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ORDER

1. In accordance with section 63(1)(a) of the Regulatory Act 2011, the Regulatory Authority (the "Authority") makes this Order issuing the attached Integrated Resource Plan Guidelines to the Transmission, Distribution and Retail ("TD&R") Licensee to provide guidance on the development of the Integrated Resource Plan ("IRP") proposal. Pursuant to section 41(1) of the Electricity Act 2016 ("EA"), the TD&R Licensee shall submit the IRP proposal to the Authority in compliance with the EA, this Order and any other administrative determination, and the request for an IRP Proposal issued on 17th November 2017 under section 40 of the EA. This Order shall be binding upon the TD&R Licensee upon actual notice.
2. So ordered this 6th day of December 2017.

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Integrated Resource Plan Guidelines

1 Introduction

1.1 This note provides guidelines on what would be expected to be included in the Integrated Resource Plan (IRP) proposal ("IRP Proposal") in order to ensure that the Regulatory Authority of Bermuda ('the Authority') is able to: meet its obligations under the Electricity Act 2016 ('EA 2016') in a manner that is consistent with the National Electricity Policy;[1] and implement the regulatory regime established by the electricity sector licences.[2] The recommendations in this note reflect established practice and precedents for the development of IRPs and similar capacity planning exercises seen in a wide variety of relevant regulatory jurisdictions.

2 IRP aims

2.1 The Electricity Act 2016 ('EA') requires that the transmission, distribution and retail ('TD&R') Licensee prepares an IRP Proposal at least every five years as determined by the Authority or as directed by the Minister. This should contain:[3]

> (a) a resource plan that includes the expected demand for the period and the state of the TD&R Licensee's existing resources; and
> (b) a procurement plan that details how the licensee proposes to meet this demand.'

2.2 Furthermore, the EA requires that the TD&R Licensee consider, inter alia:[4]

> (i) all possible resources, including new generation capacity, demand side resources (including demand response and energy efficiency), and retirement of generation capacity; and
> (ii) a range of renewable energy and efficient generation options, and a prudent diversification of the generation portfolio

2.3 The EA also requires that the TD&R Licensee, inter alia:[5]

> prioritise actions that most meet the purposes of this Act, conform to Ministerial directions, and be reasonably likely to supply electricity at the least cost, subject to trade-offs contained in the Ministerial directions or instructions from the Authority

[1] Ministry of Economic Development, (2015). *The National Electricity Sector Policy of Bermuda*. Bermuda, p. 7.
[2] Regulatory Authority of Bermuda, (2017). *Administrative determinations*. Available at: http://www.rab.bm/index.php/ele-admin-determinations
[3] Bermuda Electricity Act (2016), para 40.
[4] Ibid., para 40 (2)(a).
[5] Ibid., para 40 (2)(b).

2.4 The Authority may, subsequent to a process of consultation and review, approve the IRP Proposal issued by the TD&R Licensee, provided that it is the most appropriate approach to meeting the purposes of the EA 2016 and complies with ministerial directions.[6]

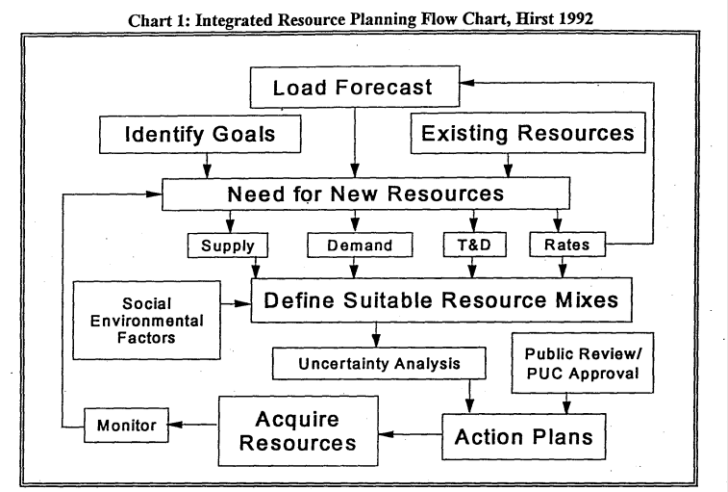
2.5 The IRP Proposal would therefore be expected to be credible, comprehensive in its treatment of available resources (whether currently available or anticipated to be available in future), auditable, and robust to identifiable sources of uncertainty in order to enable the Authority to:

- approve the lowest cost, or otherwise most appropriate, electricity capacity expansion plan that meets demand at lowest overall cost and with acceptable levels of system reliability and implementation risk to consumers;
- assess the economic, environmental, and social implications of adopting alternative capacity expansion plans so as to be able to determine the optimal trade-offs contained in ministerial directions; and
- evaluate the merits of applications by prospective independent power producers ("IPPs") or other licensees as well as other proposals that entail deviations from the IRP, in particular by calculating their benefits, costs, and risks to the electricity system.

2.6 A typical IRP development process as advised for the regulation of US electricity systems is summarised in the box below. While individual implementations may differ, this representation is included here as it shows the interaction of the main planning elements.

[6] Ibid., para 44 (2).

Box 1.1 Example of a typical IRP development process



- The initial load forecast identifies the future capacity and energy demand levels, which can be met from a mix of generation and demand-side resources.
- An IRP necessarily requires a large number of detailed assumptions to be made, for example as regards the evolution of macroeconomic performance, policy, technological improvements, resource costs and availability, and fuel prices and availability.
- The selection of the quantity and type of resources needed to meet demand and to satisfy other policy objectives ultimately allows overall system costs, and therefore tariff levels, to be estimated. The schedule of net capacity additions is typically selected based on a least-cost mathematical programming methodology that recognises a wide range of technical, operational, and economic constraints.
- Changes in expected future tariffs may, in turn, influence demand and this interaction could also be internalised in the load forecast.
- Given the high degree of uncertainty in the outturns of input parameters and other unforeseen developments, an IRP typically includes some analysis of alternative scenarios. IRPs are also typically updated periodically.

Source: Harrington et al. (1994), 'Integrated Resource Planning for State Utility Regulators', The Regulatory Assistance Project, June, p. 12.

3 IRP requirements

3A Approach and methodology

3.1 The IRP is the main output of a long-term system capacity planning process undertaken by the TD&R Licensee. At a high level, the IRP is focussed on achieving a balance between the two sides of the following equation.

$$Peak\ demand\ forecast + Reserve\ margin = Planned\ energy\ generation + Demand\ side\ response$$

3.2 The result of balancing the above equation is a schedule of planned capacity retirements, capacity additions, demand-side resource additions, technology mix, and fuel mix that meets

forecast demand while also satisfying other policy objectives related to system reliability and environmental performance as well as other technical, operational, and economic constraints.

3.3 The IRP would be expected to be based on a quantitative modelling methodology, developed using a mathematical programming approach to arrive at an optimal, least-cost capacity expansion plan that explicitly recognises a range of policy objectives as well as technical, operating, and economic constraints.

3.4 Given the asset lives applicable for electricity infrastructure, the IRP planning horizon would be expected to be at least 20 years.

3.5 In order to ensure that the IRP is credible, comprehensive, and auditable, the modelling methodology used would be expected to be transparent and well documented. In particular, the model or models underpinning the IRP would be expected to be provided to the Authority in the native format(s).

3B Policy objectives

3.6 As mentioned in section 2, the EA requires that the IRP reflects guidance from the Authority on the implicit trade-offs between key policy objectives, including overall system reliability, environmental sustainability, and affordability (i.e., costs to consumers and other users).

3.7 In the absence of specific Ministerial directions to the contrary, the IRP would be expected to reflect the objective of, at a minimum, broadly maintaining historical levels of overall system reliability.

3.8 In recognition of the fact that a robust system reliability target is critical to long-term system planning and that to date no explicit statistical measure of system reliability has been used to guide long-term system planning, the IRP would be expected to specify a suitable reliability target in terms of the Loss of Load Expectation (LOLE).[7]

3.9 The IRP would also be expected to specify a suitable 'shadow' carbon price (i.e., a price reflecting the external costs of climate change that are expected to result from greenhouse gas

[7] LOLE measures the average number of hours during which demand is statistically expected to exceed generation capacity. A statistical measure of system reliability, such as the LOLE, accounts for the variation in demand and the configuration of generation assets and so facilitates benchmarking with other markets and jurisdictions. In order to facilitate this, the Authority would expect that the TD&R Licensee documents its main policies and mitigation procedures at times when peak load exceeds (or threatens to exceed) available generation resources under normal conditions. In particular, it is expected that policies and procedures concerning treatment of interruptible loads and re-scheduling of maintenance as well as emergency generator ratings, voltage reductions, and load shedding are documented.

emissions) in order to broadly achieve the government's 'aspirational electricity generation matrix'.[8] For example, emission reductions can be included in the objective function using an emission price (e.g. the CO2 price) benchmarked against comparable jurisdictions.

3C Input assumptions

3.10 Consistent with the requirement for a quantitative modelling methodology, the IRP requires a large number of numerical inputs and assumptions to be used. For example, these inputs would be expected to include (this list is not intended to be exhaustive):

- data on the existing generation and demand-side resources, their capital and operating costs, fuel costs, technical and other operating characteristics, and expected retirement dates;
- assumptions on future macroeconomic performance (e.g., growth), government policy, and consumer, commercial and industrial demand;
- assumptions on capital, operating, and fuel costs of future generation and demand-side resources as well as constraints on their availability;
- technical and operating characteristics of future generation technologies and their availability; and
- prices for input fuels and other related commodities as well as the availability of import infrastructure.

3.11 The IRP input data and assumptions would be expected to be consistent with the Authority's past determinations. For example, the discount rate and other financial parameters used would be expected to be consistent with any recent tariff determinations.

3.12 The TD&R Licensee would be expected to engage constructively with its customers and other stakeholders on the appropriate input assumptions to be used in the IRP. In particular, views would be expected to be sought by the TD&R Licensee from stakeholders on the future availability of alternative fuels, renewable generation resources, demand-side resources, and the overall demand outlook.

3.13 In order to ensure that the IRP is credible, comprehensive, and auditable, the data inputs and assumption used would be expected to be transparent and well documented. In particular, the

[8] Ministry of Economic Development, (2015). *The National Electricity Sector Policy of Bermuda*. Bermuda, p. 7.

IRP would be expected to include detailed references and other supporting documentation where necessary to show how the various input assumptions where selected.[9]

3D Scenario analysis

3.14 Given the potential for a high degree of uncertainty in the outturns of certain input assumptions and other unforeseen developments, the IRP would be expected to include a variety of alternative scenarios alongside the 'base case'. For example, alternative scenarios would be expected to show the impact of:

- demand uncertainty;
- fuel price uncertainty;
- alternative carbon price assumptions;
- alternative capital and operating cost assumptions for future generation resources;
- alternative demand-side resource availability assumptions; and
- extended operation of existing generation resources beyond their planned retirement dates.

3.15 These scenarios would be expected to be targeted at the assumptions that have the greatest impact on overall system costs. Plausible 'high' and 'low' scenarios would be expected to be provided alongside the 'base case' for each source of uncertainty individually. In addition, alternative scenarios may be presented that illustrate the combined impact of two or more sources of uncertainty, as appropriate.

3.16 In order to ensure that the IRP is credible, comprehensive, and auditable, the data inputs and assumptions used in the alternative scenarios as well as the rationale for the selection of alternative scenarios included would be expected to be transparent and well documented.

3E System costs and tariffs

3.17 In order to enable the Authority to evaluate the most appropriate capacity expansion plan that meets demand at lowest overall cost and with acceptable levels of system reliability and implementation risk to consumers, the IRP would be expected to provide the following outputs:

[9] For example, the methodology used to develop the load forecast would be expected to be documented in detail, alongside the responses received in the course of any stakeholder engagement process.

- the schedule of planned capacity retirements, capacity additions, demand-side resource additions, technology mix, and fuel mix that is implied by the policy objectives and input assumptions used;
- the impact of the above schedule on expected network costs; and
- the impact of the above schedule on overall system costs and tariffs.

3.18 The above outputs would be expected to be provided for the base case as well as any alternative scenarios presented in accordance with section 3D.

3F Replacement of generation facilities

Any replacement of generation assets (permanent or temporary) needs to be consistent with section 20 of the Bulk Generation Licence (License number BG2017102701-02). In particular, the Authority will make a determination on whether the net benefits resulting from the replacement of the generating facilities are commensurate with the net benefits of other options that may be available in the market, particularly within any proposed timeline for any such replacement of generation assets.

3.19 The Authority would expect any notification under section 20 of the Bulk Generation Licence to be consistent with the obligations and responsibilities of such licence, with regards to ensuring security, reliability of supply and meeting performance standards. The Authority notes that the BG Licensee is currently subject to ‘Transitional’ conditions relating to various aspects of performance standards.