FINANCIAL AND ECONOMIC ANALYSIS

I. FINANCIAL ANALYSIS

A. Financial Internal Rate of Return

1. Context of the Analysis

1. The principal objectives of the project are to increase generation efficiency and to improve the availability and reliability of electricity supply by the Nauru Utilities Corporation (NUC). Additional objectives are to improve the sustainability of the existing NUC powerhouse, particularly in terms of environmental health and safety. The project will deliver new diesel-fired generation to provide reliable base-load power for the NUC, allowing the corporation to retire older generation assets and perform scheduled refurbishment of existing units to extend their service lives. The project will also include improvements to the existing structure housing the NUC's generation units.

2. Methodology

2. The financial analysis of the project was carried out in accordance with Asian Development Bank (ADB) Guidelines.[1] All financial costs and benefits are expressed in mid-2014 prices. Cost streams used for calculating the financial internal rate of return (FIRR) are capital investment and operation and maintenance (O&M) costs at market prices inclusive of taxes and duties. The financial and economic analysis has to be caveated in respect of the severe limitations at the NUC relating to fuel metering, gross generation output, and residential customer consumption. NUC staff have cooperated in attempts to accurately determine fuel consumption, generation output, and sales data, but the severe metering inadequacies leave a high degree of uncertainty. Consequently, assumptions of some key parameters are based on the best estimates of the NUC and consultants.

3. **Projected financial costs and benefits**. The project financial analysis quantifies costs and benefits of the project for the project implementing agency (the NUC), for the investment project as a whole, and for each project component. For the new generator component, project financial costs include (i) the initial cost of the hardware and electrical works needed for the installation and integration with the NUC's electrical grid; (ii) annual and periodic O&M expenditures, including parts replacements as needed; and (iii) consulting services for design, tendering, training, and project supervision as required (2015–2016). The project physical and price contingencies are included in the total financial costs. Physical contingencies are assumed to be 10.0% of the base costs and price contingencies are estimated at 2.5% on foreign exchange costs and 5.0% on local currency costs. Table 1 (supplementary document) shows the financial costs for the project, which total $5,535,901.

4. **Fuel costs**. For the new diesel generator, diesel fuel and lube oil prices are assumed to be constant for the 25-year project. The prices assumed for 2014 are $1.3 per liter for diesel and $2.3 per liter for lube oil.

5. **Retail tariffs**. The Government of Nauru recently announced new retail tariffs for 2014. The financial analysis assumes an average tariff based on the estimated weighted average price across customer classes for 2013 and 2014. Thereafter, tariffs are assumed to be

[1] ADB. 2005. *Financial Management and Analysis of Projects.* Manila.

constant for the 25-year period. Table 2 (supplementary document) shows the calculation for the weighted average tariff for 2014. In addition, for the revenues calculation it assumes 90% of the weighted average tariff, with the remaining 10% assumed to cover supply and distribution costs.

6. **Project technical inputs**. The specific size and performance characteristics of the new generator are unknown at this stage. For the purpose of the analysis, standard market data and assumptions by the project preparatory technical assistance consultant have been used where possible. Table 3 (supplementary document) shows the assumed generator characteristics and the power output of the generator.

7. **System losses**. There is little information on system losses at this stage. This study has adopted the data published by KEMA International in May 2012 for the purpose of calculating electricity available for sale.[2] Losses data are shown in Table 3 (supplementary document).

8. **Operational costs**. The plant operational costs have been estimated at $8 per megawatt-hour.

9. **Weighted average cost of capital**. Deriving a cost of capital for the NUC is not straightforward as the corporation's capital structure is 100% government equity and no return on equity has previously been applied to it. The NUC does not have any borrowings, nor does it pay a dividend. Consequently, it has neither a cost of debt nor a cost of equity. In addition, it is difficult to derive a real opportunity cost of capital for Nauru. As a result, the approach followed has been to calculate a real, pre-tax weighted average cost of capital (WACC) based on the ability to use ADB grant funds and government contribution in other financially attractive projects for the country in line with other Asian Development Fund grant projects in the Pacific. The adopted nominal post-tax WACC value of 10% represents an estimation of such opportunity cost. This nominal WACC has been converted to real pre-tax WACC using an inflation rate of 2.5% and a tax rate of zero. The derived value is thus 7.32%.

3. Calculation of Financial Internal Rate of Return and Sensitivity Analysis

10. The combined project has a financial internal rate of return (FIRR) of 11.5%, and a financial net present value (FNPV), using a financial discount rate equal to the WACC of 7.32%, of $3.69 million. Sensitivity analysis was carried out on the following key parameters:

(i) Increase in costs:
   (a) Increase in capital and operational expenditures by 20%. The project FIRR decreases to 9.8% and the FNPV reaches $2.38 million.

(ii) Decrease in benefits:
   (a) Increase in fuel and lube oil costs by 10%. The project FIRR decreases to 2.4% and the FNPV decreases to –$4.01 million.
   (b) Decrease in tariffs by 10%. The project FIRR decreases to 0.74% and the FNPV reaches –$5.14 million.
   (c) Decrease in energy output by 20%. The project FIRR decreases to 9.65% and the FNPV is $1.88 million.
   (d) In the combination of these four cases, the FNPV becomes negative with a value of –$12.68 million.

[2] Pacific Power Association. 2012. *Quantification of the Power System Energy Losses in South Pacific Utilities for Nauru Utilities Corporation*. Suva.

11. Table 4 (supplementary document) shows the financial results of the analysis including the sensitivity indicator (SI)[3] and the switching value (SV).[4]

12. The results are heavily sensitive to fuel prices and tariffs. At present, the NUC does not pay for the fuel and the analysis has shown that, if the NUC is to pay for the fuel, tariffs need to increase at least with inflation to cover costs. Sensitivity was carried out keeping all values constant, and the results were negative. This is because the calculated levelized cost of energy is $350 per megawatt-hour (MWh), but when losses and auxiliary service consumption is added, it increases to $444/MWh, which is higher than the weighted average tariff.

4. Financial Performance and Projections

13. **Historical financial performance**. The NUC provides power to all households in Nauru, and all businesses and government offices with the notable exception of the Nauru Phosphate Corporation mining operations. Until very recently, electricity tariffs for all customer categories, but particularly the residential sector, were set well below full cost-recovery levels. However, increases are understood to be in the pipeline, and these will significantly increase the NUC's revenues. In the residential sector, tariffs are set to virtually double but still remain well below full cost-recovery levels.

14. The NUC has only produced one set of partial audited accounts, for 2013. These accounts indicate that tariffs have a significant impact on NUC's finances. Although the NUC does not pay for fuel (it is supplied free by the government), does not have outstanding debts to service, and does not pay dividends to the sole shareholder (the government), an A$1.55 million subsidy payment from the Government of Australia was required for the NUC to register a very small operating profit for the year. It is apparent that the NUC is operating at well below cost-recovery levels.

15. **Projected financial performance.** Financial projections through 2041 have been prepared solely for the project (and not for the NUC as a whole):

(i) World fuel prices will rise in real terms. In addition, nominal values have been calculated applying United States inflation rates for fuel and lube prices.
(ii) Financial projections have been undertaken using the weighted average retail tariff for 2014 to all NUC consumers and applying Australian inflation rates to calculate the nominal value over time.
(iii) Australian inflation rates have been applied to operation and maintenance costs over time.
(iv) Full depreciation is charged to operating costs for income statement projections over the life of the project.
(v) The project components contribute towards absorbing demand for electricity from current off-grid customers, starting in mid-2016.
(vi) The project is financed through international grants to the government and booked as capital at the NUC level, avoiding potential debt repayment issues.
(vii) If the analysis is undertaken assuming prices in real terms, the net present value is negative.

[3] SI: The ratio of the percentage change in net present value to the percentage change in a selected variable. A high value for the indicator (at least greater than 1.0) indicates project sensitivity to the variable.
[4] SV: In sensitivity analysis, the percentage change in a variable for the project decision to change, i.e., for the economic net present value to become zero or the EIRR to fall to the cut-off rate.

16. **Financial performance and projections of the project**. The financial projections show that the project can save up to 21.6% on fuel costs per kilowatt-hour (kWh) generated, compared with current fleet, because of its higher efficiency. In the case where the project displaces current diesel generation, the NUC will benefit from lower costs in terms of fuel, lubricants, and operation and maintenance per kWh sold.

B. Performance of the Nauru Utilities Corporation

17. In its financial statements for July 2013 to June 2014, the NUC reported net revenue of $4.10 million and total costs of $3.59 million, excluding a doubtful debtors allowance of $139,500. However, the accounts did not include the cost of fuel, which has been estimated at $10.85 million, resulting in a net deficit for the NUC of $10.30 million for the period.

18. For July 2014 to June 2015, it is assumed that total sales of electricity will be 21.2 gigawatt-hours (GWh). This would result in $9.60 million of revenue from electricity sales and total revenues increasing to $10.07 million. However, if costs are kept constant, the NUC would still have a deficit of $4.4 million.

19. After the new generator has been commissioned, the financial performance of the NUC will improve on an output basis. That is, the cost per MWh sold will be lower, driven by the better efficiency of the project compared to the current system.

20. An analysis has been undertaken to assess the impact of the new project in the NUC's accounts. The assumption made is that the new generating equipment will be utilized to provide electricity to unserved residential customers, to commercial customers who use their own generators, and to displace some of the old generators. The analysis estimates that in July 2017 to June 2018 sales could reach 28.46 GWh with estimated revenue of $12.96 million, increasing total revenues to $13.23 million. Another assumption made in this analysis is that operation and maintenance and selling, general, and administrative costs could be reduced by approximately 13%. In this scenario, total fuel costs are estimated at $12.37 million, which would reduce the deficit to $2.08 million.

21. **Tariff**. The tariff would need to increase further to cover the cost of generation and supply. A 15%–20% increase will help to reduce the deficit to zero. However, other issues might arise with electricity theft, unpaid bills, and commercial customers switching to self-generation (in the event that the retail tariff increases to a level that is above their own generation costs).

C. Financial Management Assessment

22. A financial management assessment was carried out at the NUC. The NUC's financial management systems and practices, like its other business processes, are only recently established and rudimentary in nature. An Australian-qualified accountant was appointed to the NUC as finance director in early 2014 and has begun to introduce and implement acceptable financial management practices at the NUC.

23. NUC accounting policies and procedures appear to be generally consistent with international best practice, with a number of limitations. The NUC currently runs its own computer-based accounting system (Mind Your Own Business) but does not have the ability to generate detailed project reports. The current subsidies received from the Government of Nauru (in terms of fuel for the power station) or from Australia or the European Union are simply journalized in NUC's accounts to recognize the value of the subsidy received, whilst accounting

for the expense or asset in NUC's books to recognize the transaction. There is no further breakdown of the project funds budget, balance, etc. This is a limitation that can impact the NUC's ability to account for and report the value of its in-kind contribution to the project.

II. ECONOMIC ANALYSIS

A. Macroeconomic Context

24. Nauru has experienced strong economic growth in very recent years, following a sustained period of economic decline due largely to the collapse of the phosphate mining industry on the island. The recent growth is due mainly to three factors:

(i) expansion of the refugee processing center, which has created permanent employment opportunities; short-term construction-related employment opportunities; and related economic activity such as hotels, restaurants, and retail outlets;
(ii) improved phosphate production; and
(iii) substantial development partner funding from donors such as ADB, the EU, and the Government of Australia for key infrastructure projects.

25. Until several years ago, the phosphate corporation was responsible for the generation, distribution, and supply of electricity. The decline of the phosphate industry and near-total collapse of the Nauruan economy left Nauru's diesel-fired generation assets dilapidated, unreliable, and extremely inefficient. All of the NUC's installed generators are operating at far below their rated capacity and are nearing the end of their useful lives. The powerhouse (physical structure) is also in poor condition, which represents a vulnerability to Nauru's supply security. While Nauru is virtually 100% electrified, service reliability is extremely poor. Unscheduled—and often prolonged —interruptions are frequent. As in other parts of the Pacific where significant intermittent renewable generation sources are being introduced into legacy diesel-based systems (e.g., Yap), Nauru will remain reliant on thermal generation (i.e., diesel) for its base load and for system stability and reliability for the foreseeable future.

B. Least-Cost Analysis

26. A least-cost analysis was undertaken in assessing energy options for Nauru. Renewable energy options such as wind and solar have been assessed in earlier studies. These options are not currently cost-effective; the wind resource in Nauru is extremely intermittent, for example. Solar insolation characteristics are reasonable in Nauru and a site has been earmarked for a major solar farm. However, the investment requirements for this solar farm are considerable ($70 million) and no funding has yet been forthcoming. An energy road map was included in the 2012 Nauru Economic Infrastructure Strategic Investment Plan and aims to progressively address the possible replacement of fossil fuels with renewable energy. However, a 2013 report by the International Renewable Energy Agency lists several significant challenges and barriers to enhanced deployment of renewable energy technologies in Nauru.[5]

27. Medium-speed light-fuel-oil or diesel reciprocating engines of 2.6–3.0 megawatt capacity have been identified as the optimum solution to Nauru's current situation. One unit is to be funded jointly by the Asian Development Fund and the European Union under this project. A similar unit is to be supplied under funding from the Government of Australia.

[5] International Renewable Energy Agency. 2013. *Renewable energy opportunities and challenges in the Pacific Islands region: Nauru.* Abu Dhabi.

28. The key scope of this project is a new, medium-speed diesel generator. However, additional works have also been identified to ensure that the generation units in the NUC's powerhouse can operate sustainably. These additional works are as follows:

(i) rehabilitating the powerhouse roof, which contains asbestos and allows significant volumes of water to leak into the powerhouse during storms;
(ii) demolishing an old and redundant water tower that is structurally unsound and is in danger of collapsing, jeopardizing NUC's core operations;
(iii) constructing a water collection and oil separation facility to eliminate the accumulation of sump oil beneath the floor of the powerhouse (a significant fire hazard); and
(iv) undertaking site preparation works that are essential for the new generator under this project and also the one to be supplied under Australian funding.

29. Of these different work streams, only the new diesel generator has a readily defined benefit stream—more efficient and reliable electricity production and the possibility to serve current unserved demand. The other work streams have benefits associated with them but these are difficult to quantify accurately. The new generator and the roof rehabilitation are to be grant-funded under this project, whilst the remainder of the scope is to be financed directly by the government or the NUC as a condition of the grant.

30. The benefits of the new generator can be summarized as follows:

(i) The new unit will increase the system capacity, allowing the NUC to supply unserved demand thus reducing self-generation by the commercial and industry sector.
(ii) The higher-efficiency diesel generator funded by this investment will consume less diesel fuel than would be consumed without the project.
(iii) The new unit will be more reliable than the existing generators and will thus also improve supply reliability to consumers and reduce the frequency and duration of outages.

31. The economic analysis is undertaken for the project in its entirety, including the work streams to be financed by the government or the NUC. Equally, the benefits from each work stream are aggregated.

32. A with-project scenario is compared directly to a without-project scenario in accordance with Asian Development Bank (ADB) guidelines.[6] The project operating period is 25 years following full commissioning in the third quarter of 2016. All benefits and costs are expressed in constant mid-2014 prices. The domestic price level is adopted for tradable inputs, from which taxes and duties have been removed. A shadow wage rate for unskilled labor of 0.85 of the market wage rate has been applied to the unskilled labor component of the capital and operation and maintenance costs. Nauru uses the Australian dollar as its national currency and Australia is the country's main trading partner. The shadow exchange rate factor has been calculated by applying the trade-weighted-estimate approach outlined in an ADB Economics and Research Department technical note. Use of the simplified formula for calculating the standard conversion factor (SCF) suggested in the technical note is justified in view of the lack of the data in Nauru that would be required for a more detailed analysis.[7]

[6] ADB. 1997. *Guidelines for the Economic Analysis of Projects*. Manila.
[7] The formula for the simple trade-weighted formula is: SCF= (Imports [cif] + Exports [fob])/([Imports + Import taxes] + [Exports – Export taxes])

33. The following trade-related data have been obtained from the Nauru Bureau of Statistics:
(i) imports (cif) (2013): A$146.0 million;
(ii) exports (fob) (2013): A$49.0 million;
(iii) import taxes (FY2014 proposed budget): A$16.9 million; and
(iv) export taxes (FY2014 proposed budget): A$0.0.

34. Applying these values, the SCF for Nauru for FY2014 is 0.92 and the shadow exchange rate factor is therefore 1.09.

1. Economic Costs

35. For the new diesel generator, project economic costs include (i) the initial costs of the hardware and electrical works needed for the installation and integration with the NUC's electrical grid; (ii) incremental annual and periodic operation and maintenance expenditures, including parts replacements as needed, required for the component through its useful life; and (iii) consulting services for design, tendering, training, and project supervision as required (2015–2016). The project physical contingency is included in the total economic costs. The other elements of the work scope (import duty and price contingency) are not treated as having economic costs per se. Total financial costs excluding price contingencies and taxes are $5,125,538, which converts to an economic cost of $5,489,623. The economic costs are presented in Table 5 (supplementary document).

2. Economic Benefits

36. The quantified economic benefits of the new diesel generator are as follows:
(i) **Nonincremental benefit:**
(a) Operating savings in fuel, lube oil, and operational expenditures on the electricity displaced by the new generator.
(b) Savings made by supplying commercial and industrial customers who currently self-generate when the NUC supply fails.
(ii) **Incremental benefit:**
(a) Increased system capacity to supply unserved demand and increased demand from residential customers.

37. The benefits have been quantified as follows:
(i) **Nonincremental benefits:**
(a) These benefits have been measured by calculating the net savings of displacing electricity generated by the old generators with electricity generated by the new generator. Table 6 (supplementary document) shows the data used for the calculations of the savings made in dollars/MWh.
(b) These benefits to commercial customers have been calculated by the savings made between their own self-generation costs and the costs of supply with the new generator. The average costs of self-generation has been estimated at $750/MWh, using the following assumptions:
(1) average cost per MWh of a 100 kilowatt (kW) unit ($630/MWh) with a weight of 75%, and
(2) average cost per MWh of a 5 kW unit ($1,130/MWh) with a weight of 25%.

(ii) **Incremental benefits:**

(a) The cost of unserved demand in Nauru and the willingness to pay by residential customers is unknown. For the purpose of this study the average residential tariff in the Pacific Rim has been used, which it is $420/MWh.

(b) Unserved residential demand has been estimated at 20%.

38. Future demand growth has been projected using the average expected population growth at 1.8% per annum.

39. In the with-project scenario there are a number of benefits that result from eliminating the existing inadequacies in and around the NUC powerhouse, as detailed and evaluated in Table 7 (supplementary document).

3. Economic Internal Rate of Return, Economic Net Present Value, and Levelized Cost of Energy

40. The tariff in real terms for each customer class (residential, commercial, and government) is assumed to remain constant. Current tariffs are shown in Table 8 (supplementary document).

41. The project is expected to generate 20,323 MWh per annum and to result in fuel savings of around 21.6% per kWh generated compared to the old system, which equates to approximately 1.5 million liters per annum.

42. In addition, the benefits shown in Table 7 (supplementary document) have been included in the economic analysis of the project.

43. The economic internal rate of return of the consolidated project is 48.3%, with a project economic net present value of $10.50 million. The levelized cost of energy from the new diesel installation, calculated over its 25-year life cycle using a discount rate of 12%, is $0.35/kWh. The economic costs and benefits of the project over the project life are presented in Table 9 (supplementary document).

44. A sensitivity analysis has been carried out to analyze the impact of the main variables in the economic results. Table 10 (supplementary document) shows the results of this analysis.

45. Overall, the project shows robust results, with the economic internal rate of return remaining well above a 12% hurdle rate under all cases investigated.