and in accordance with the procedures established for this purpose in sections 61 and 62 of the RAA.

1 Definitions

“Authority” means the Regulatory Authority of Bermuda;

“BELCO” means the Bermuda Electric Light Company Limited, as established pursuant to the Bermuda Electric Light Company Act 1951;

“Commencement Date” means 28 October 2016, the date on which the EA came into force;

“EA” means the Electricity Act 2016;

“EC Response” means the recommendations presented to the Minister by the EC in a paper entitled Net Metering Inquiry Response on 11 October 2016;

“EC” means Energy Commission, the body established under the Energy Act 2009 and which (i) advised the Minister in the discharge of his functions under that Act; and (ii) considered BELCO’s proposals to vary its prices or charges; and (iii) provide a recommendation to the Minister in relation to such proposed variations of its prices and charges; and which ceased to exist when the Energy Act 2009 was repealed pursuant to section 65(1) of the EA which came into effect on the Commencement Date;

“EGD” means the Regulatory Authority (Transitional Measures for Bermuda Electric Light Company Limited Solar Net Metering Scheme) Emergency General Determination (the “Emergency General Determination”) issued by the Authority on 2nd March 2017;

“Fuel Adjustment Rate” means a mechanism that is designed to recover the cost of fuel used to produce electricity, calculated based on the cost of fuel per barrel and its projected usage;

“Minister” means the Minister responsible for the Electricity sector, which is the Minister of Economic Development for Bermuda;

“Net Metering Scheme” or **“Scheme”** means the scheme introduced by BELCO in or about 2010 aimed at incentivizing residential electricity customers to install solar PV, wind and tidal energy and under which they would receive payment in respect of any excess energy generated and not consumed by such customers in any calendar month and which they sold to BELCO;

“RAA” means Regulatory Authority Act 2011;

“Renewable Energy Metering Payment” means a monthly payment by BELCO to Renewable Energy Participants in respect of Renewable Energy Participants’ net excess energy in any Month, and which is calculated by multiplying the amount of such energy exported to BELCO’s grid by a set rate;

“Renewable Energy Participants” means BELCO’s residential and commercial electricity customers who: (i) currently sell excess energy generated by solar PV or Wind Generation to BELCO and (ii) any new customers who wish to sell excess energy generated by Solar PV or Wind Generation to BELCO;

“Scheme Participants” means BELCO’s residential electricity customers who have participated in the Scheme;

“Solar Photovoltaic” or **“Solar PV”** means a technology in which sunlight is converted into electrical power;

“TD&R Licence” means the Transmission, Distribution and Retail Licence referenced in section 20(1)(a) of the EA;

“Tidal Generation” means a technology in which the ocean tides (or waves) are converted to electrical power; and

“Wind Generation” means a technology in which wind power is converted into electrical power.

2 Interpretation

- (1) For purposes of interpreting this General Determination:
 - (a) unless the context otherwise requires, words or expressions shall have the meaning assigned to them by the RAA and the EA;
 - (b) where there is any conflict between the provisions of this General Determination and the EA or RAA, the provisions of the EA or RAA, as the case may be (and subject to sections 3(2) and 3(3) of the EA), shall prevail;
 - (c) terms defined herein and in the EA and RAA have been capitalised;
 - (d) headings and titles used herein are for reference only and shall not affect the interpretation or construction of this General Determination;
 - (e) references to any law or statutory instrument include any modification, re-enactment or legislative provisions substituted for the same;
 - (f) a document referred to herein shall be incorporated into and form part of this General Determination and a reference to such document is to the document as modified from time to time;
 - (g) expressions cognate with those used herein shall be construed accordingly;
 - (h) use of the word "include" or "including" is to be construed as being without limitation; and
 - (i) words importing the singular shall include the plural and vice versa, and words importing the whole shall be treated as including a reference to any part unless explicitly limited.

3 Legislative and Procedural Background

- (1) This General Determination has been undertaken in accordance with section 62 of the RAA and the exercise by the Authority of its powers under sections 6, 14, 65(2) and 68 of the EA.
- (2) The Authority initiated this consultation by publishing a Consultation Document on 16 March 2017 that invited responses from members of the public, including electricity sectoral participants and sectoral providers, as well as other interested parties. The purpose of the Authority’s initial Consultation Document was to consult on the transitional tariff set forth in the EGD.
- (3) The Consultation Document asked the following questions:

- What is your view of the how renewable energy, in particular solar PV has evolved in Bermuda? Please provide views on the uptake of this technology and other technologies which may be beneficial to Bermuda.
- Looking to the future, how important do you believe solar PV is for Bermuda? If a respondent views solar PV as important please provide your views on what its costs and benefits are, how these should be quantified, and how these should be reflected in the framework for electricity regulation.
- Should there be capacity limits on solar systems installed on individual customers' premises in Bermuda? Should this be included within a formal licensing framework?
 - If so, who should be responsible for assessing the system sizes and their limits (BELCO, Department of Planning, RAB, etc.)
 - Should solar PV system sizing for a customers' premises be limited to the prior 12-month consumption of a residence/business and/or should it be based on forecasted consumption?
- The Authority has, via the Emergency General Determination, and on a transitional basis, mandated that BELCO should pay for electricity received from Solar PV systems on the basis of the Energy Commission recommendations of October 2016 (see the Determination for detail). What are your views on this transitional measure?
- What level and type of cost transparency should be mandated on BELCO to facilitate the determination of an appropriate feed-in tariff for electricity provided by Solar PV? In particular:
 - The Authority intends to mandate full accounting separation between BELCO's (i) generating, and (ii) transmission, distribution and retail activities. Please provide your views on specific aspects of BELCO's operational activities that are relevant to the cost transparency and related determination of the feed-in tariff rate?
 - What levels of cost element transparency would you expect within a BELCO feed-in tariff for Solar PV?
- What do you believe should be the economic basis for renewable energy systems in Bermuda, specifically in the context of feed-in tariffs? Alongside any general comments by respondents please provided responses to the following:
 - Should BELCO's renewable energy Metering Scheme reflect a cost-benefit methodology or an avoided cost methodology?
 - What cost rate design for renewable energy participants is best suited to incentivizing greater utilization of cleaner energy sources and technologies in Bermuda?
 - What other factors should be considered in determining the cost rate design for feed-in tariffs?
- Should solar PV or other renewable energy programs be incentivized within a specific regulatory framework for renewables in Bermuda?
- In your view, are there any barriers to solar PV or other forms of renewable generation investment?
 - If so, what are these barriers?

- How could they be removed to enable further investment?
- (4) The Consultation Document also invited respondents to raise any other matters that the Authority should consider regarding the transitional solar feed-in tariff.
 - (5) Responses to the Consultation Document were solicited from the public electronically through the Authority's website at rab.bm.
 - (6) The response period commenced on 16 May 2017 and concluded on 27 April 2017.
 - (7) The Authority received eighty-three responses from the public.

4 Final Determination

- (1) Pursuant to section 62 of the RAA and in accordance with sections 6, 14, 17, 20 and 24 of the EA using the general powers granted to the Authority under section 13 of the RAA and in accordance with the procedures established for this purpose in section 62 of the RAA, the Authority hereby determines that:
 - (2) The adoption and implementation of the Transitional Measures for BELCO's Renewable Energy Metering Scheme as set forth in paragraph 6 of this Schedule below is in the public interest and would (i) provide certainty on this matter to sectoral providers; (ii) promote the use of cleaner energy sources and technologies; (iii) provide sectoral participants and end-users with non-discriminatory interconnection to transmission and distribution systems; (iv) promote the Bermuda economy; and (v) promote and preserve competition.

5 Transitional Measures for BELCO's Renewable Energy Metering Scheme ("Transitional Measures")

- (1) BELCO shall continue to operate its Small Scale Residential Net Metering Scheme in accordance with the following recommendations set out in section 2 of the EC Response:
 - (a) The transitional solar PV power purchase program should be adopted for both the residential and commercial solar PV producers with the BELCO avoided cost proposed rate of \$0.1736 per KWh for new renewable energy systems going forward, with no limit on the number of participants as proposed by BELCO.
 - (c) The financial cost of power purchase is fully absorbed by BELCO until a new power purchase regime is implemented by the Authority. Costs for power purchase are to be allocated to a FAR like recovery account as of January 1, 2017 as stated in the [EC's] recent rate case filing directive.

For the avoidance of doubt, BELCO shall pay to Renewable Energy Participants in respect of any energy exported to BELCO's grid in any calendar month and which they sell to BELCO:

- (i) from 15 August 2016 until 31 December 2016, the CRSEER; and
 - (ii) from 1 January 2017 until the issuance by the Authority of an Administrative Determination on BELCO's proposed changes to the Solar Net Metering Scheme or any General Determination pursuant to section 36 of the EA, a rate of \$0.1736 per KWh.
- (2) BELCO shall continue to pay Renewable Energy Metering Payments to Renewable Energy Participants in accordance with paragraph 5(1) of this Schedule pending issuance by the Authority of an Administrative Determination

on BELCO's proposed changes to the Renewable Energy Metering Scheme or any General Determination pursuant to section 36 of the EA.

- (3) BELCO shall forthwith pay to Renewable Energy Participants any difference between (i) the actual payments made by BELCO to Renewable Energy Participants under the Scheme and (ii) the amounts payable by BELCO to Renewable Energy Participants in accordance with paragraph 6(1) of this Schedule, pending issuance by the Authority of any subsequent Administrative Determination on the Renewable Energy Metering Scheme or any General Determination pursuant to section 36 of the EA.

APPENDIX C

Regulatory Authority of Bermuda

TECHNICAL REPORT ON THE ANALYSIS OF NET METERING AND TRANSITIONAL AVOIDED COST SCHEMES

Submitted by: Nigel Burgess, CEng
23 June 2017

Executive Summary

The Regulatory Authority of Bermuda (Authority) issued, via an Emergency General Determination (“EGD”), a ruling that would provide small scale renewable energy customers with a new feed in tariff (based on avoided costs) and be accepted into a renewable energy program provided by the newly regulated power utility. In this provision, pursuant to the Authority sought a fair and equitable solution for all parties involved and in doing so issued a cost-based transitional scheme for all participants.

The migration from the subsidised net metering program to the avoided cost-based transitional scheme will have an impact on current small scale renewable energy installations, particularly those that export electricity to BELCO. However, the extent of their impact to the migration between schemes will vary, according to the extent to which their renewable energy systems operate beyond the electricity needs of their properties. The analysis report provided in this report will show that the transitional scheme implemented by the EGD does not materially impact on the majority of residential renewable energy installations.

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Introduction

The Regulatory Authority of Bermuda's (the "Authority") decision to implement the Transitional Measures for Bermuda Electric Light Company Limited Solar Net Metering Scheme was based on the recommendations of the former Energy Commission ("EC"). The EC was instructed by the Minister of Economic Development (the "Minister") to include in the inquiry:

- An analysis and assessment of the current Residential Net Metering and Commercial Renewable System Excess Energy Rate ("CRSEER") programmes
- A review of cost-based ratemaking principles and feed in tariffs for solar photovoltaic ("PV") customers that are used in similar sized jurisdictions
- Recommendations for development of transitional feed-in-tariffs rates for independent power producers (residential and commercial) who wish to use the electric grid to distribute the power they generate
- Recommendations for development of rate structures for independent power producers (residential and commercial), which accurately reflect costs incurred by the Bermuda Electric Light Company Limited ("BELCO").
- The inquiry should be carried out in consultation with relevant stakeholders, including BELCO and members of the renewable energy industry.

The recommendations from the EC produced the methodology used in the Transitional Measures for Bermuda Electric Light Company Limited Solar Net Metering Scheme issued by the Authority by Emergency General Determination on 2 March 2017 (the "EGD").

Net Metering Scheme vs Transitional Scheme

The initial net metering program offered by BELCO was a subsidy-based methodology that offered wind, solar, and tidal generation scheme participants the same price for exporting energy to the grid (BELCO), as that at which they buy energy from the grid (BELCO). The BELCO bill or credit was determined from the net of the exported and imported energy.

The EGD terminated the net metering scheme and implemented a transitional program. This transitional program is referred to as net billing and is an avoided cost-based methodology. The difference between the two programs is the energy export price. The price for renewable energy exports is based on the avoided cost to BELCO (and specifically based on the avoided cost rate provided to the EC in August 2016) for producing the energy provided to the grid by the renewable energy customer (scheme participant), which is \$0.1736. This price includes a weighted yearly average of avoided fuel cost, avoided lubrication (used in the engines), and avoided transmission line losses.

It should be noted that both schemes allow the scheme participants to self-consume their produced energy at the BELCO retail rate.

For reference, the initial net metering scheme included wind, solar, and tidal generation systems, however, as solar PV systems occupy over 99% of the total renewable energy systems on the program, analysis was carried out solely on solar PV.

Analysis of the Schemes for Various Loads and Solar PV System Sizes

Moving from the former 'net metering' program to the EGD transitional program (as implemented by the Authority) will have an impact on some of the participants in the prior 'net metering' scheme. However, this impact varies depending on the size of the solar PV system, overall consumption, and consumption patterns of the scheme participant. Scheme participants that have systems appropriately sized to accommodate daytime loads and consumption patterns will have minimal impact. However, participants that have larger systems that are 'over- sized' (i.e. producing more electricity than they will consume) will be more affected. Scheme participants that were formerly of the Commercial Renewable System Excess Energy Rate (CRSEER) program are positively affected by the change to the transitional scheme; the scheme is identical to the CRSEER, save for the benefit of a greater export tariff.

Systems that were considered commercial scale have been excluded from this analysis and the focus is on the former residential scale systems (less than 15kW).

Size and Life of Solar Systems Subject to Cost and Usage Analysis

Analysis included in this report was performed on 2kW, 5kW, 10kW, and 15kW solar PV systems. Various loads were modelled to simulate low to very high electricity consumption by the scheme participants.

The consumption patterns were kept identical for each simulation. However overall consumption was adjusted for low (400kWh/month), medium/average (700kWh/month), high (1100kWh/month) and very high (1500kWh) usage. The analysis was performed over a 25-year period, which is the life expectancy of a solar PV system. However, to keep the analysis uniform, the load, energy consumption, and energy pricing was kept constant over the period.

Only the energy (kWh) portion of the bills were considered in the analysis; taxes, fuel surcharge and the facilities charges are not included in the cost analysis. [Note: The additional BELCO charges are in addition to overall electricity bills and not factored into the selling of energy (kWh) to BELCO. However, it should be noted that the value of the fuel surcharge and taxes are a benefit when self-consuming solar PV system production; this value is not used in the calculations but is noted as additional benefit when self-consuming].

The analysis provided in this report was performed on an adapted form of the System Advisor Model (SAM) analysis tool, which is a performance and financial model designed to facilitate decision making within the renewable energy industry.² The model makes performance predictions and cost of energy estimates for grid-connected power projects based on installation and operating costs and system design parameters (which are specified as inputs to the model). Detailed local load data, including hourly consumption readings over a one-year

² SAM provides analysis of data for various billing and net metering options. The Transitional Program was not an option, therefore the modification of BELCO net metering scheme's results were used. Relevant export data was extracted for analysis to be performed outside of the SAM program into an Excel based program.

period, are not available in Bermuda at this point. Therefore, load models are from residences in Augusta, GA. Was used. They have a similar climate and coastal properties as Bermuda was used.

Summary of Analysis

The results of the analysis, detailed below in Table 1, show the impacts of each load scenario under the two schemes.

In Table 1, for each system size, the annual solar PV production, total self-consumed energy, and total exported energy were kept constant at each consumption (usage) level. The constant consumption level gives each system at that level the same electricity bill in the absence of a renewable energy system. This allows for the total value of solar PV production (annual and per kWh), the value of solar PV exports, and the payback period to be compared in the analysis.

The value of solar PV production per kWh for the net metering and the transitional program are compared in Figure 1. This value gives a standard comparable reference which is independent of the size of the system and only dependent on production and its value. Table 1 outlines and compares these values. These comparable results give a clear representation of the impact of the transition.

Figure 1 shows the value of solar PV production per kWh increasing under each program as the consumption levels increase. As the system becomes larger, the values trend falls. The value of solar PV production under the net metering scheme is \$ 0.336. For the 2kW system the values range from \$0.271 – \$0.334, 5kW system \$0.226 – \$0.303, 10kW system 0.202 – \$0.259 and 15kW system 0.194 – \$0.237 for low to very high energy usage.

This increase in value of solar PV production per kWh between each rise in the consumption level can be attributed to larger self-consumption and less solar PV system energy exported to the grid as the next highest consumption level, which is indicated in Figure 2. The decrease between each system size is solely attributed to the amount of exported system production.

The total solar PV system exports compared to production (Figure 2) for the 2kW system is 40% at low usage, 19% at medium usage, 6% at high usage, and 1% at very high usage levels. The monthly impact to costumers moving from net metering to the transitional program would be \$18.21, \$8.46, \$2.53, and \$0.56, respectively for low, medium, high and very high energy consumers. As shown above, the impact of the net billing is the least to the high-energy consumers. These types of consumers also export the least amount of their solar PV production.

Over-Sized Systems

The greatest exports are from the larger systems where the system production greatly exceeds consumption. The total exports relating to production for the 15kW system is 88% at low usage, 80% at medium usage, 70% at high usage, and 61% at very high usage levels. The monthly impact to costumers moving from net metering to the transitional program would be \$267.50, \$242.64, \$212.75, and \$186.51, respectively for low, medium, high and very high energy consumers.

Average-Sized Systems

The average sized system in Bermuda is 5kW, as stated in the Energy Commission’s Enquiry report, with the average monthly residential consumption at 700kWh a month (medium usage). Scheme participants with these characteristics will export 50% of their energy production to the grid. Their annual electricity portion (excluding facilities charge, fuel surcharge, and taxes) of their bill will be \$1844, with the total value of the solar PV production at \$1913 under the Transitional program (via the EGD). This solar PV production value is \$607 per annum less than that under the Net Metering program. However, as shown, the Transitional program still enables the customers to be in a yearly net credit position with their electricity bill. With capital costs of \$20,852 the simple payback increases from 8.27 years under the Net Metering program to 10.9 years under the Transitional program. The value of the production per kWh in the Transitional program is \$0.255 which is less than the prior net metering value but 100% greater than the levelised cost of electricity (LCOE) –breakeven price of solar PV system considering the capital and operation and maintenance (O&M) cost and lifetime energy production of the system—of \$0.12.

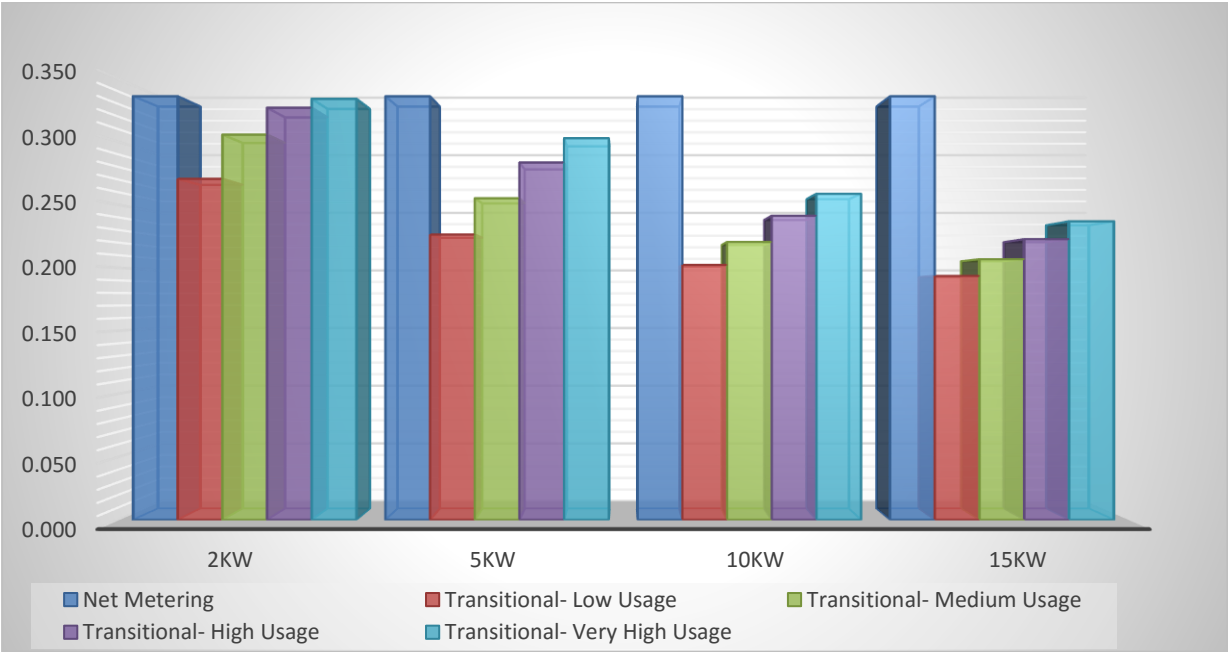


Figure 1: Value of Solar PV Production per kWh: Net Metering-vs- Transitional Program

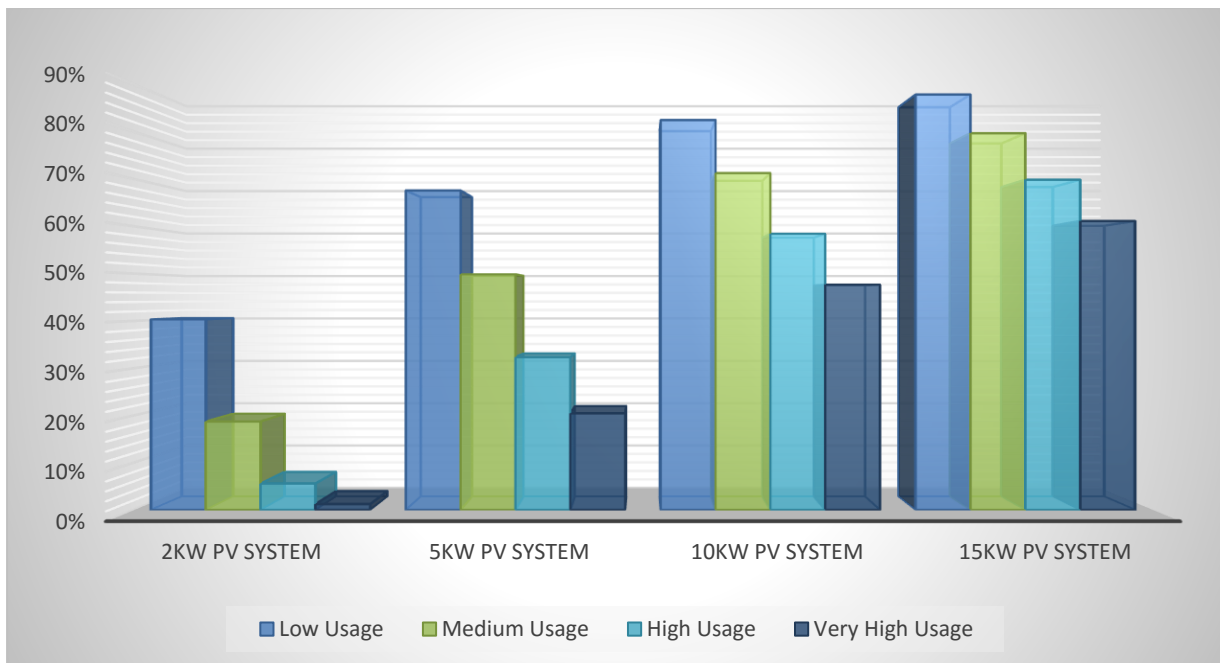


Figure 2: Percentage of Solar PV Production Exported

Conclusion

The migration from the subsidised net metering program to the cost-based transitional scheme does have an impact on current residential solar installations, dependent on the size of their system. While there is a positive impact to former CRSEER customers who have benefited from a better export tariff while remaining on the same program methodology, some former small-scale residential customers are negatively affected. The extent of their exposure to the migration between schemes will vary depending on:

- the size of their solar PV system,
- overall energy consumption, and
- energy consumption patterns.

The analysis shows that there is not a significant variation in the financial return of the small scale solar programs when the exports to the grid are minimised (i.e. when scheme participants have energy production which closely matches their consumption patterns). These participants are the least affected (if affected at all). Those most impacted are the scheme participants who are excessive net energy producers.

Therefore, the average solar PV scheme participant will have limited financial exposure by the move to the transitional program and these participants will continue to be in a net credit position, although with their payback period now increased.

The kWh value of solar (via the output of the model used for this analysis) is comparable for both the prior Net Metering scheme and the EGD scheme when electricity exports are minimised. It should be noted that although this value is reduced when exports are increased, the value is above the LCOE and still provides a significant return on the investment.

The conclusion of this cost and usage analysis is that, as an investment, solar PV systems continue to offer a return on the investment in under half the lifetime of the system. While the EGD has changed the financial rates and methodology, the analysis shows that there is still significant value and a rationale to invest in small scale solar systems. This implies that solar installers could attract new solar scheme participants without the prior subsidisation from the majority of the BELCO customer base (as was the case under the prior net metering scheme or from Government rebate programs).

It should be noted that there is also additional value of solar PV production that is not quantified within the report. The fuel costs and taxes contribute no value to the scheme participants when they export electricity, however all self-consumed energy does include these costs. This is an added benefit of self-consuming and further adds to the importance of sizing a system correctly to get the most value out of the solar PV system.

Table 1: Summary of Results

2kW PV System	400kWh/month		700kWh/month		1100kWh/month		1500kWh/month	
	Low Usage		Medium Usage		High Usage		Very High Usage	
	2kW Net	2kW Trans	2kW Net	2kW Trans	2kW Net	2kW Trans	2kW Net	2kW Trans
Annual PV Production (year 1) kWh	3,333		3,333		3,333		3,333	
Total energy self-consumed (kwh)	1,989		2,708		3,146		3,292	
Total exported energy (kwh)	1,343.99		624.54		186.57		41.42	
Percentage of System energy Exported	40%		19%		6%		1%	
Electricity bill without system (year 1)	905		1,844		3,382		4,996	
Total Value of Production	\$ 1,120.55	\$ 902.02	\$ 1,120.55	\$ 1,019.00	\$ 1,120.55	\$ 1,090.22	\$ 1,120.55	\$ 1,113.82
Value of exports	\$ 451.85	\$ 233.32	\$ 209.97	\$ 108.42	\$ 62.72	\$ 32.39	\$ 13.93	\$ 7.19
Net capital cost	\$9,268		\$9,268		\$9,268		\$9,268	
Payback period (years)	8.27	10.27	8.27	9.10	8.27	8.50	8.27	8.32

5kW PV System	400kWh/month		700kWh/month		1100kWh/month		1500kWh/month	
	Low Usage		Average Usage		Above Average Usage		High Usage	
	5kW Net	5kW Trans	5kW Net	5kW Trans	5kW Net	5kW Trans	5kW Net	5kW Trans
Annual PV Production (year 1) kWh	7,499		7,499		7,499		7,499	
Total energy self-consumed (kwh)	2,435		3,762		5,073		5,964	
Total exported energy (kwh)	5,063.61		3,736.58		2,426.14		1,535.48	
Percentage of System energy Exported	68%		50%		32%		20%	
Electricity bill without system (year 1)	905		1,844		3,382		4,996	
Total Value of Production	\$ 2,521.16	\$ 1,697.82	\$ 2,521.16	\$ 1,913.60	\$ 2,521.16	\$ 2,126.67	\$ 2,521.16	\$ 2,271.49
Value of exports	\$ 1,702.39	\$ 879.04	\$ 1,256.24	\$ 648.67	\$ 815.67	\$ 421.18	\$ 516.23	\$ 266.56
Net capital cost	\$20,852		\$20,852		\$20,852		\$20,852	
Payback period (years)	8.27	12.28	8.27	10.90	8.27	9.80	8.27	9.18

10kW PV System	400kWh/month		700kWh/month		1100kWh/month		1500kWh/month	
	Low Usage		Average Usage		Above Average Usage		High Usage	
	10kW Net	10kW Trans	10kW Net	10kW Trans	10kW Net	10kW Trans	10kW Net	10kW Trans
Annual PV Production (year 1) kWh	15,145		15,145		15,145		15,145	
Total energy self-consumed (kwh)	2,668		4,363		6,302		7,929	
Total exported energy (kwh)	12,476.76		10,781.65		8,843.24		7,216.32	
Percentage of System energy Exported	82%		71%		58%		48%	
Electricity bill without system (year 1)	905		1,844		3,382		4,996	
Total Value of Production	\$ 5,091.75	\$ 3,063.03	\$ 5,091.75	\$ 3,338.65	\$ 5,091.75	\$ 3,653.84	\$ 5,091.75	\$ 3,918.38
Value of exports	\$ 4,194.69	\$ 2,165.97	\$ 3,624.79	\$ 1,871.69	\$ 2,973.10	\$ 1,535.19	\$ 2,426.13	\$ 1,252.75
Net capital cost	\$42,129		\$42,129		\$42,129		\$42,129	
Payback period (years)	8.27	13.75	8.27	12.62	8.27	11.53	8.27	10.75

15kW PV System	400kWh/month		700kWh/month		1100kWh/month		1500kWh/month	
	Low Usage		Average Usage		Above Average Usage		High Usage	
	15kW Net	15kW Trans	15kW Net	15kW Trans	15kW Net	15kW Trans	15kW Net	15kW Trans
Annual PV Production (year 1) kWh	22,497		22,497		22,497		22,497	
Total energy self-consumed (kwh)	2,755		4,590		6,796		8,755	
Total exported energy (kwh)	19,741.60		17,907.36		15,701.43		13,742.13	
Percentage of System energy Exported	88%		80%		70%		61%	
Electricity bill without system (year 1)	905		1,844		\$3,382		\$4,996	
Total Value of Production	\$ 7,563.49	\$ 4,353.51	\$ 7,563.49	\$ 4,651.75	\$ 7,563.49	\$ 5,010.44	\$ 7,563.49	\$ 5,329.02
Value of exports	\$ 6,637.13	\$ 3,427.14	\$ 6,020.45	\$ 3,108.72	\$ 5,278.82	\$ 2,725.77	\$ 4,620.10	\$ 2,385.63
Net capital cost	\$62,556		\$62,556		\$62,556		\$62,556	
Payback period (years)	8.27	14.37	8.27	13.45	8.27	12.49	8.27	11.74