# 9 FINANCIAL AND ECONOMIC ANALYSIS

The financial and economic analysis of the master plan seeks to answer two key questions:

- What is the financial impact on the electricity distribution utilities that receive rural electrification assets and have to operate and maintain them; and
- From Government's perspective as an investor in rural electrification, how do the revenues generated and other economic benefits derived from rural electrified consumers relate to the investments made in infrastructure.

It is noted that the scope of this master plan is restricted to grid electrification only. Off-grid areas previously identified in the Off-grid Energisation Plan have not been considered in the planning activities, and are not considered in the present financial and economic analysis.

## 9.1 Financial Analysis

### 9.1.1 Methodology and Approach

#### 9.1.1.1 Definition of Distribution Entities

The financial analysis quantifies the financial impact on the utilities receiving rural electrification assets. For this reason, a financial analysis is done for each distribution area that is currently active, i.e. the analysis is undertaken for the three existing REDs, namely NORED, CENORED and Erongo RED, plus a combination of the remaining areas.

In previous master plans, the financial and economic analysis was done on a regional basis. In the original 2000 master plan this approach was reasonable because at that time the regional councils operated the electricity distribution services to the RE consumers in most regions. In the meantime however, the industry structure has changed substantially and only the central and southern regional councils (Khomas, Omaheke, Hardap and Karas) and NamPower Distribution still distribute electricity in rural areas outside the areas served by the REDs.

In areas not served by the REDs, NamPower receives the medium voltage assets (22kV and 33kV) outside rural localities, and the regional councils receive the medium (11kV) and low voltage assets within localities. Customers are served by the regional councils. NamPower Distribution serves the Khomas, Omaheke, Hardap and Karas regions as one entity, while the individual regional councils each have their own operations.

In order to facilitate analysis on a comparable basis to the REDs, the financial analysis for the central and southern areas is conducted as if they were operating as one entity. This means that the financial numbers for NamPower Distribution and the four regional councils of Khomas, Omaheke, Hardap and Karas are combined, and the impact of rural electrification on these combined areas is assessed.

The advantage and main reason for using this approach is that actual financial and technical data is available for the REDs as well as at least some of the entities in southern Namibia. Analysis is therefore fully relevant to actual operating entities. Analysis at a regional level (e.g. per political region) is no longer appropriate since the electricity distribution industry in most of the country is no longer operated at regional level, and data on regional level is unavailable.

**Therefore, the present financial analysis is undertaken in FOUR select areas: NORED, CENORED, ERONGO RED and CENTRAL & SOUTHERN Namibia.**

#### 9.1.1.2 The Revenue Requirement Methodology for Utilities in Namibia

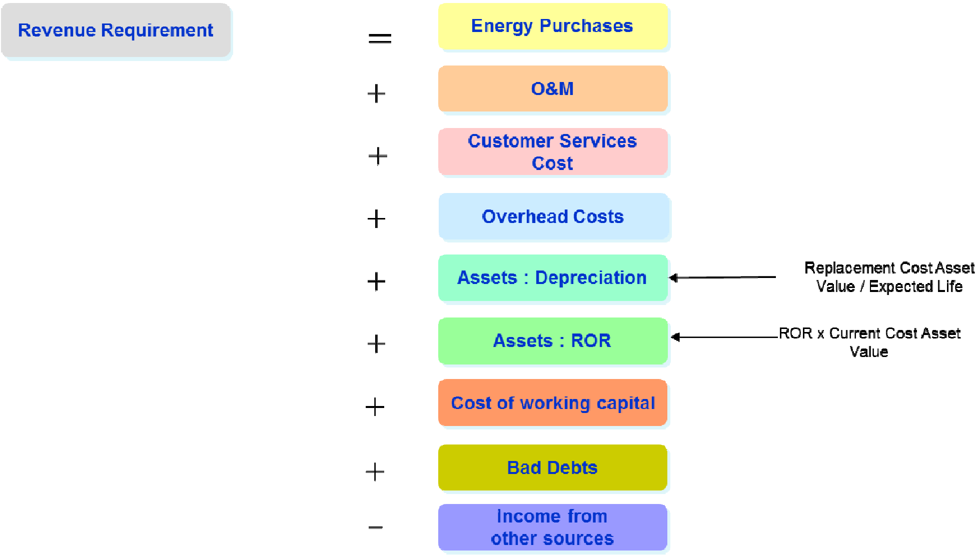
The method used to assess the impact of rural electrification on utilities is closely aligned with the revenue requirement methodology applied by the ECB to all distribution entities. This is a well understood and standardised methodology in Namibia. An additional advantage of choosing this methodology is that the ORM (Operating and Reporting Manual, as provided by distribution entities to the ECB) data for the distribution entities can be directly used as inputs.

The revenue requirement methodology allows distribution entities to recover a well-defined amount of revenue from its customers every year. A utility that recovers all allowable costs, i.e. the full revenue requirement, is considered to be “cost reflective”. This implies that the income generated by a utility from payments received from its customers fully reflects the cost of providing the electricity services. It is a stated objective of the Regulator that utilities should be cost reflective.

The revenue requirement is composed of all reasonable operating costs plus reasonable financial costs less any income from non-tariff sources that a utility may have[17]. It is computed as shown in Figure 58:

[17] Source: Electricity Control Board

*Figure 58: Computing a utility's revenue requirement [Source: Electricity Control Board]*




In addition to actual cash expenses incurred as a result of providing electricity services, asset-related non-cash costs are also allowed and include depreciation charges on assets, and a specified return on assets. The amount of return (profit) on assets allowed by the ECB is regulated by way of a specified weighted average cost of capital (WACC) which utilities have to apply. Utilities are only allowed to include a return on assets on those particular assets that were funded by the utility itself. This implies that assets funded by customers or from outside sources such as the state or by way of grant funding may not be used to generate a return on assets for the utility.

For the financial impact computation undertaken in this chapter, the significance of the revenue requirement method is as follows:

- It assumes that utilities will be able to recover all costs including those arising from the rural electrification assets and associated consumers through their electricity tariffs;
- Utilities may not earn a return on rural electrification assets financed by the state or third parties;
- Utilities may depreciate assets including those added through the government's rural electrification programme on the assumption that utilities are responsible for the maintenance of such assets and their replacement at the end of their useful life;
- Utilities may recover additional costs from all consumers served by the utility, not only those customers benefitting from rural electrification assets.

### 9.1.1.3 Computing the Financial Impact of Rural Electrification

The approach chosen in this REDMP to compute the financial impact on the electricity distribution utilities that receive rural electrification assets and have to operate and maintain them is to prepare a sales and income statement forecast of the entities, both with and without rural electrification assets. The forecast without rural electrification is treated as the base case. The scenario including rural electrification assets is treated as an investment case, which is measured against the base case. The same set of general assumptions (inflation, NamPower tariff increases, growth of existing customer base and growth of existing consumption) is used in both the base case and investment case. By comparing the base case to the investment case, the impact of additional RE assets is assessed.

The primary impacts of rural electrification are indicated in the following parameters:

- Assets are added through rural electrification, which are depreciated, thus adding depreciation charges;
- Assets are operated and maintained by the distribution entity, thus adding operating and maintenance costs; and
- Customers are added through rural electrification, and they consume electrical energy. This adds customer service costs, energy purchase costs as well as revenue from the electricity supplied to such customers.

For the purpose of this analysis it is assumed that all distributors will be allowed tariff increases to meet their respective revenue requirement each year. It is furthermore assumed that the tariffs charged by most distributors are already close to being cost reflective.

For the base case, the financial impact model computes a 20-year forecast of the high level income statement for each of the four distribution areas defined in section 9.1.1.1. The key outputs of this computation are:

- A revenue requirement forecast;
- A sales forecast; and
- An average tariff forecast resulting from the sales and revenue requirement forecasts.

The same computation is done for the investment case with rural electrification, where:

- Operating costs are increased in relation to the rural assets;
- Consumers are added each year according to the provisions of this REDMP;
- Electricity sales are increased by the estimated consumption added by new rural consumers; and
- A new average electricity tariff is computed each year, to meet the utilities' annual revenue requirements.

**Note:** The above methodology implies that ALL consumers in a utility's area pay a higher or lower tariff, depending on the contribution by rural electrification, and not only the new rural consumers added through RE. This procedure is in line with the current regulatory methodologies which allow cross-subsidisation between consumer groups and encourage tariff harmonisation across geographical locations.

The base case and investment case are then compared to one another, and the impact that the rural electrification programme has on the electricity distributor is determined.

#### 9.1.1.4 Key Assumptions

The following key assumptions are made in forecasting the financials of distribution utilities:

- The current regulatory regime and its application for distribution utilities will remain unchanged during the forecast period;
- The Regulator will grant tariff increases to distribution utilities to meet their respective revenue requirements every year;
- All rural electrification assets are funded by the state; and
- The distribution utilities receive no subsidies or grants towards the operation and maintenance of the added rural electrification assets, and are required to recover all additional costs arising as a result of RE from their entire customer base through their electricity tariffs.

#### 9.1.1.5 Data Sources

The main source of financial data on the distribution entities is in the form of the most recent ORM (Operating and Reporting Manual) sheets obtained from the ECB. When applying for tariff increases, all distribution utilities submit their ORM to the Regulator, normally this is done annually. As such, the ORMs are considered a reliable and uniform source of combined technical and financial data on all distributors. In addition, annual financial statements for the distributors are also consulted, but are not always readily available for non-RED entities.

The ORM provides data on the following:

- Key operating cost categories
- Customer numbers
- Employee numbers
- Revenues
- Sales volumes
- Power purchase quantities
- Network losses

Data on existing network assets is augmented from recent asset valuation data. The method to value all assets is standardised to the Namibian Electrical Network Assets (NENA) format, as adopted by the ECB. This is a uniform way of counting and valuing network assets in all distribution entities in Namibia. Reasonably up to date NENA data exists for the three existing REDs; however, this is not the case for NamPower Distribution and the four regional councils outside the REDs.

In the case of NamPower Distribution, the 2006 NENA data is used, and the latest values for all asset types are applied. In the case of the regional councils, the NENA data compiled in 2005 for the REDs formation process is used, in combination with the latest NENA unit values. For the Omaheke Regional Council, recent customer and sales data is available because it is being operated by CENORED. For the Hardap Regional Council, a recent ORM is available and is used. For the Karas Regional Council, the latest available ORM data is used, noting that the Council has not submitted an

ORM to the ECB for some years. NamPower Distribution's sales data for central and southern Namibia does provide information on energy sold to distributors (being the regional councils and small local authorities). As better sales data is not available, this input is used as a proxy for estimating the sales volumes to rural end consumers for central and southern Namibia.

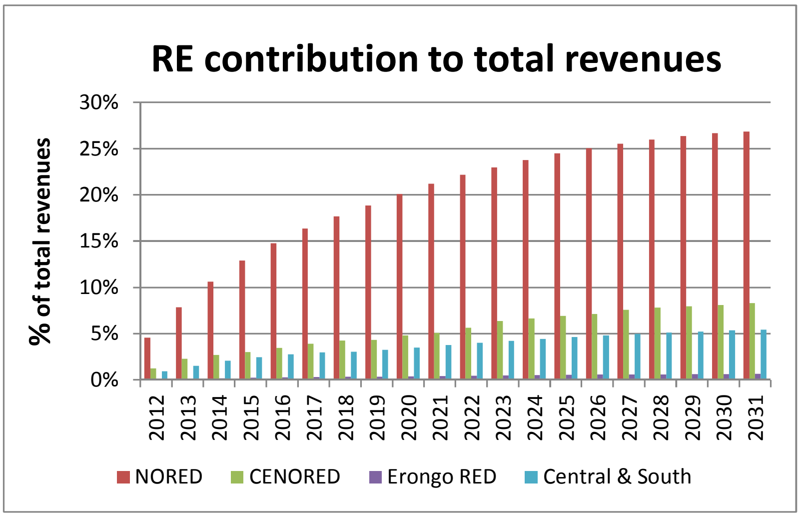
### 9.1.2 Financial Analysis Results

This section presents the results of the financial analysis, focusing on the financial impact on the four distinct electricity distribution utilities as a result of receiving rural electrification assets and having to operate and maintain them.

#### 9.1.2.1 Percentage Revenue from Rural Electrification Customers

The percentage of revenue contributed to total revenues generated per distribution area is shown in Figure 59. The graph vividly illustrates the significant difference in the impact from RE customers per distribution area. NORED has the largest growth and total number of rural customers, and accordingly, will generate the most significant amount of revenue from this customer segment in the years to come.

*Figure 59: Percentage contribution of revenue from rural electrification customers to total revenue per distribution area*




#### 9.1.2.2 Cash Flow

Cash flow is revenue generated minus operating costs. Figure 60 shows the cash flows generated from rural electrification customers only, for each of the four distribution areas. The graph illustrates that utilities serving rural customers require additional sources of income to remain viable.

*Figure 60: Cash flows from rural electrification customers per distribution area*

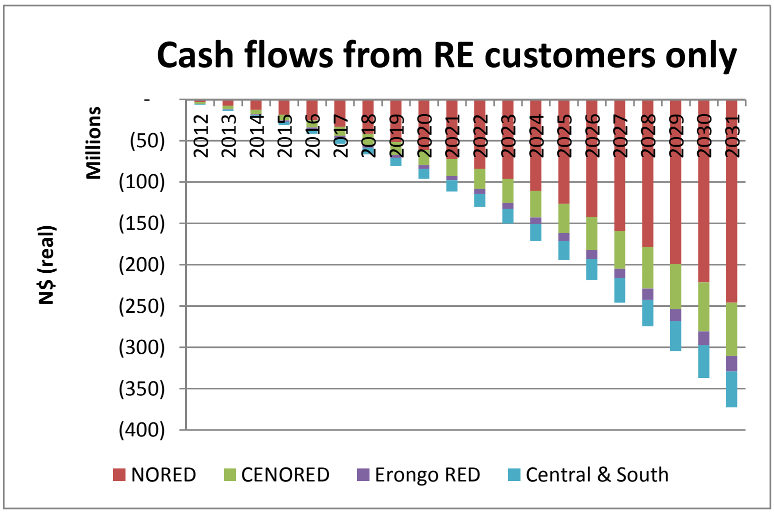
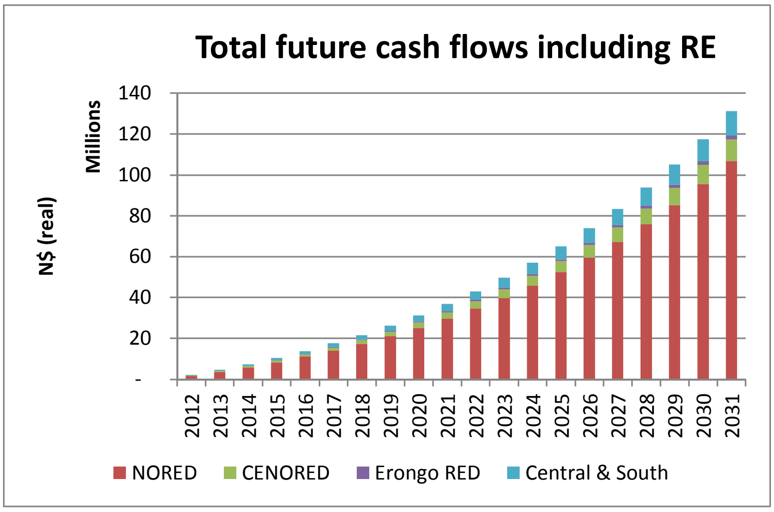



Figure 61 shows the cash flows generated from revenues collected from **all** customers served by a particular distribution entity for each of the four distribution areas, minus the operating expenses as a result of rural electrification. The graph shows minor increases in cash flow for Erongo RED, moderate increases for CENORED and the Central & Southern area, and substantial increases for NORED.

*Figure 61: Total future cash flows from all customers for all distribution areas*

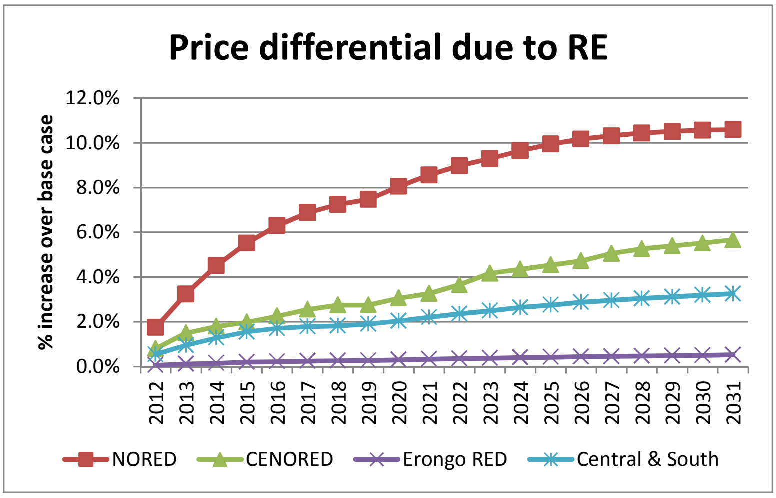



The difference between Figure 60 and Figure 61 illustrates the extent to which existing customers cross-subsidise the rural electrification customers.

#### 9.1.2.3 Tariff Levels

Utilities are required to recover all costs arising as a result of their operations, including from rural electrification, from their customers. This is achieved by charging cost reflective electricity tariffs. When comparing the tariffs required for the investment case with those for the base case (i.e. without RE), the former requires higher tariffs. This increase can be expressed as a price differential between the investment and base case, which is shown in Figure 62. The graph shows that RE will have a minor impact on tariffs for Erongo RED (because this area has few RE customers), and a significant requirement for tariff increases for NORED, who have the highest number of RE customers.

*Figure 62: Percentage tariff increase between base and investment case, as a result of rural electrification*




#### 9.1.2.4 Customers Served

The REDMP forecasts when and how many rural electrification customers are added in the four distribution areas. Figure 63 shows the annual addition of RE customers in the four distribution areas. As the graph illustrates, NORED is by far the single largest contributor of new RE customers, while moderate numbers of RE customers are added in the CENORED and Central & Southern areas. Erongo RED has the smallest number of new RE customers per year, as a result of the demographic distribution of the population in that distribution area.

*Figure 63: Customers added annually through rural electrification as envisaged inthis REDMP*

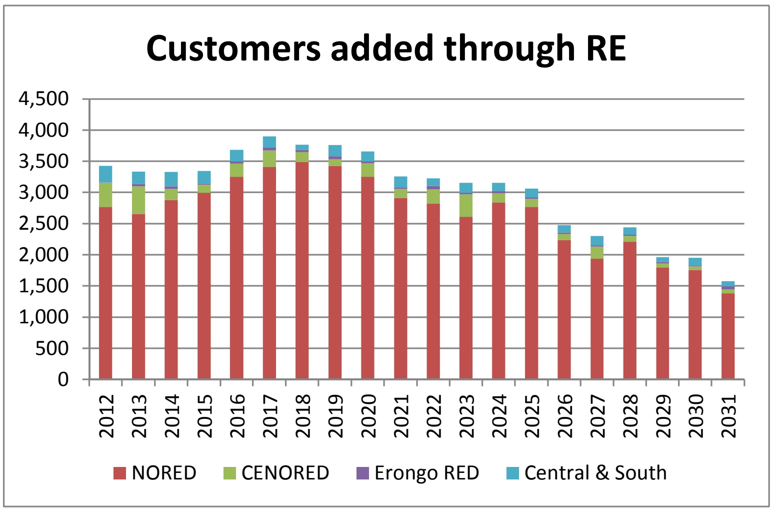
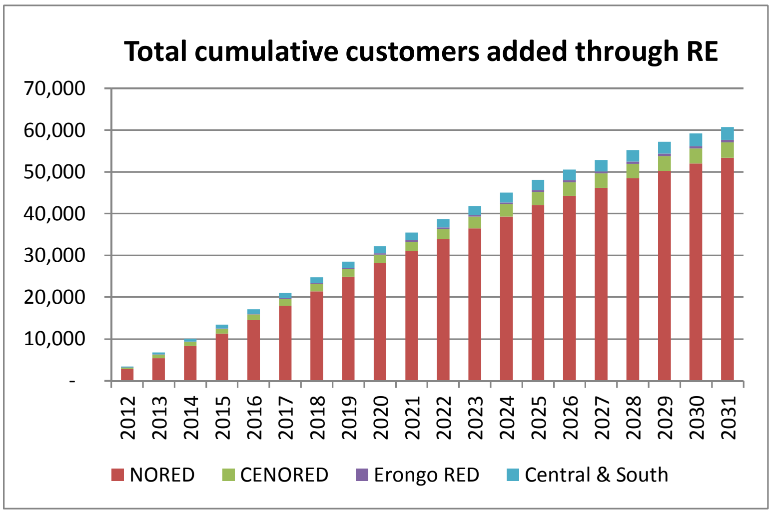



Figure 64 shows the total cumulative number of customers added through the continued rural electrification process as planned in this REDMP. As already shown in Figure 63, the single largest recipient of new RE customers is NORED, while both CENORED and the Central & Southern areas have moderate increases in total RE customers through the coming years.

*Figure 64: Total (cumulative) number of customers added through rural electrification*

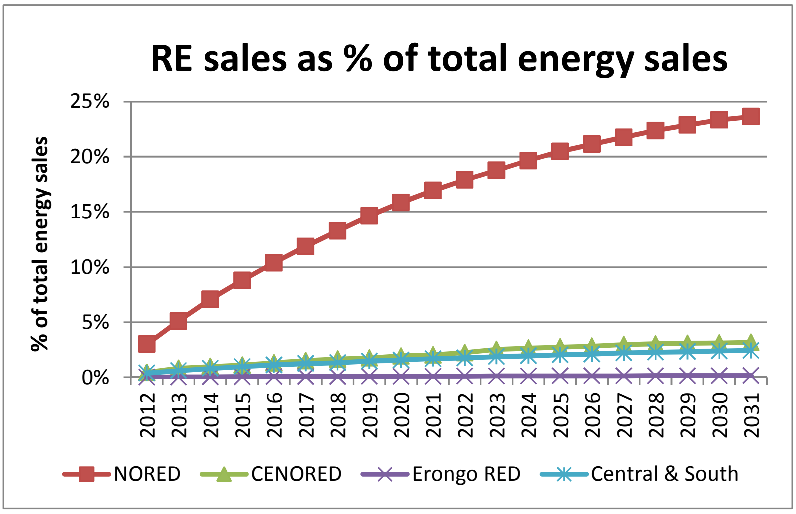



### 9.1.2.5 Energy Sold

Adding rural electrification infrastructure enables rural dwellers to benefit from modern electricity services. Access to electricity services can be measured by the number of new connections created, as described in section 9.1.2.4, and by the total energy sold. The impact of rural electrification can be expressed by how much additional electrical energy is consumed per distribution area as a result of RE; this is depicted in Figure 65. The graph shows that RE energy sales in both CENORED and the

Central & Southern areas will remain less than 5% of the total energy sold over the coming 20 years, while the significant number of rural customers in the NORED area will contribute almost one-quarter of all energy sales by 2031.

*Figure 65: Increase in RE sales as a percentage of total energy sales per distribution area*




### 9.1.2.6 Investment in Rural Electrification

This REDMP defines the timing and location of rural electrification infrastructure investments over the coming 20 years. Figure 66 shows the average capital expenditure per connection, while Figure 67 shows the annual nominal and cumulative real investment in rural electrification per distribution area.

*Figure 66: Capital expenditure per connection*

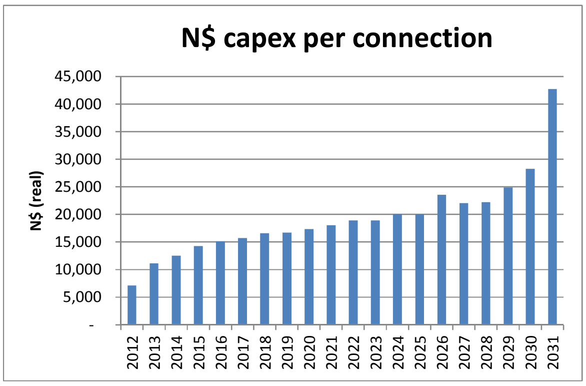
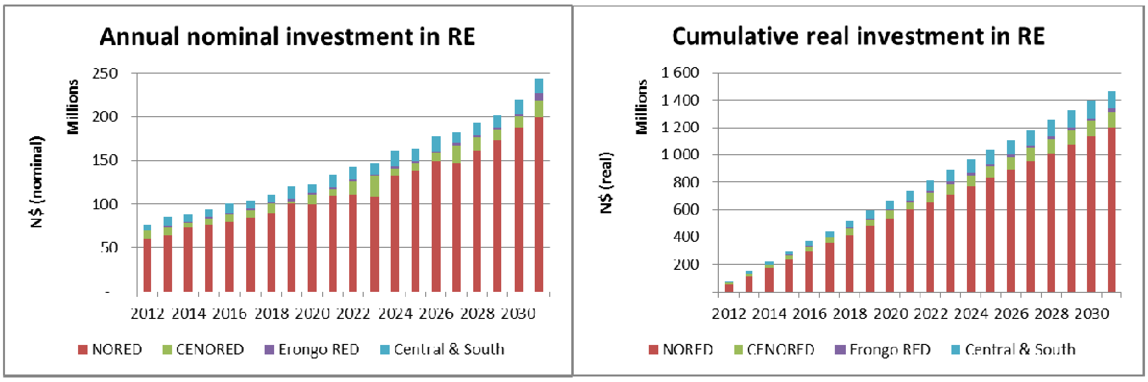


*Figure 67: Annual nominal investment in RE (left), and cumulative real investment in RE (right)*




#### 9.1.2.7 Number of Customers per Employee

The number of customers per employee per distribution area is shown in Figure 68. All distribution areas show a downward trend in the number of customers served per employee, except for NORED. This is the result of NOREDs existing high customer/employee ratio and its high forecast growth in the existing customer base.

*Figure 68: Number of customers served per employee per distribution area*

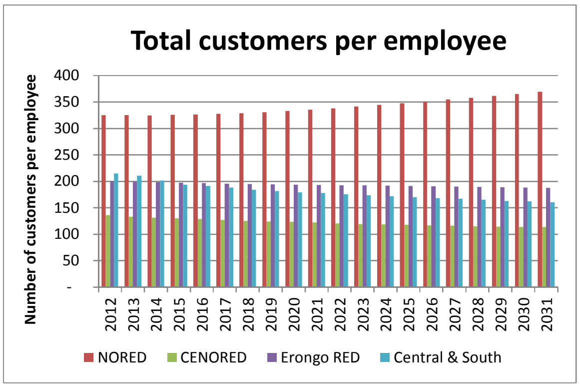
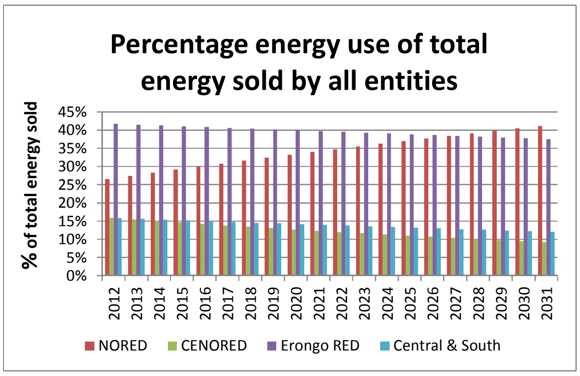



Figure 69 shows the percentage of the total electrical energy sold in all distribution areas per such area[18]. It is noted that Erongo RED sells more than 40% of the total energy in 2012. Over time, Erongo RED is overtaken by NORED, which has higher growth from existing consumers plus the largest impact from rural electrification. The energy sold in both CENORED and central and southern Namibia

[18] This excludes the energy sold by local authorities in central and southern Namibia, as well as energy sold by NamPower Distribution directly to end consumers. It also excludes energy sold directly by NamPower Transmission to large end users.

declines in prominence, due to the low growth from existing customers and relatively small impact from rural electrification.

*Figure 69: Percentage of total energy sold per distribution entity*



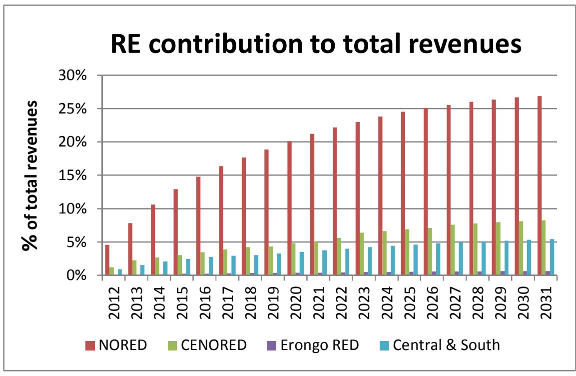

### 9.1.3 Sensitivities

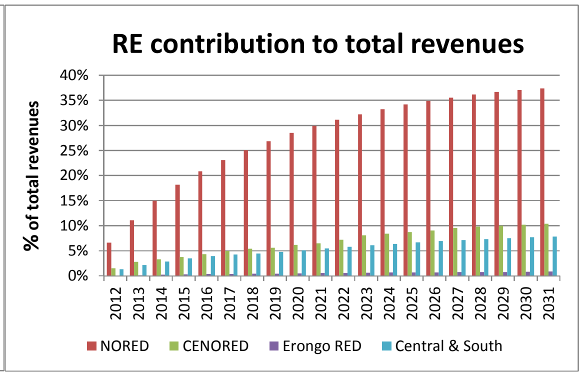
This section explores the impact on the distribution entities when key parameters are changed from the base case.

#### 9.1.3.1 Changing the Consumption of RE Customers

The base case makes certain assumptions regarding the consumption of different types of consumers added by rural electrification. Specifically, the consumption of private households can vary according to economic circumstances. The base case uses a conservative energy use figure of 100kWh per month per household. If the actual electrical energy consumption doubles from the base case, then rural customers would contribute more to meeting the operating costs as a result of rural electrification. As seen in Figure 70, the resulting revenue from rural customers in the NORED area would rise from about 25% in the base case to over 35% in the doubling scenario.

*Figure 70: Rural electrification contribution to total revenues: base case (left) versus doubling of energy consumption (right)*



Doubling the electrical energy consumption of rural consumers will also almost double their contribution to overall sales of the different distributors. As seen in Figure 71, this scenario raises the proportion of RE sales in the NORED area from almost 25% to almost 50% in 2031, while in the other areas the effect remains below10%. For NORED, this implies that there is a considerable up-side if consumption exceeds expectations.

*Figure 71: Rural electrification contribution to total energy sales: base case (left) versus doubling of energy consumption (right)*

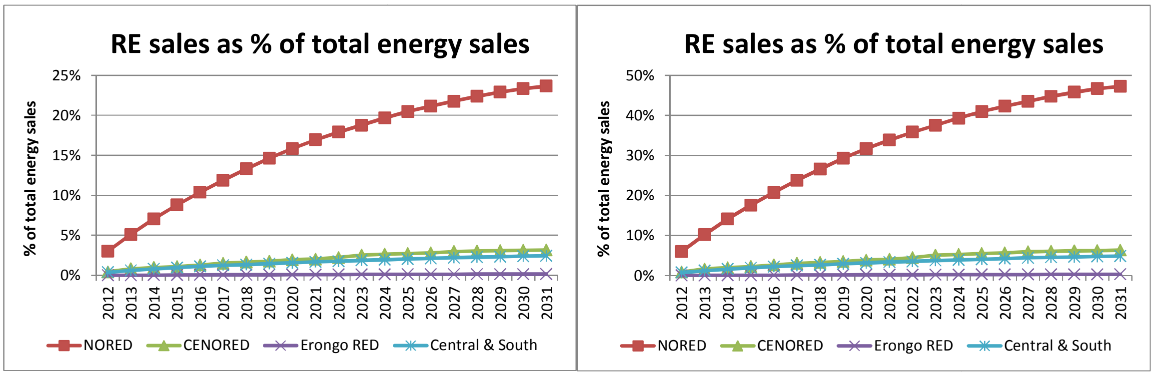
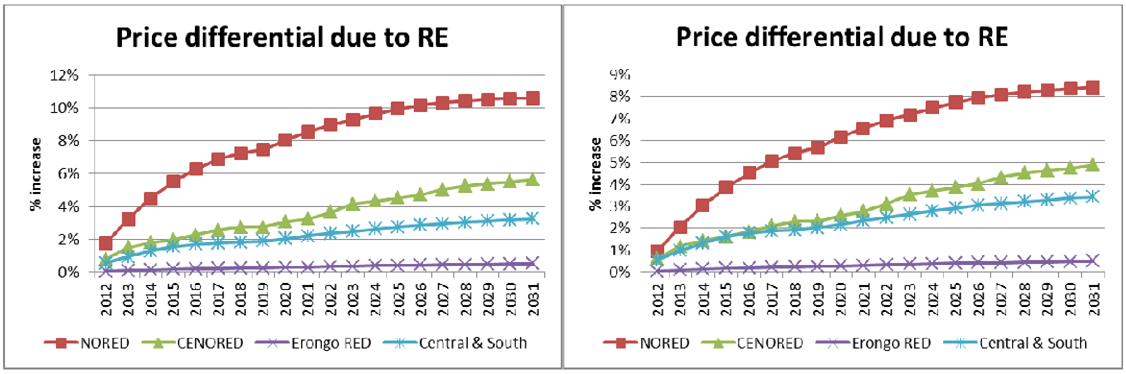



Figure 72 shows that the price differential due to rural electrification is impacted only moderately by doubling the consumption of RE consumers, dropping it by about 2% for NORED and about 1% for CENORED. The other two areas show little impact to this sensitivity parameter.

*Figure 72: Price differential due to RE: base case (left) versus doubling of energy consumption (right)*




### 9.1.3.2 Changing Consumption Growth of Existing Customers

Changing the consumption growth for existing customers has a large impact on the total electrical energy sold by the utilities. Figure 73 and Figure 74 illustrate that against a base case energy consumption of approximately 1.75 TWh, doubling the growth results in an energy consumption of 3.5 TWh, while halving the growth rate implies a total energy consumption of 1.3 TWh in 2031.

*Figure 73: Total electrical energy sold by distribution entities: base case (left) versus doubling of growth (right)*

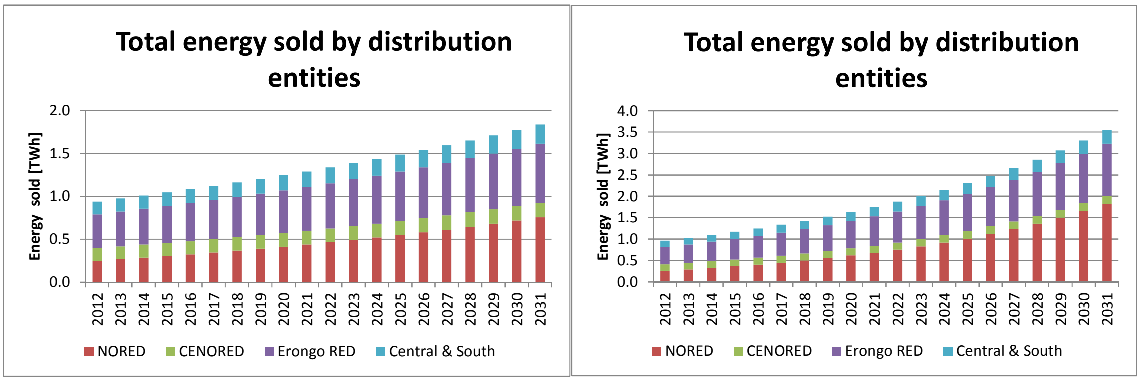



*Figure 74: Total electrical energy sold by distribution entities: base case (left) versus halving of growth (right)*

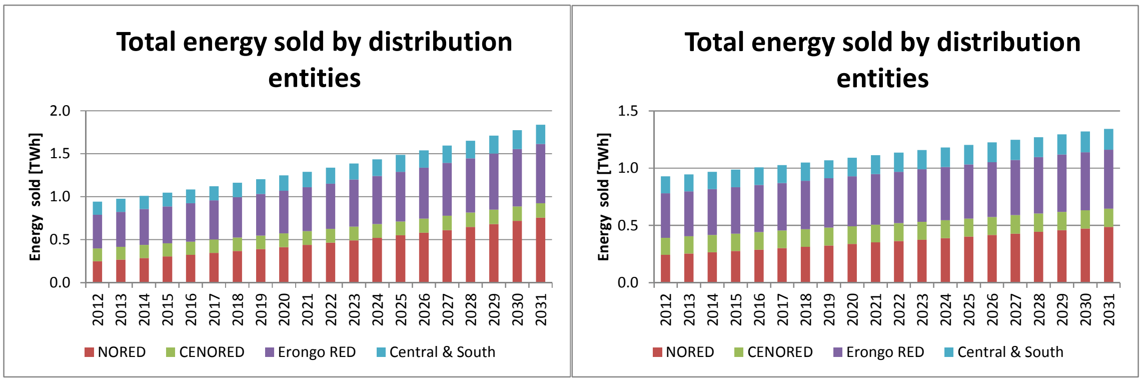



Figure 75 shows that doubling the electrical energy consumption growth of existing customers does not have a large impact on the cash flow from RE customers. Doubling the growth will reduce the overall average tariff somewhat, but evidently not to a large extent.

*Figure 75: Cash flows from RE customers only: base case (left) versus doubling of growth (right)*

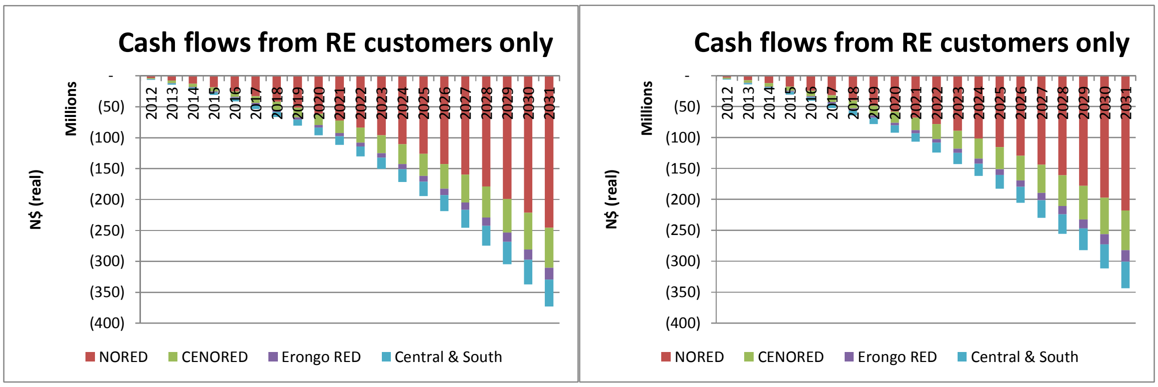
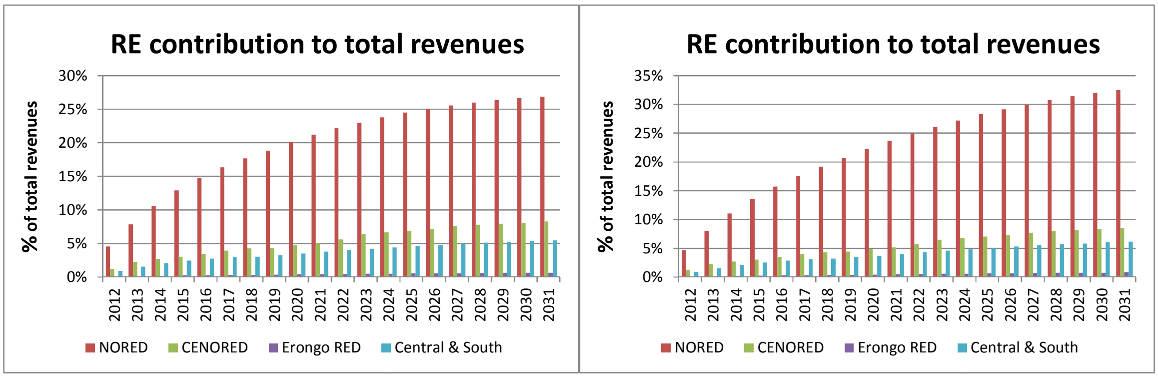


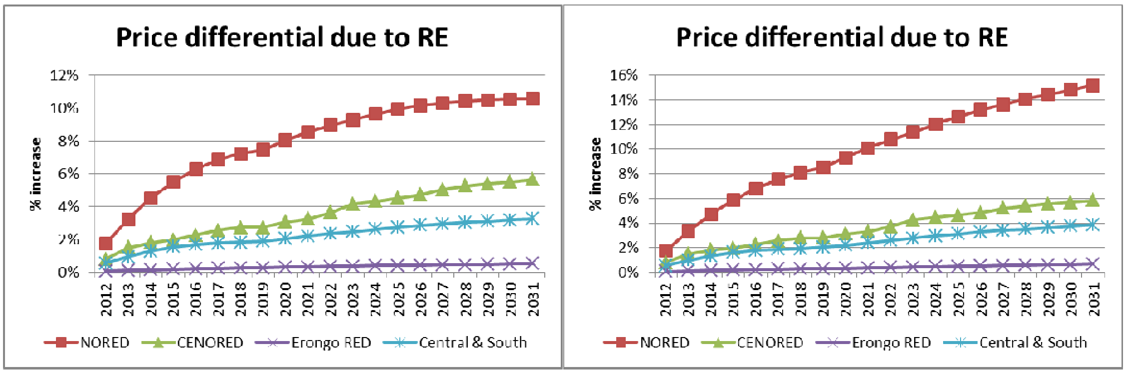
Figure 76 shows that the contribution of RE customers to total revenue per utility rises somewhat if the growth for existing customers is halved from the base case. However the sensitivity to this parameter is relatively low.

*Figure 76: Rural electrification contribution to total revenues: base case (left) versus halving of growth (right)*




The effect of halving the growth of electrical energy consumption of existing customers on the average electricity price is shown in Figure 77. The price differential due to RE in NORED increases from around 10% to almost 16%. For CENORED, there is little change (because the base case growth is very low), while in central and southern Namibia the gap increases from around 3% to 4%. For Erongo RED, the difference is negligible, because RE in that region is very limited in scope.

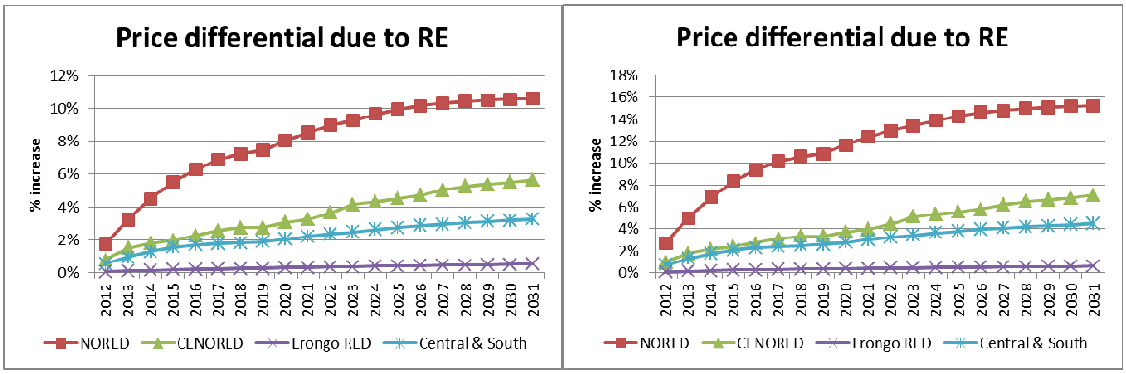
*Figure 77: Price differential due to RE: base case (left) and halving of growth (right)*




### 9.1.3.3 Changing O&M Costs of RE Infrastructure

Doubling the O&M cost of the rural electrification assets makes a large difference to the price differential for NORED, increasing it to almost 16% from just over 10% in the base case. As shown in Figure 78, the impact on the other distributors is smaller.

*Figure 78: Price differential due to RE: base case (left) and doubling O&M cost to 10% of assets employed (right)*




Halving the O&M cost of the rural electrification assets has a moderate impact on the price differential as can be seen in Figure 79. While doubling the O&M cost increases the differential in NORED by around 50%, halving the cost reduces it by only around 20%.

*Figure 79: Price differential due to RE: base case (left) and halving O&M cost to 2.5% of assets employed (right)*

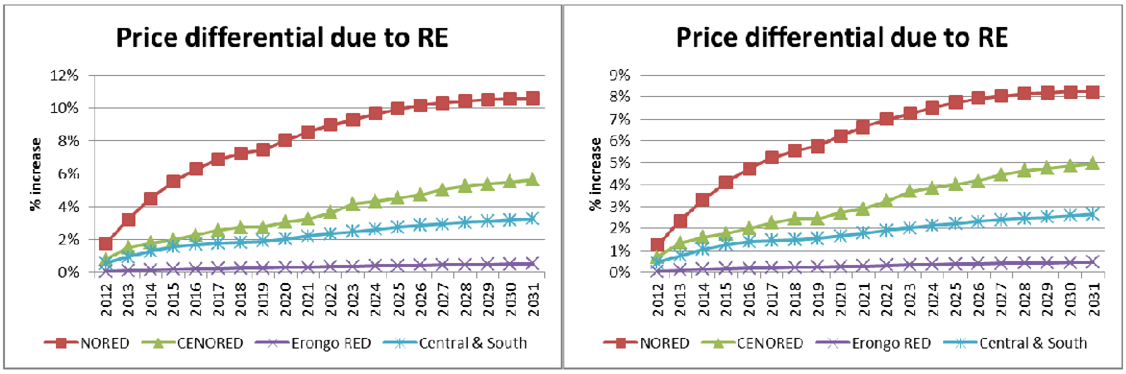
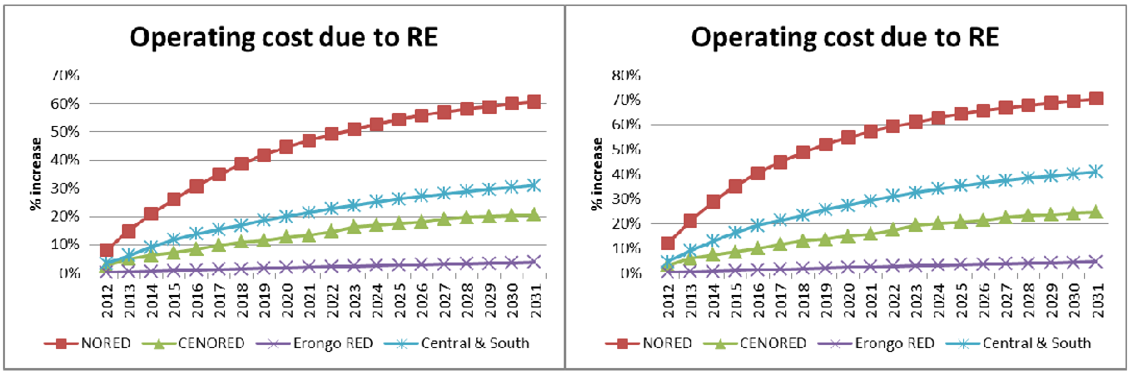



Figure 80 shows that the contribution made by RE to the overall variable operating cost rises by 10% for both NORED and central and southern Namibia if the rural O&M cost is doubled from the base case.

*Figure 80: RE contribution to operating costs: base case (left) and doubling O&M cost to 10% of RE assets employed (right)*




### 9.1.3.4 Summary Observations

In summary, the following observations are made from the sensitivity analysis:

- For Erongo RED the impact of rural electrification is smallest, and therefore the sensitivity analysis does not yield significant results;
- For NORED the impact of rural electrification is large, and the sensitivity analysis shows a significant impact as a result of rural electrification;
- Rural electrification has a moderate impact on CENORED and the Central & Southern areas;
- Doubling the consumption of rural electrification customers has a significant impact on the rural electrification share of overall sales, but only a limited impact on the price differential required to cover the additional cost of rural electrification;
- Doubling or halving the consumption growth of existing customers does not have much impact on the cash flow from rural customers, while having a large impact on the price differential required for rural electrification. This is particularly the case in NORED, where the impact of rural electrification is significant;
- Doubling the O&M cost of rural electrification infrastructure has a large impact on the price differential in NORED, while halving this cost item has a smaller impact on reducing the price differential.

## 9.2 Economic Analysis

This section first describes the economic analysis undertaken as part of the REDMP development process, and then presents the main results of the analysis.

### 9.2.1 Methodology and Approach of the Economic Analysis

Operational activities undertaken by distribution entities generate cash flows. These are either cash inflows (revenues), or cash outflows as a result of operating expenditures, cost of sales, staff and overheads and similar expenses. In addition, cash is used for capital investments, to repay loans and to provide for working capital. In the economic analysis for the REDMP, capital investments to undertake rural electrification are added to operating cash flows resulting from the rural electrification programme.

The free cash flow available to a distribution entity is the net cash generated by operational activities minus that used for investments in fixed and working capital. As such, free cash is the net amount of cash available to a distribution entity. Once the free cash flow is known, the net present value (NPV) of each distribution entity with and without rural electrification assets is determined.

The NPV is an important indicator of the viability and desirability of a particular rural electrification project, because it shows whether and by how much the returns generated through the project exceed the cost of realising it. For example, if one finds that a particular distribution entity's base case has a positive NPV, while the same distributor's investment case (i.e. including rural electrification) returns a negative NPV, the rationale for embarking on the investment is questionable (from a financial point of view), as the total cash generated by the investment is less than the total cash consumed over the REDMP investment horizon of 20 years.

Because cash in- and outflows occur at different times over the lifetime of the physical assets, the NPV is the sum of all cash flows discounted to the present using a discount rate, which for Namibian electricity distribution entities is provided by the ECB, in form of the weighted average cost of capital (WACC). Generally, if the NPV is larger than zero, it is expected that the distributing entity will have created a net financial value from the rural electrification investment. Alternatively, if the NPV is less than zero, the entity incurs more expenses than it was able to recover, and the company would have lost in value. As such, the NPV is a generally accepted measure that uses the time value of money to quantify if and by how much value is created or destroyed by embarking on a given project.

While the NPV of the rural electrification programme gives an indication of its financial viability, there are additional important indicators to assess the impact of supplying rural customers with grid electricity. Economic value perspectives often include the macro-economic value created in society if additional schools, clinics and households are electrified, the value generated by those who benefit by being connected to the national electricity grid, the benefit as a result of realising the productive capacity of electrical energy, but also, the cost of not electrifying rural areas, the cost of not being connected to modern energy services, the cost of lost production as a result of not having access to electricity, and others. Many of the above value indicators, although important, will not be quantified in this REDMP, as they require complex economic modelling, which is beyond the scope of this master plan.

To quantify the economic benefit created as a result of providing access to electrical energy to rural customers, a simple analysis is undertaken which assesses the total value in today's terms if each new connection realised under the REDMP creates a given economic value per year.

To answer the question how revenues and/or benefits generated from rural electrification customers relate to the investments made in such infrastructure, both the total revenue generated and the revenue plus benefits realised as a result of rural electrification are compared to the total investment in rural electrification. This comparison is an important indicator for Government's continued investment in rural electrification, and may also be used to compare the revenue and benefit potential generated in other Government projects to those achieved through rural electrification.

The economic benefit generated by rural electrification is compared to the cost of realising new connections, and is expressed as a ratio of benefits to costs (in today's terms). A benefit-to-cost ratio larger than one implies that the benefits generated outweigh the costs, while a benefit-to-cost ratio of smaller than one implies that the costs exceed the benefits that are realised. Because it is not possible to accurately quantify the actual benefit realised per connection, the benefit-to-cost ratio is presented for three different values of the benefit generated per connection.

## 9.2.2 Economic Analysis Results

### 9.2.2.1 Free Cash Flows of Distribution Entities

The free cash flow available to a distribution entity is the net cash generated from operational activities minus that used for investments in fixed and working capital. Table 46 summarises the present value of the free cash flow available to each distribution entity, with and without taking the capital expenditure required for rural electrification investments into account.

*Table 46: Present value of free cash flows generated without and with rural electrification assets, per distribution area*

| NORED | CENORED | ERONGO RED | CENTRAL & SOUTHERN | NORED | CENORED | ERONGO RED | CENTRAL & SOUTHERN |
|---|---|---|---|---|---|---|---|
| Free cash flow without RE capital expenditure, in million N$ | | | | Free cash flow with RE capital expenditure, in million N$ | | | |
| 316 | 33 | 6 | 38 | -799 | -77 | -16 | -87 |

### 9.2.2.2 Net Present Value of Distribution Entities

Distribution entities generate revenues and incur expenses. These cash in- and outflows change over time, and are dependent on whether additional assets, such as for example rural electrification assets, are added to an entity. The NPV is used to account for the different timing of future cash flows, and expresses these in a single value representing the total net value from all future operations in today's currency. Table 47 presents the NPV for the different distribution entities, showing the effect on each distribution entity without and with rural electrification. The scenario "with rural electrification" takes the cost of introducing RE assets into account. A utility with an NPV larger than zero is creating net value from its future operations, while an NPV which is less than zero indicates that the entity loses in value.

*Table 47: Net Present Value of distribution entities without and with rural electrification, including asset funding*

| NORED | CENORED | ERONGO RED | CENTRAL & SOUTHERN | NORED | CENORED | ERONGO RED | CENTRAL & SOUTHERN |
|---|---|---|---|---|---|---|---|
| NPV without rural electrification, in million N$ | | | | NPV with rural electrification, in million N$ | | | |
| 145 | 226 | 1,040 | -148 | -653 | 149 | 1,024 | -235 |

It is noteworthy that the introduction of rural electrification (including the cost of RE assets) has a value-reducing effect on all distribution entities. NORED in particular would be considered a non-viable entity if they have to fund the RE assets as put forward in this REDMP, while the Central & Southern area is non-viable even without having to invest in additional RE infrastructure.

Table 48 presents the NPV for the different distribution entities with rural electrification, showing the effect of excluding and including the capital required for rural electrification assets.

*Table 48: Net Present Value of distribution entities with rural electrification, excluding and including asset funding*

| NORED | CENORED | ERONGO RED | CENTRAL & SOUTHERN | NORED | CENORED | ERONGO RED | CENTRAL & SOUTHERN |
|---|---|---|---|---|---|---|---|
| NPV with rural electrification (excluding asset funding), in million N$ | | | | NPV with rural electrification (including asset funding), in million N$ | | | |
| 462 | 259 | 1,046 | -110 | -653 | 149 | 1,024 | -235 |

Comparing the left columns of Table 47 and Table 48 respectively illustrates the value-adding effect that rural electrification assets have on all distribution entities, provided that these entities do not have to finance such assets. On the other hand, as illustrated in Table 48, if the distribution entities have to provide the capital required to introduce the rural electrification assets as planned in this REDMP (refer to right columns in Table 48), the net value of all distribution entities is reduced. In the case of NORED in particular, the decrease in company value between a scenario where the utility uses RE assets but does not have to fund them (left-most column in Table 48), versus the scenario where the utility has to fund the RE assets (right hand side of Table 48), is dramatic, and would render the utility non-viable. On the other hand, the NPV of both CENORED and Erongo RED is reduced if these entities have to fund the RE assets as planned in this REDMP, but they remain viable. Lastly, the Central & Southern area remains non-viable, even without having to invest in additional RE assets.

#### 9.2.2.3 Economic Benefit as a Result of Rural Electrification

Providing access to modern electrical energy services is expected to generate economic value, for the individual beneficiary, the wider community, and the country as a whole. The actual economic value created however depends critically on whether electricity supplied to rural areas is used for productive purposes, which would generate value adding products and/or services, and stimulate additional economic activity, and how much of it would be used for consumptive purposes only.

It is beyond the scope of this REDMP to provide a detailed assessment of where and how much value could potentially be created through each connection made as a result of the 2010 REDMP. This section therefore focuses solely on a simplified assessment of the economic impact under the assumption that each new rural connection adds N$100 (low), N$1,000 (medium) or N$7,500 (high) in 2011, which escalates in value as a result of the aggregated inflation rate used in the analysis. In this way, the wider economic benefits created as a result of providing access to electrical energy to rural customers is expressed as a monetary value. Such benefits are created as a result of being provided with grid electricity as per the REDMP's planned rural electrification programme.

Table 49 summarises the present value of the economic benefits realised in the coming 20 years, as a result of the creating an economic value ofN$100 (low), N$1,000 (medium) or N$7,500 (high) per new connection in 2011, escalated at 6% per annum per connection until the end of the REDMP investment horizon in 2031.

*Table 49: Present value of the economic value added assuming a low, medium and high economic value contribution per new RE connection, in millions of N$*

| DISTRIBUTION ENTITY | | LOW | MEDIUM | HIGH |
|---|---|---|---|---|
| NORED | million N$ | 67.3 | 673.1 | 5,047.9 |
| CENORED | million N$ | 3.8 | 38.4 | 288.1 |
| ERONGO RED | million N$ | 0.7 | 7.0 | 52.3 |
| CENTRAL & SOUTH | million N$ | 3.8 | 38.3 | 287.0 |
| | **Total (million N$)** | **75.7** | **756.7** | **5,675.3** |

The total economic benefits derived from rural electrification exceed the associated investment if each new RE connection creates an economic benefit of approximately N$1,610 per year in 2011, escalated at the annual inflation rate until 2031.

### 9.2.2.4 Investments in Rural Electrification

Investments in rural electrification create revenues for distribution entities, and broad economic benefits for society. This section compares the rural electrification investment as put forward in this REDMP, with the associated economic benefit presented in section 9.2.2.3. It then compares the RE investment per connection, the cumulative RE investment for all RE connections established, the ratio of the investment and revenues generated, and ratio of investment and economic benefits realised (assuming that N$1,000 is generated in 2011 per new rural connection, which is escalated annually with the inflation rate) as a result of rural electrification.

It is instructive to contrast the potential economic benefit created as a result of rural electrification with the actual RE investment, as described in this REDMP. Table 50 summarises the present value of all investments in rural electrification assets as put forward in this REDMP.

*Table 50: Present value of total investments in rural electrification assets per distribution area, as per REDMP*

| DISTRIBUTION ENTITY | | RE Investment |
|---|---|---|
| NORED | million N$ | 989.9 |
| CENORED | million N$ | 97.9 |
| ERONGO RED | million N$ | 19.2 |
| CENTRAL & SOUTH | million N$ | 111.6 |
| | **Total (million N$)** | **1,219** |

Figure 81 shows the investment per rural connection for the four distribution entities considered in this REDMP (left), as well as the cumulative RE investment for the total number of RE connections established over the course of the REDMP implementation (right).

*Figure 81: Investment per rural connection (left), and cumulative investment for all RE connections established (right)*

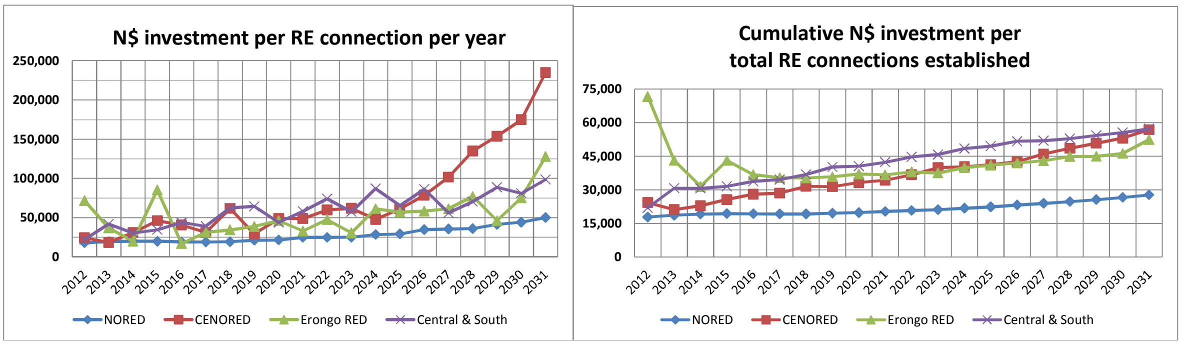



Figure 82 shows the RE investment per N$ revenue generated per year (left), as well as the cumulative RE investments for the cumulative revenue generated from RE assets. It is to be noted that the revenue generated from RE investments excludes the cost associated with operating and maintaining such assets. The investment per N$ revenue generated therefore has to be much smaller than one for a distribution entity to have a reasonable chance of reaping benefits from such assets.

*Figure 82: Investment per N$ RE revenue generated (left), and cumulative investment for all RE revenue (right)*

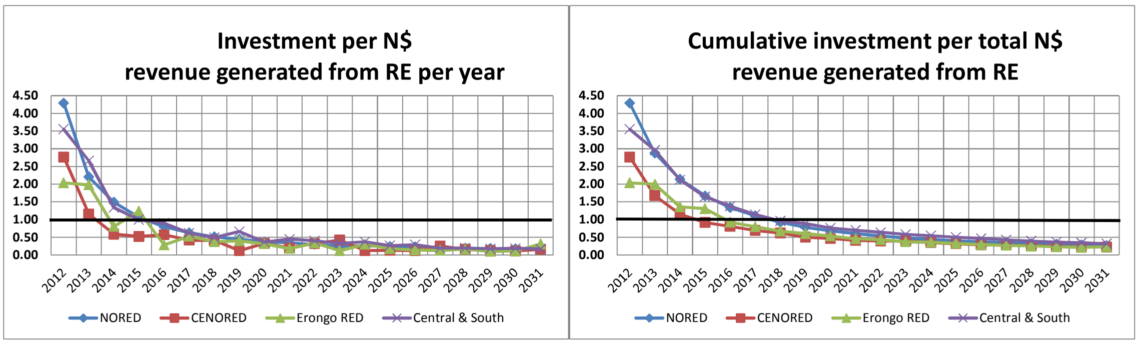


Figure 83 shows the cumulative investment per cumulative economic value generated over the course of the implementation of the REDMP, assuming that each new connection generates an economic benefit of N$1,000 per year from 2011 onwards, which is escalated at the annual inflation rate. It is interesting to note that the cumulative investment per N$ total economic benefit generated drops below N$1-00 in the period between 2015 and 2018, which implies that the total economic value generated from this time onwards exceeds the investment made in rural electrification.

*Figure 83: Cumulative investment per N$ cumulative economic benefit generated*

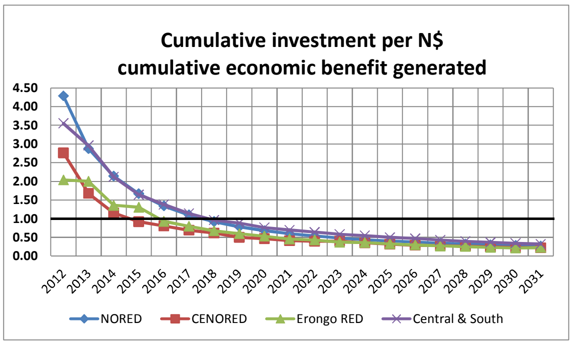



Figure 83 also lends itself as an indicator for Government's continued investment in rural electrification, and may be used to compare the investment and potential economic benefits generated in other Government projects to those achieved through rural electrification.

#### 9.2.2.5 Benefit-to-Cost Ratio of Rural Electrification

The economic benefit created through rural electrification is compared to the cost of realising new rural electricity connections, and is expressed as a ratio of benefits to costs. A benefit-to-cost ratio which is larger than one implies that the economic benefits outweigh the costs, while a ratio smaller than one implies that the costs exceed the benefits realised through the envisaged electrification programme.

Because it is not possible to accurately quantify the actual economic benefit realised per connection, Figure 84 shows the benefit-to-cost ratio for medium (realising N$1,000 economic benefit per new RE connection in 2011 per year, which is escalated annually at the annual inflation rate) and high economic value addition scenarios (realising N$7,500 economic benefit per new RE customer in 2011, again escalated annually at the annual inflation rate), taking only the capital costs required to establish the rural electrification infrastructure as per the present REDMP into account.

*Figure 84: Benefit-to-cost ratio of RE for medium (left) and high (right) economic value created per new connection, taking only the capital cost associated with the RE infrastructure into account*

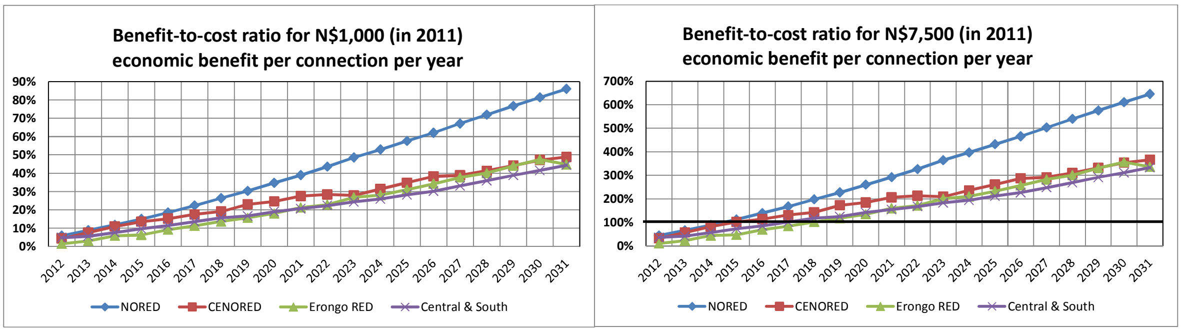



Figure 84 (left) illustrates the dilemma of rural electrification, in that the capital costs are high, while the economic returns are often low. However, as assumed in Figure 84 (right), provided that substantial economic benefits can be generated per connection, the costs of rural electrification are less than the economic benefit realised. This emphasises the need for the productive use of electricity if rural electrification is to be continued in future. If additional activities that create new economic value can be introduced as and when rural areas are electrified, the overall economics of rural electrification can have a significant positive influence on the direct beneficiaries as well as the country as a whole.

## 9.3 Reflections and Conclusions

Since Independence, Namibia's rural electrification programme has delivered modern electricity services to tens of thousands of rural households. Clinics, schools and other Government infrastructure has been connected, enabling the state to provide services to those who live and work far from urban areas. Without any doubt, rural electrification has made a significant contribution to national development, and helped to create a conducive environment for upliftment, progress and development.

The REDMP brings planning and structure to the process of rural electrification. This is necessary, because rural electrification is capital intensive. The cost of connecting ever-more distant communities to the national grid increases rapidly and the cost to operate rural electricity assets is high. This places an ongoing burden on those who operate and maintain rural electrification assets, and their customers.

After Namibia's Independence, a substantial number of rural electrification assets were funded by way of grant funding. This has assisted Government to rapidly expand electrification infrastructure into rural areas. Today, Government is the only significant provider of funding for rural electrification. With many competing pressures on Government coffers, continued rural electrification will only take place if political support can be sustained in future.

In present-day Namibia, with the exception of select areas, Regional Electricity Distributors (REDs) are responsible for the distribution of electricity to customers. Central and southern Namibia are not yet served by REDs, and the distribution of electrical energy is undertaken by NamPower Distribution as well as a number of local authorities and regional councils. The ongoing electrification of rural Namibia implies that more and more rural electrification assets will have to be operated and maintained by the REDs, and/or similar distributing entities.

Because of the sparse population in many rural areas in Namibia, rural networks tend to be costly to build, operate and maintain, and revenues generated through such infrastructure is often insufficient to meet the required capital and operating cost. However, distribution entities responsible for the operation and maintenance of rural electrification infrastructure need to be and remain financially viable. One way to achieve this is to have a sufficiently large base of customers to enable cross-subsidisation from areas where surpluses from the sale of electricity are generated, to areas which are not viable on their own. In the absence of such cross-subsidisation, many rural networks are not and will not be viable (unless these consumers are charged much higher tariffs than urban consumers), even if their capital expense is shouldered by Government.

It is important to ascertain what the financial impact on electricity distribution entities is if such entities are to receive rural electrification assets, and would have to operate and maintain them in future. If distribution entities are allowed to recover their total cost of operations through electricity tariffs, which is the case under the present regulatory system, the financial impact of additional rural electrification assets is directly transferred to the customers served by such entities. Customers would have to be able to carry the extra cost of having additional rural electrification assets introduced into their distribution area, by paying higher electricity prices. However, rural customers in particular, often have a limited ability to pay for services.

From the Government's perspective, as the key contributor of rural electrification assets in Namibia, the benefits that are generated through rural electrification need to be understood, and how these relate to the investments associated with such infrastructure. In addition, the question needs to be asked how the benefits that rural electrification introduces can be sustained without unduly burdening those entities – and the customers they serve – who have to operate and maintain RE assets? The results of the present study indicate that in some areas the price of electricity will have to be raised by up to 10% in order to cope with the additional cost of operating additional rural networks.

In the face of rapidly increasing regional power prices, which have an immediate effect on local electricity prices, Government will have to carefully consider whether placing this additional burden on electricity consumers can in fact be justified. Since this master plan is a 20-year plan, there remains some time to consider the implications of imposing additional costs on rural dwellers, before electricity prices become unaffordable to the majority of rural consumers.

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# 11 APPENDICES

The appendices, as referred to in the relevant sections of this report, are:

Appendix A: Technical Guidelines for Network Planning

Appendix B: ADMD Specified for Point Score System Infrastructure, and NENA Consumer Connection Costs

Appendix C: Customer Sub-Classification for Load Forecasting

Appendix D: Maps of the 20-Year Proposed Network Extensions

Appendix E: Information to be Submitted on Completion of Rural Electrification Projects

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