7 MAIN OUTPUTS AND FINDINGS

The methodologies and models developed in Section 6 provide a structured approach to deriving a rural electricity distribution master plan (REDMP) for each of the 13 regions in Namibia. The master plan will enable the MME to meet the set electrification targets and priorities for the coming 20 years.

This section presents an overview of the main results of the 2010 REDMP. The key data and statistics derived from the GIS databases (Section 7.2) establishes the baseline for a detailed 20-year REDMP that is described in Section 7.3. Off-Grid Localities are listed in Section 7.4. Maps of the 20-year networks are included in Appendix D.

The REDMP is presented on a regional level. The regional reports cover additional detail, down to constituency level, and also include the specific names of all Localities, schools and other Government buildings that will benefit from future electrification under this REDMP. Where required, identified network strengthening is also covered under the relevant regional reports.

The term Access to Electricity (as defined in Section 2.1) is explicitly used to measure progress, and describes Localities that have been electrified. Various tables and charts in the following sections will refer to infrastructure with and without Access to Electricity, expressed at 5-year intervals over the coming 20-year period.

7.1 Overview of the 20-Year REDMP Results

Based on a prioritised and most effective building sequence, this REDMP foresees the systematic electrification of 2,879 rural Localities. These include 740 Government buildings, 642 of which are schools, and 59,774 rural homesteads. A summary of the main results of the REDMP is shown in Table 14.

The REDMP enables the MME to electrify all existing Government buildings within the next 20 years. Table 15 presents the percentage of rural homesteads per region that are to be electrified through the REDMP. The table also provides an estimate weighted average cost per homestead connection.

The total budget for the 20-year programme as envisaged in this REDMP amounts to N$ 1,473,361,699, which translates to an annual budget of N$ 73,668,085[13].

[13] These values are as at 2011. The annual estimated budget is an average value. Regional reports show the actual budget required per region per year.

Table 14: Summary of the 2010 REDMP results

REGION	Estimate Budget	Total Localities	Total Homesteads	Total Points (Priority)	Total Schools	Total Government Buildings
Caprivi	256,230,796	273	16149	19524	55	71
Erongo	23,399,079	32	616	806	2	5
Hardap	8,990,380	13	139	179	1	1
Karas	19,515,720	15	241	351	3	3
Kavango	195,654,667	369	8205	14397	161	204
Khomas	3,985,548	3	30	150	3	3
Kunene	213,328,029	370	6845	8876	44	51
Ohangwena	154,703,917	406	6195	10740	115	122
Omaheke	100,995,984	165	2652	3202	13	13
Omusati	191,599,037	445	7323	12260	117	127
Oshana	77,009,314	248	3690	4719	27	28
Oshikoto	172,438,806	457	6311	9769	87	97
Otjozondjupa	55,510,422	83	1378	2038	14	15
Total	**1,473,361,699**	**2,879**	**59,774**	**87,011**	**642**	**740**
Average p.a.	73,668,085					

Table 15: Percentage homesteads connected per region, and the associated estimate cost per connection

REGION	Percentage Rural Homesteads Electrified	Cost per Homestead Connection [N$]
Caprivi	54.4%	15,867
Erongo	8.0%	37,986
Hardap	1.4%	64,679
Karas	8.6%	80,978
Kavango	32.1%	23,846
Khomas	0.3%	132,852
Kunene	29.4%	31,166
Ohangwena	15.1%	24,972
Omaheke	25.1%	38,083
Omusati	14.6%	26,164
Oshana	17.3%	20,870
Oshikoto	15.8%	27,324
Otjozondjupa	10.6%	40,283
Total	**21.0%**	**24,649**

The detailed results of implementing the 20-year electrification programme as described in this REDMP are presented in Subsections 7.3.1 to 7.3.6. They are also summarised in the following charts, representing all Locality infrastructure. It should be noted that the total figures (e.g. the total number of Localities without Access to Electricity) in the charts below represent all identified infrastructure, and not only those considered for electrification as part of the 2010 REDMP. Results may therefore seem negligible when compared to the grand totals. Figures 25 and 26 show the results for the defined Localities. Figures 27 to 33 show the total infrastructure (all Government buildings and

homesteads included in the Localities), schools, total Government buildings (including schools) and homestead results. Progress is shown at 5-year intervals.

A total of 13,566 Localities are identified for consideration under the 2010 REDMP. Of these, 5,296 are classified to already have Access to Electricity. An additional 2,879 Localities are selected to benefit from the implementation of the REDMP, and are prioritised for electrification. The electrification programme in terms of Localities added every 5 years, as well as the number with and without Access to Electricity as years progress, is shown in Figures 25 and 26 below.

Under the REDMP, a total of 8,175 rural Localities will have Access to Electricity by 2030.

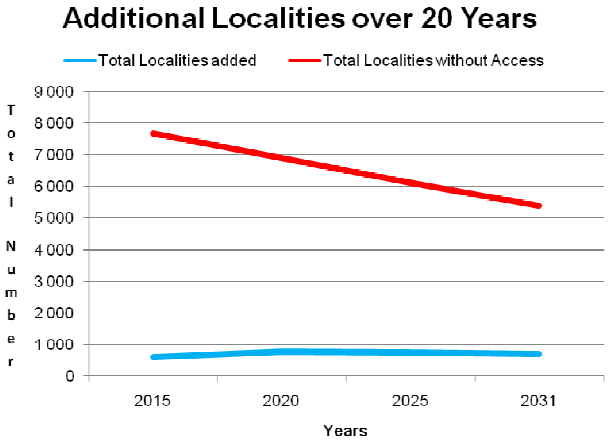


Figure 25: Localities added in 5-year intervals, and the associated decrease in total Localities without Access to Electricity

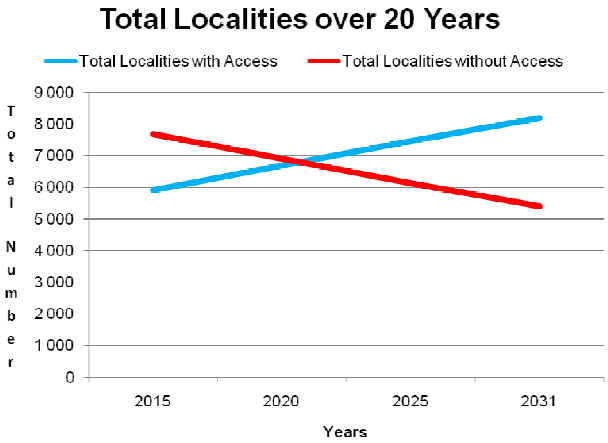


Figure 26: Total number of Localities with and without Access to Electricity, shown in 5-year intervals for the next 20 years

Results presented for the total infrastructure, as referred to in Figure 27, includes all Government buildings and homesteads (all infrastructure identified in this REDMP). A total of 740 Government

buildings and 59,774 rural homesteads (representing 21% of the baseline number of rural homesteads identified in 2010) will be electrified under the 2010 REDMP, implying a total addition of 60,514 newly electrified beneficiaries by 2030.

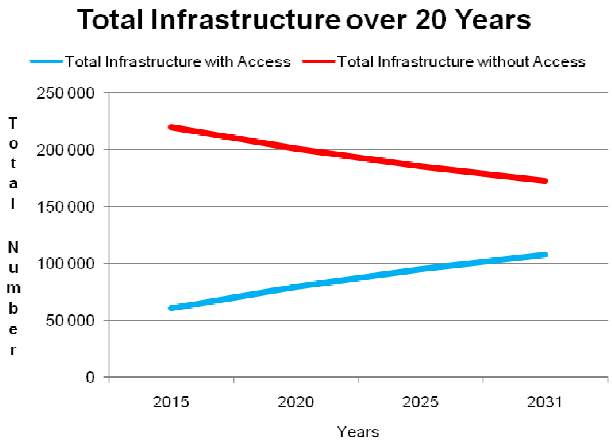


Figure 27: Total infrastructure (all Government buildings and homesteads) with and without Access to Electricity, shown in 5-year intervals for the next 20 years

The MME set the target that all Government buildings, and especially schools, are to be electrified in the next 20 years. As shown in Figures 28 to 31, this target is met. In particular, the REDMP was developed to ensure that the MME is able to electrify a total of 642 rural schools and 98 other Government buildings. Figures 28 to 31 show that the number of Government buildings without Access to Electricity drops to zero in 2030.

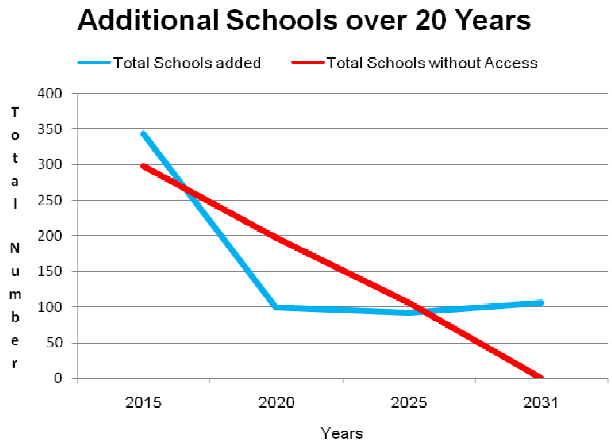


Figure 28: Schools added in 5-year intervals, and the associated decrease to zero in the total number of schools without Access to Electricity

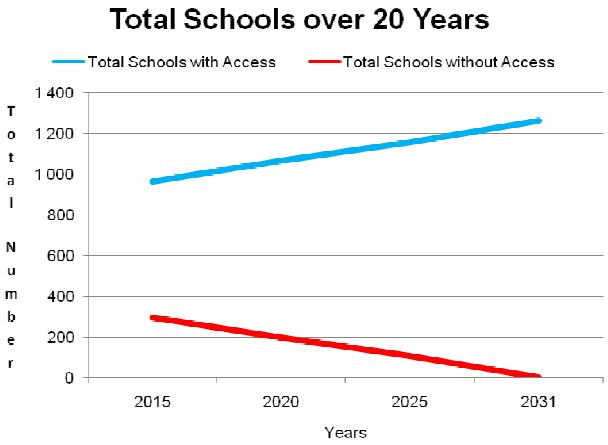


Figure 29: Total number of schools with and without Access to Electricity, shown in 5-year intervals for the next 20 years

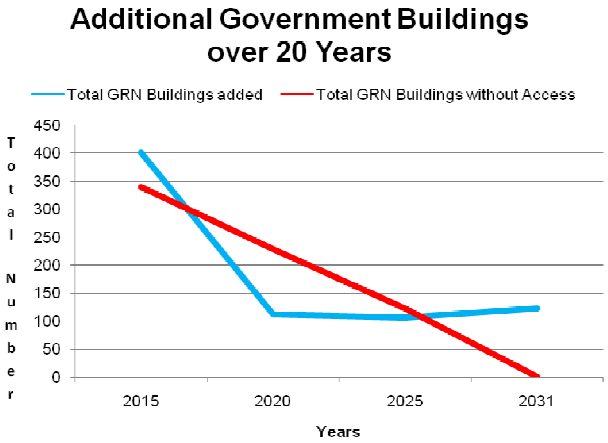


Figure 30: Government buildings (including schools) added in 5-year intervals, and the associated decrease to zero in the total number of Government buildings without Access to Electricity

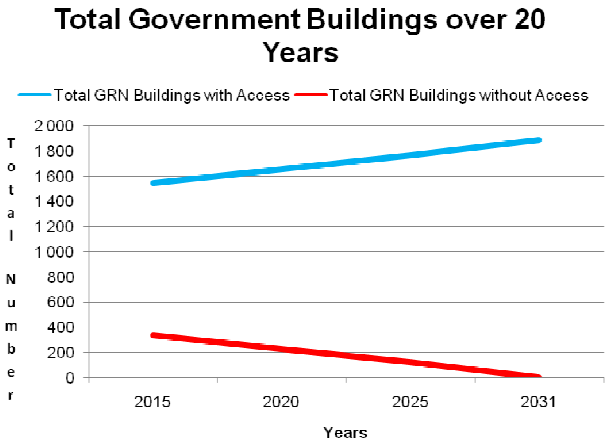


Figure 31: Total number of Government buildings (including schools) with and without Access to Electricity, shown in 5-year intervals for the next 20 years

As depicted in Figures 28 and 30, showing the total numbers in years 2020 and 2025, the number of schools and other Government buildings added every 5 years drops off from an initial high, and again increases towards 2030. This characterises the prioritised building sequence, where initially a large number of Government buildings close to existing connection points are electrified. As the master plan progresses and reaches more remote Rural Areas, new networks have to be established before additional buildings can be connected. This explains the increase in the number of Government buildings towards 2030, as network connection points get closer to where such infrastructure is located.

A total of 59,774 rural homesteads, representing 21% of the total baseline number of rural homesteads identified in 2010, is included for electrification in the 2010 REDMP. If the plan is implemented in its entirety, the total number of rural homesteads with Access to Electricity will have increased to 104,362 by 2030, as shown in Figure 32.

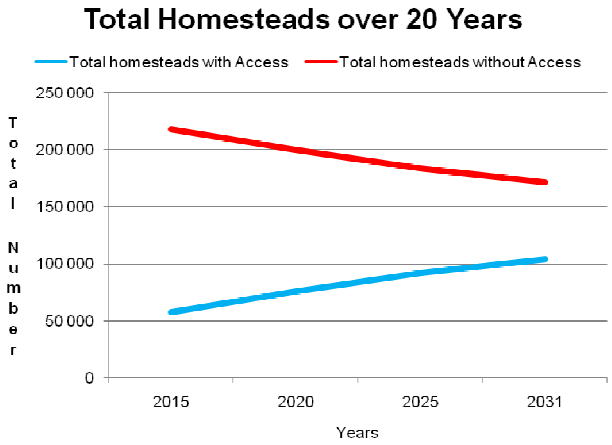


Figure 32: Total number of homesteads with and without Access to Electricity, shown in 5-year intervals for the next 20 years

7.2 Key Data and Statistics

This section presents the key data collected during the 2010 REDMP Study, as well as the statistics derived from the compiled GIS database. This data underpins the baseline from which the prioritised electrification programme is developed. A summary of the regional electrification programmes is presented in Section 7.3.

Subsection 7.2.1 provides general information on the total number of homesteads as well as rural homesteads that were identified. Subsection 7.2.2 gives an overview of the existing distribution networks and energy consumed in 2010. An evaluation of the general rural electrification conditions is presented in Subsection 7.2.3, wherein identified rural Localities (and included infrastructure) are classified as either having Access to Electricity, or not. These results are expressed as regional percentages.

7.2.1 Homesteads Identified in 2010

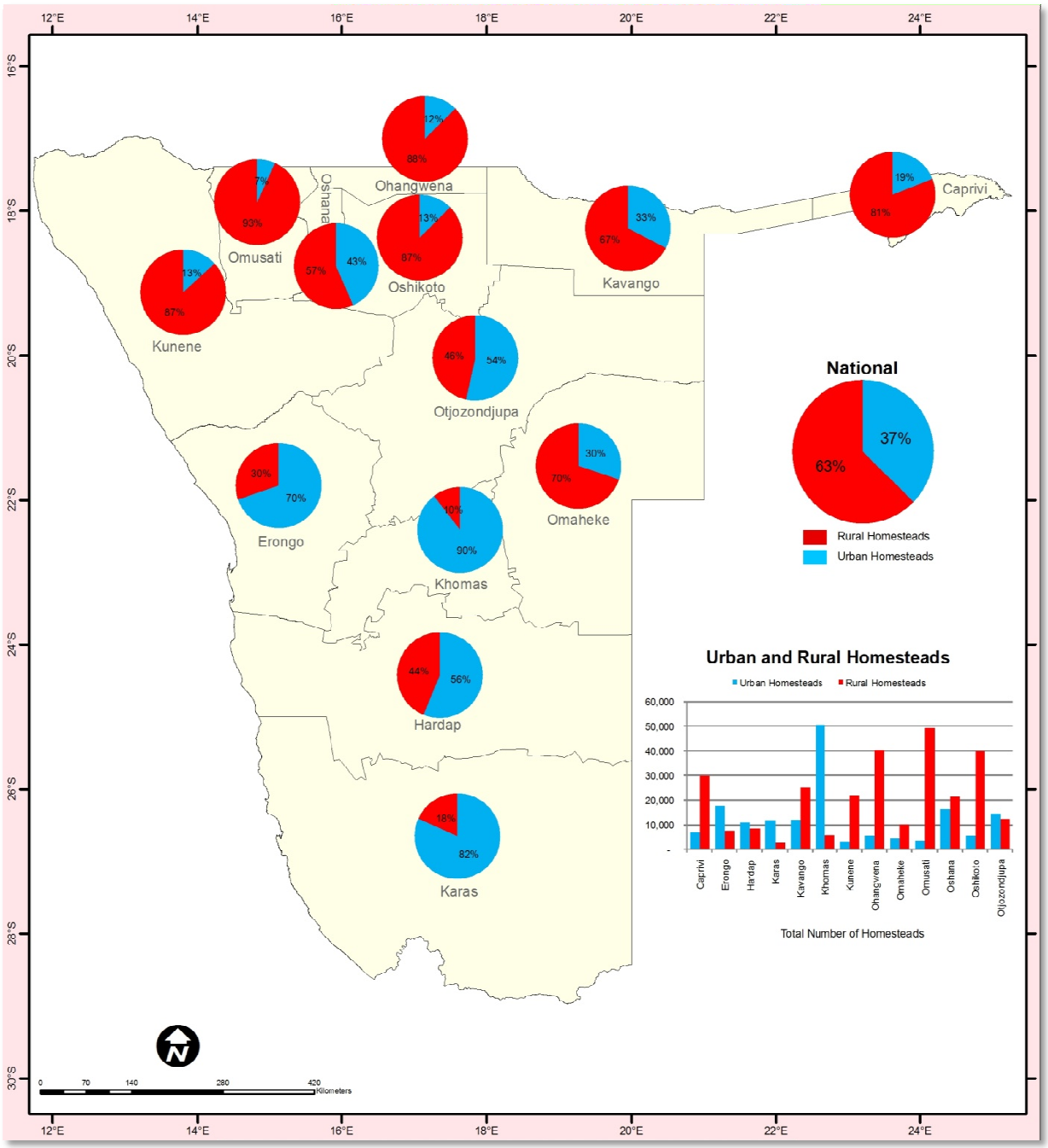
Table 16 summarises the statistics derived from the mapped 2010 GIS homestead points. Also included is the 2001 as well as preliminary 2011 Census data. A total of 275,859 rural homesteads were identified in the GIS, for consideration in this REDMP.

Table 16: GIS and Census homestead counts and annual population growth percentages

REGION	Urban Homesteads per GIS	Rural Homesteads per GIS	Total Homesteads per GIS	Preliminary Total Homesteads per NPC Survey 2011	Variance	Total Homesteads per Census 2001	Population Growth p.a. - NIDS 2006	Population Growth p.a. - Census 2001
Caprivi	7,009	29,957	36,966	46,546	9,580	16,839	1.6%	0.0%
Erongo	17,722	7,691	25,413	25,754	341	27,496	5.4%	1.3%
Hardap	11,018	8,569	19,587	16,325	-3,262	15,039	2.4%	0.3%
Karas	11,983	2,670	14,653	20,660	6,007	15,481	0.3%	1.3%
Kavango	12,246	25,321	37,567	43,828	6,261	30,467	3.6%	3.7%
Khomas	50,415	5,856	56,271	-	-	58,580	4.2%	4.0%
Kunene	3,317	21,992	25,309	12,411	-12,898	12,489	2.8%	1.9%
Ohangwena	5,787	40,538	46,325	51,808	5,483	35,958	1.7%	2.4%
Omaheke	4,369	10,129	14,498	19,476	4,978	12,590	-1.9%	2.5%
Omusati	3,620	49,410	53,030	53,255	225	38,202	-0.2%	1.5%
Oshana	16,315	21,284	37,599	39,852	2,253	29,557	0.2%	1.8%
Oshikoto	5,709	39,828	45,537	47,918	2,381	28,419	0.3%	2.2%
Otjozondjupa	14,521	12,614	27,135	36,945	9,810	25,338	1.4%	2.8%
	164,031	275,859	439,890			346,455		

It should be noted that homesteads were counted during the Study. The term homestead in the REDMP is subsequently used as a proxy for the homestead points mapped. It therefore differs from the homestead count as done for the census, as is evident from the variance column included in Table 16.

The distribution of rural and urban homesteads on a regional basis, is shown in Map 21.



Map 21: Rural and urban homestead distribution, REDMP 2010

7.2.2 Distribution Networks and Energy Consumption in 2010

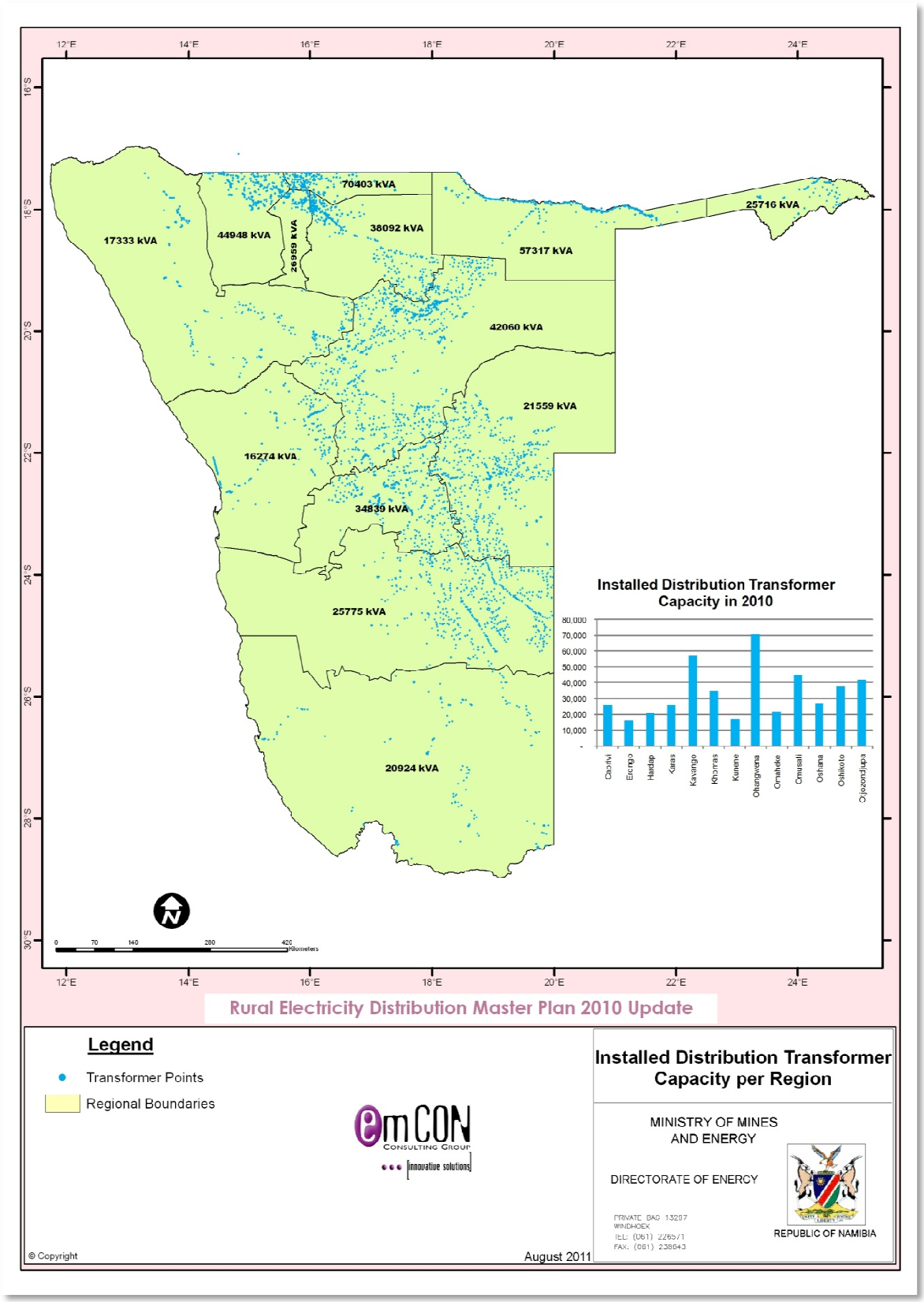
An overview of the installed transformer capacity and total distribution network lengths (as determined from the GIS) is given in Table 17 (DX and TX trfr in the table are abbreviations used for distribution- and transmission to distribution transformer capacities). Distribution networks refer to networks of

voltages of 33 kV and below. Transmission to distribution transformers therefore step the voltage down from the higher transmission line voltages to a level of 33 kV or below. Table 17 also includes the total estimated regional ADMD and energy consumed in 2010. It is noted that the ADMD and energy use statistics include the regional urban areas which are otherwise excluded from the Study, while mining operations are excluded.

Table 17: Existing distribution networks and energy consumption, REDMP 2010

REGION	DX Trfr Capacity [kVA]	TX to DX Trfr Capacity [kVA]	DX Network Length 2010 [km]	ADMD 2010 [kVA]	Energy 2010 [MWh]
Caprivi	25,716	15,000	437.17	6,465	34,206,705
Erongo	16,274	128,500	1,164.91	75,381	404,180,049
Hardap	20,924	31,500	3,667.32	15,092	80,225,613
Karas	25,775	95,000	1,637.23	34,208	186,668,679
Kavango	57,317	26,000	3,197.61	16,887	89,762,493
Khomas	34,839	21,500	2,230.67	158,139	816,909,639
Kunene	17,333	13,000	1,460.27	5,017	26,483,932
Ohangwena	70,403	22,500	811.04	14,092	74,609,051
Omaheke	21,559	23,500	3,554.76	11,129	58,615,174
Omusati	44,948	17,500	1,024.87	8,256	43,190,128
Oshana	26,959	40,000	716.79	22,917	118,070,784
Oshikoto	38,092	56,000	1,971.89	16,456	86,913,216
Otjozondjupa	42,060	104,500	4,865.27	49,584	277,199,863
	442,199	594,500	26,739.80	433,623	2,297,035,326

Map 22 illustrates how the installed distribution transformer capacity is distributed throughout all regions in Namibia.



Map 22: Installed distribution transformer capacity per region, REDMP 2010

7.2.3 Access to Electricity in 2010

The following tables, charts and maps represent all infrastructure that formed the Localities considered for electrification as part of the 2010 REDMP. Total values given in the tables (last column) represent the sum of infrastructure with and without Access to Electricity in 2010. Apart from the tables that display exact values, a bar chart illustration of results per region is also included, followed by a national map showing the regional percentage values.

Tables, charts and maps are shown firstly for the defined Localities, followed by total infrastructure (all Government buildings and homesteads contained in the Localities), schools, total Government buildings (including schools) and homesteads.

Table 18: Total number of Localities per region with and without Access to Electricity in 2010

REGION	Localities with Access	Localities without Access	Total Localities (Rural)
Caprivi	60	635	695
Erongo	264	200	464
Hardap	598	126	724
Karas	205	19	224
Kavango	356	630	986
Khomas	469	132	601
Kunene	270	660	930
Ohangwena	245	1,599	1,844
Omaheke	635	280	915
Omusati	374	1,758	2,132
Oshana	313	906	1,219
Oshikoto	499	1,082	1,581
Otjozondjupa	1,008	243	1,251
	5,296	8,270	13,566

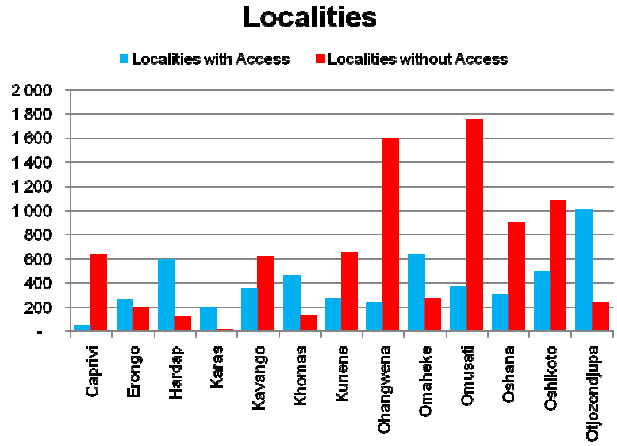
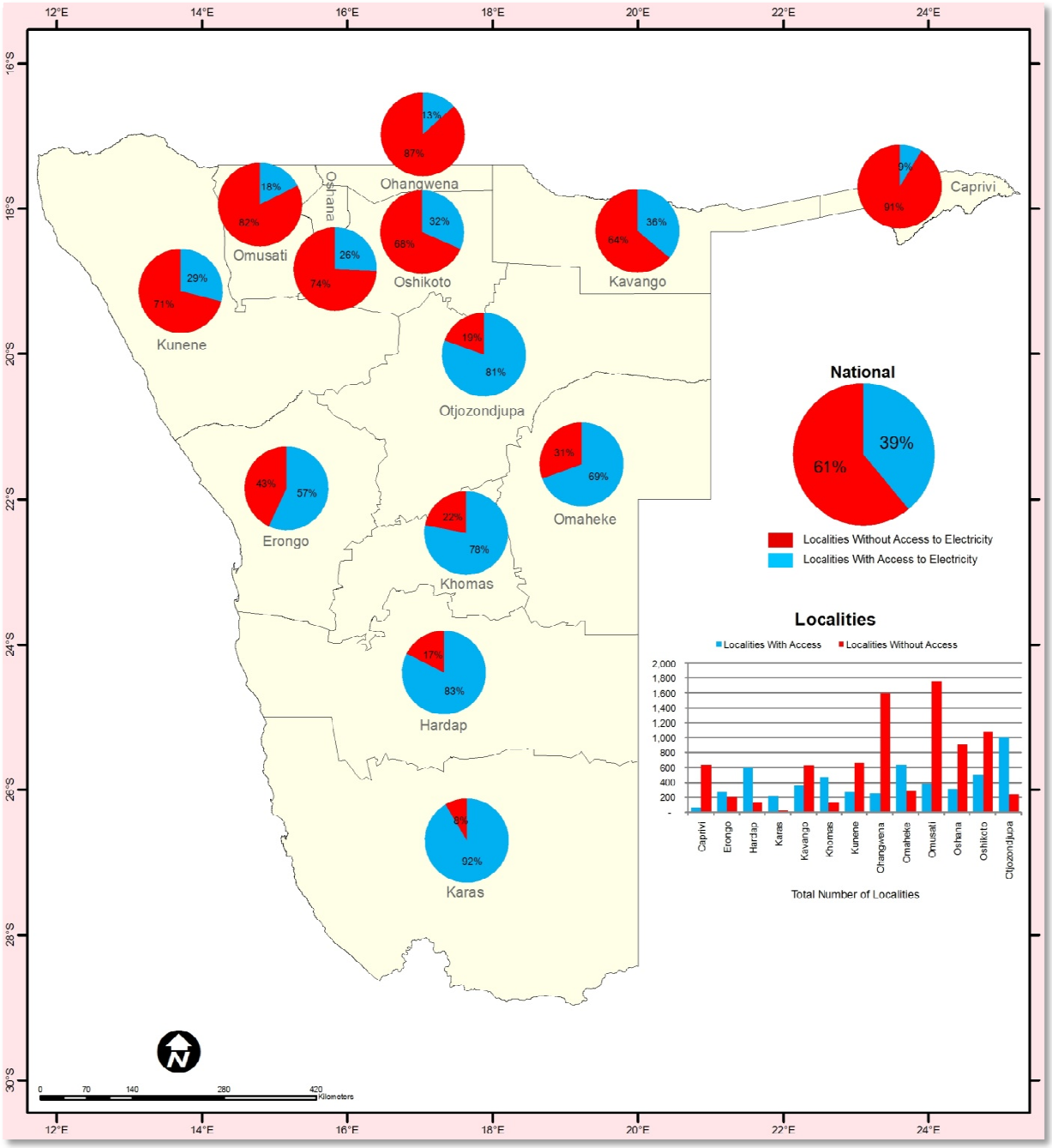


Figure 33: Total number of Localities per region with and without Access to Electricity in 2010

As can be seen from Table 18, a total of 8,270 rural Localities is classified to currently (status 2010) be without Access to Electricity. The Ohangwena and Omusati regions have the highest numbers, with 1,599 and 1,758 respectively.

It is noted that for some of the less densely populated regions in Namibia (e.g. Karas and Hardap in the south), the percentage value of Localities with Access to Electricity is high, while the percentages for total infrastructure (more specifically homesteads) in these regions, is very low (refer to Maps 23 and 24). This is due to the fact that homesteads are few and far apart, and therefore do not form part of the Localities defined (not enough homesteads close enough to each other to constitute a Locality considered for electrification).



Map 23: Total percentage value of Localities per region with and without Access to Electricity in 2010

Table 19: Total infrastructure (all Government buildings and homesteads) per region with and without Access to Electricity in 2010

REGION	Total Infrastructure with Access	Total Infrastructure without Access	Total Infrastructure
Caprivi	2,965	27,828	30,793
Erongo	1,252	6,464	7,716
Hardap	1,994	6,601	8,595
Karas	147	2,540	2,687
Kavango	8,331	18,246	26,577
Khomas	2,021	3,848	5,869
Kunene	3,290	19,095	22,385
Ohangwena	3,618	37,386	41,004
Omaheke	2,495	7,702	10,197
Omusati	5,011	45,048	50,059
Oshana	3,987	17,567	21,554
Oshikoto	7,928	32,102	40,030
Otjozondjupa	4,019	8,653	12,672
	47,058	233,080	280,138

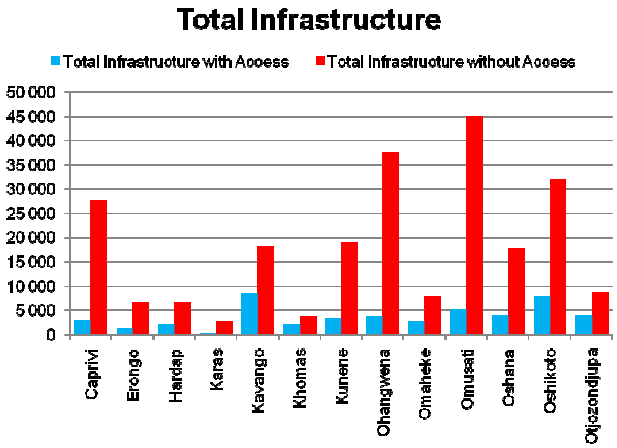
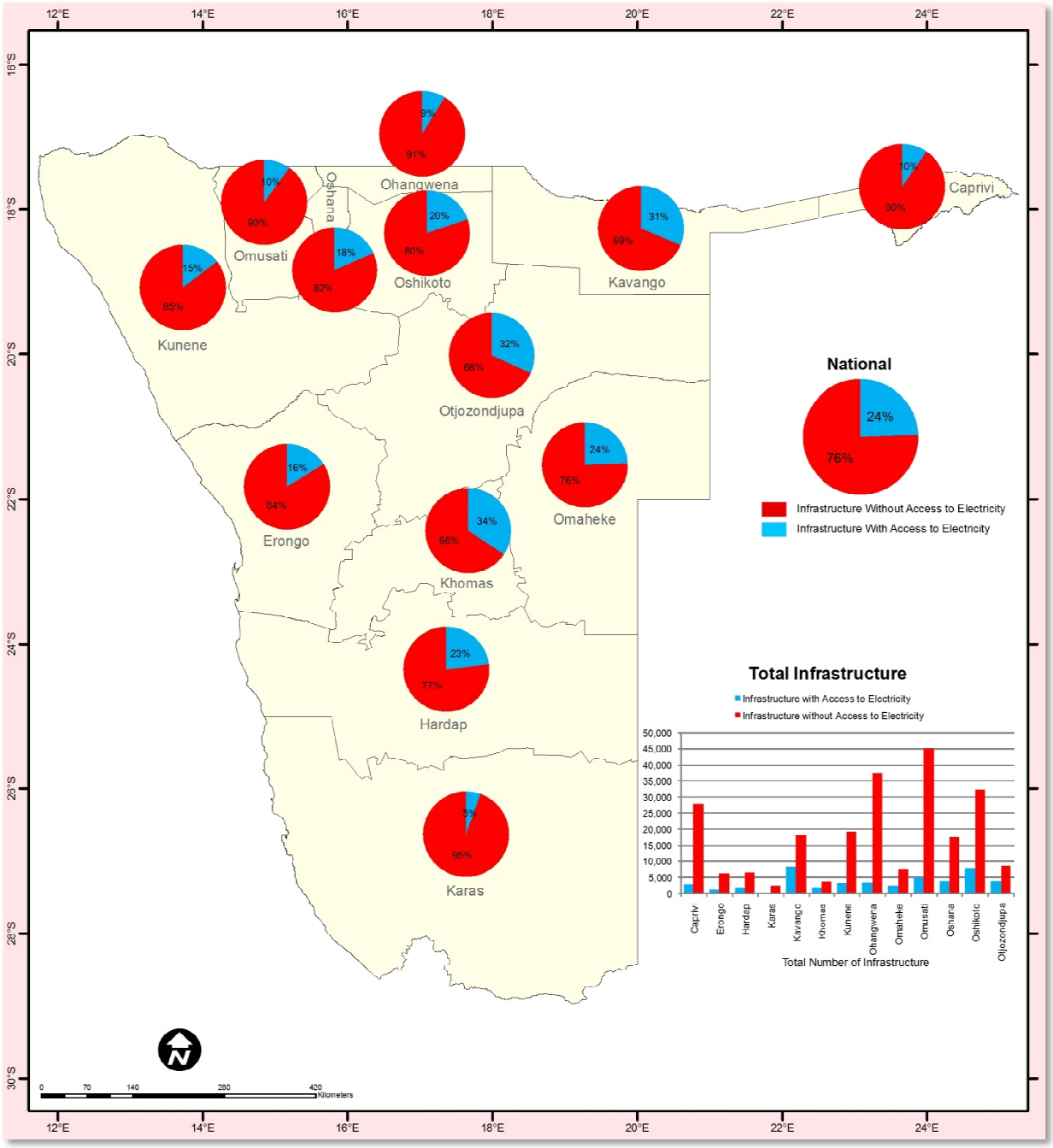


Figure 34: Total infrastructure (all Government buildings and homesteads) per region with and without Access to Electricity in 2010

Total infrastructure includes all Government buildings and homesteads identified in this REDMP Study, and amounts to 280,138. This infrastructure constitutes the 13,566 Localities that are defined. The infrastructure counts with and without Access to Electricity in 2010, as derived in the Study, is given per region in Table 19, and further illustrated in Figure 34 and Map 24.

From Map 24 it can be seen that in 2010, a national percentage of 16% (47,058) of all identified rural infrastructure has Access to Electricity.



Map 24: Total percentage value of infrastructure per region with and without Access to Electricity in 2010

Table 20: Total number of schools per region with and without Access to Electricity in 2010

REGION	Total Schools with Access	Total Schools without Access	Total Schools
Caprivi	31	55	86
Erongo	10	2	12
Hardap	22	1	23
Karas	9	3	12
Kavango	147	161	308
Khomas	8	3	11
Kunene	16	44	60
Ohangwena	97	115	212
Omaheke	8	13	21
Omusati	117	117	234
Oshana	66	27	93
Oshikoto	85	87	172
Otjozondjupa	5	14	19
	621	642	1,263

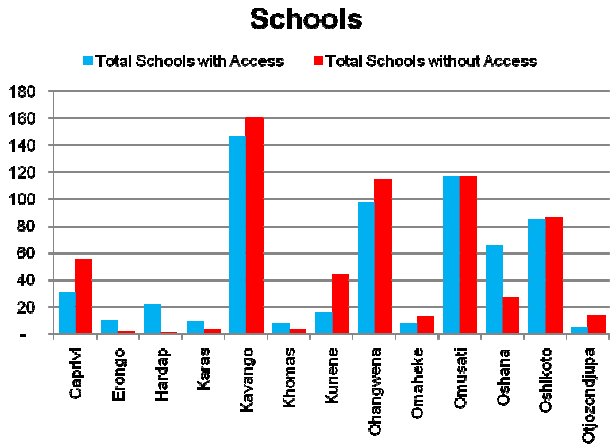
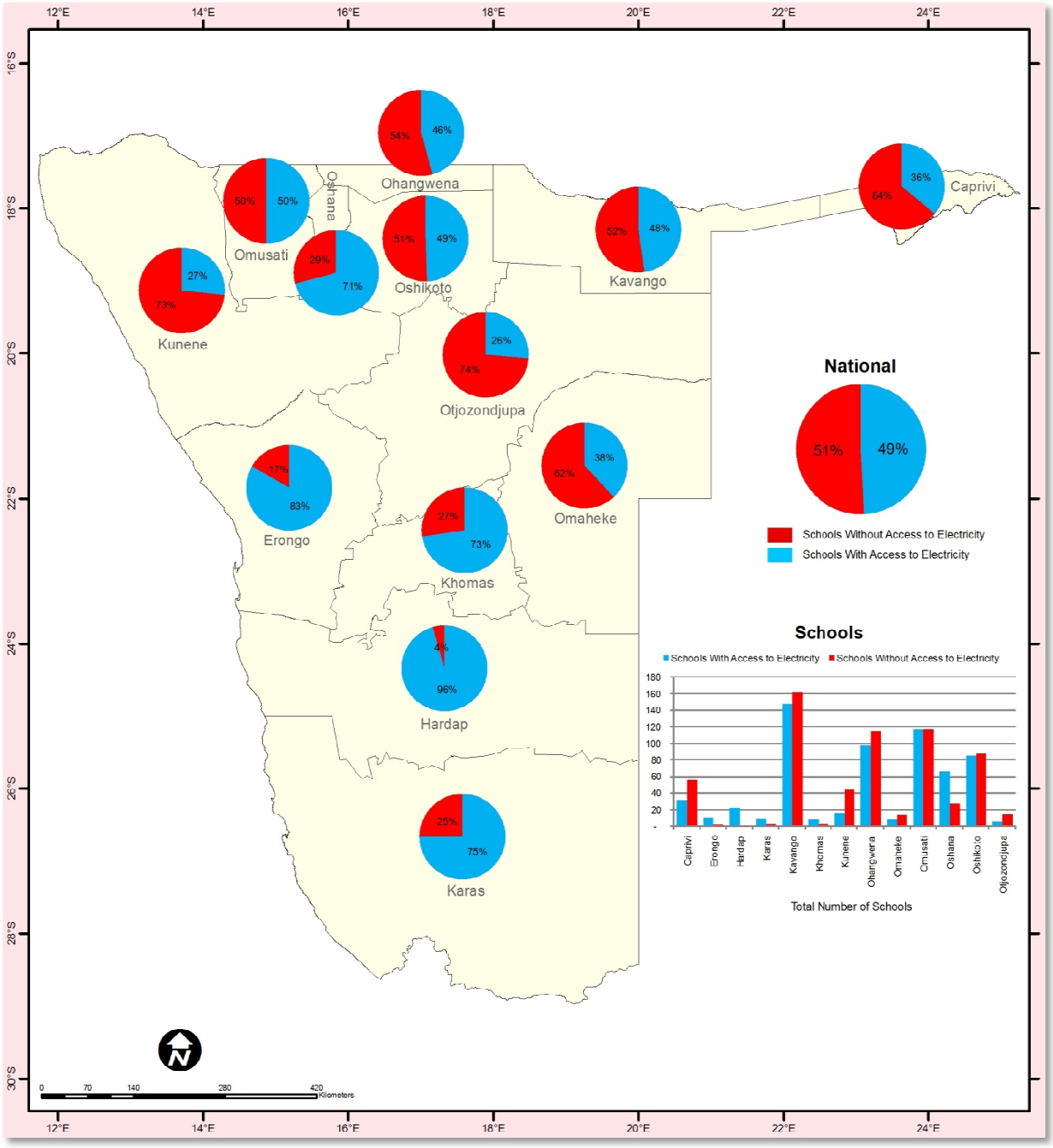


Figure 35: Total number of schools per region with and without Access to Electricity in 2010

A total of 1,263 schools in Rural Areas are identified, and their distribution throughout all regions given in the last column of Table 20. The regional number of schools with and without Access to Electricity in 2010 is also presented in the table, and further illustrated in Figure 35 and Map 25.

Government buildings, and especially schools, is a focus area of this REDMP, which aims to electrify all within the coming 20 years to 2030. On a national level, in 2010, 46% of rural schools are still without Access to Electricity. The percentages for all regions is given in Map 25.



Map 25: Total percentage value of schools per region with and without Access to Electricity in 2010

Table 21: Total number of Government buildings (including schools) per region with and without Access to Electricity in 2010

REGION	Total Government with Access	Total Government without Access	Total Government (Rural)
Caprivi	74	71	145
Erongo	12	5	17
Hardap	24	1	25
Karas	11	3	14
Kavango	537	204	741
Khomas	10	3	13
Kunene	23	51	74
Ohangwena	118	122	240
Omaheke	9	13	22
Omusati	151	127	278
Oshana	74	28	102
Oshikoto	98	97	195
Otjozondjupa	6	15	21
	1,147	740	1,887

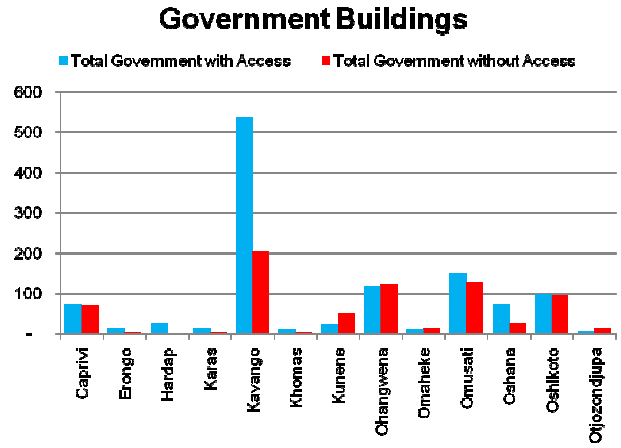
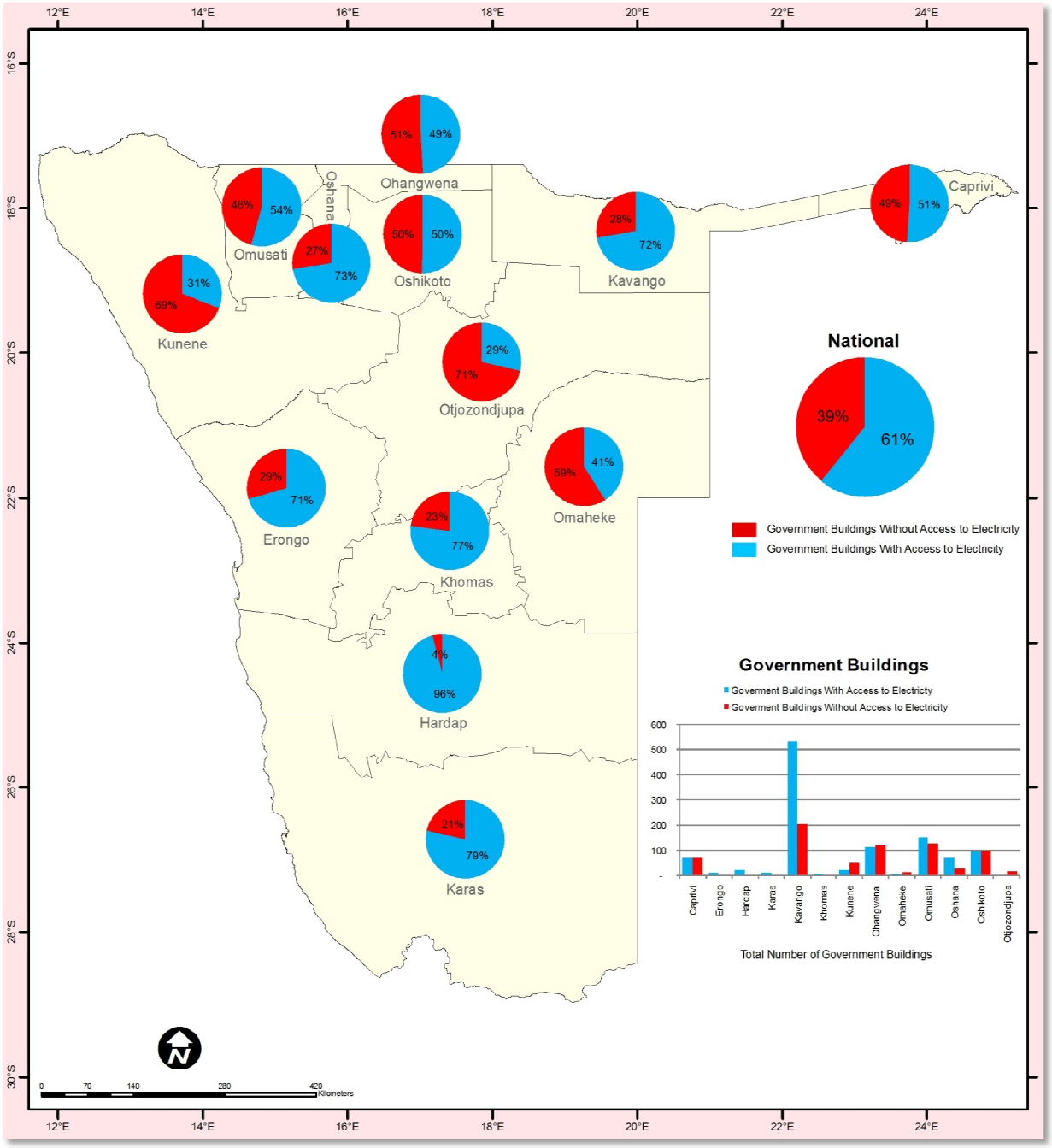


Figure 36: Bar chart illustration of the total number of Government buildings (including schools) per region with and without Access to Electricity in 2010

The total number of Government buildings identified in Rural Areas in the REDMP Study amounts to 1,887, which includes the 1,263 schools already described. Therefore, apart from the schools, a total of 624 other Government buildings are included. The distribution of Government buildings per region with and without Access to Electricity is presented in Table 21. From the illustration of these numbers in Figure 36, it is evident that the Kavango Region has the largest number of identified Government buildings.

In 2010, the total number of Government buildings without Access to Electricity amounts to 740, of which 642 in particular are schools. This represents 41% of all identified Government buildings, as can be seen in Map 26.



Map 26: Total percentage value of Government buildings per region with and without Access to Electricity in 2010

Table 22: Total number of homesteads per region with and without Access to Electricity in 2010

REGION	Total homesteads with Access	Total homesteads without Access	Total homesteads (Rural)
Caprivi	2,629	27,328	29,957
Erongo	1,240	6,451	7,691
Hardap	1,969	6,600	8,569
Karas	134	2,536	2,670
Kavango	7,338	17,983	25,321
Khomas	2,011	3,845	5,856
Kunene	3,187	18,805	21,992
Ohangwena	3,320	37,218	40,538
Omaheke	2,486	7,643	10,129
Omusati	4,609	44,801	49,410
Oshana	3,822	17,462	21,284
Oshikoto	7,830	31,998	39,828
Otjozondjupa	4,013	8,601	12,614
	44,588	231,271	275,859

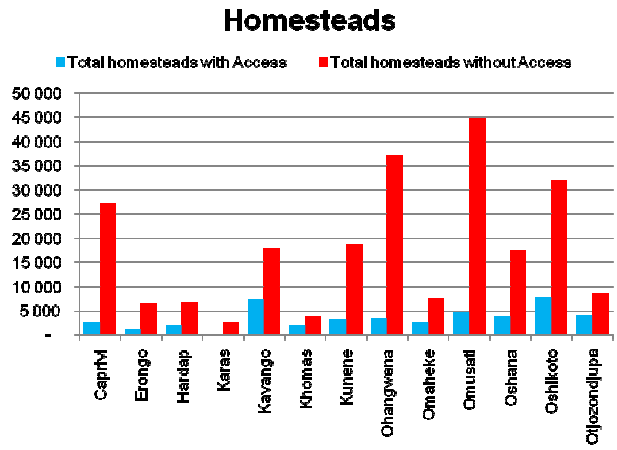
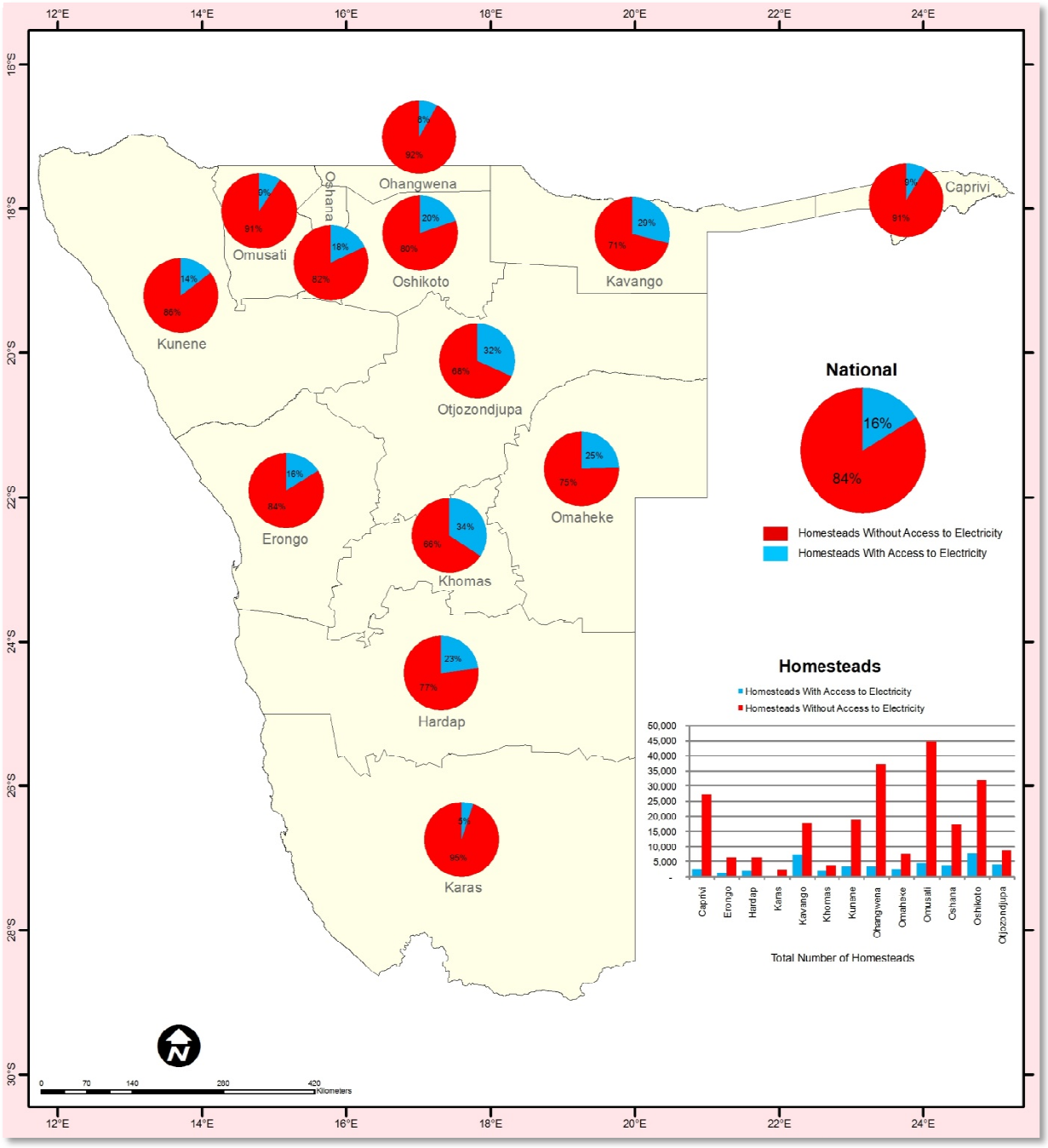


Figure 37: Total number of homesteads per region with and without Access to Electricity in 2010

A total of 275,859 rural homesteads are identified in the REDMP Study. The distribution of this total, as well as the number of homesteads with and without Access to Electricity in 2010, is presented in Table 22, and further illustrated in Figure 37 and Map 27.

In 2010, 16% of rural homesteads are considered to have Access to Electricity, which translates to a total number of 44,588. Refer to Map 27 for the percentages per region.



Map 27: Total percentage value of rural homesteads per region with and without Access to Electricity in 2010

7.3 Rural Electrification Programme

The electrification programmes for each of the 13 regions are shown in 5-year intervals. In particular, programmes are expressed as the total number of Localities (and infrastructure included) electrified every 5 years, for the next 20 years. Tables and illustrative charts are again shown for Localities, total infrastructure, schools, total Government buildings and homesteads. Apart from listing the total number of Localities added per region, the tables also reflect the impact thereof on the total number with and without Access to Electricity as the years progress. These values are shown as cumulative totals to illustrate overall progress. Maps of the 20-year electrification programmes are included in Appendix D.

The 20-year regional and total budgets are summarised in Table 14 (Section 7.1). Detailed information on the Locality names and estimated budgets (per locality, per year, etc.) are provided in the relevant regional reports.

It should be noted that the total numbers in this section's tables and charts represent all identified infrastructure (which include all rural Government buildings and homesteads), not only those considered for electrification as part of the 2010 REDMP. Results may therefore seem negligible when compared to the grand totals. What can be seen however, is a steady reduction in the number of Localities (and infrastructure included) not having Access to Electricity, as new Localities are systematically electrified. A good indication of progress is therefore the total number of infrastructure added every 5 years, as shown in Tables 27 to 30.

7.3.1 Localities added in 5-Year Intervals

Localities contain all Government buildings and homesteads considered in the REDMP Study. A total of 2,879 Localities (and infrastructure included) in Rural Areas will be electrified under the present REDMP by 2030. The electrification programme for these Localities for the coming 20 years is shown in Tables 23 to 26, and further illustrated in Figures 38 to 41.

5-Yearly additions of 590 in 2015, 770 in 2020, 758 in 2025 and 761 in 2030 respectively add to the total of 2,879 Localities, which will increase the total number of Localities with Access to Electricity from 5,886 in 2010 to 8,175 in 2030. Refer to Tables 23 to 26 for the exact number of Localities added per region.

Due to the selection criteria applied for rural electrification, the 8,175 Localities with Access to Electricity in 2030 will represent the larger Localities in each region, and include all Localities with Government buildings. At the end of the electrification programme, 5,391 Localities will still be without Access to Electricity. These will however, contain only homesteads (10 or more), and no Government buildings.

Table 23: Total number of Localities added per region from 2010 to 2015, showing the resulting number of Localities with and without Access to Electricity in 2015

LOCALITIES 2015			
REGION	Total Localities added	Total Localities with Access	Total Localities without Access
Caprivi	39	99	596
Erongo	8	272	192
Hardap	4	602	122
Karas	4	209	15
Kavango	80	436	550
Khomas	3	472	129
Kunene	93	363	567
Ohangwena	86	331	1,513
Omaheke	40	675	240
Omusati	98	472	1,660
Oshana	48	361	858
Oshikoto	70	569	1,012
Otjozondjupa	27	1,035	216
	600	5,896	7,670

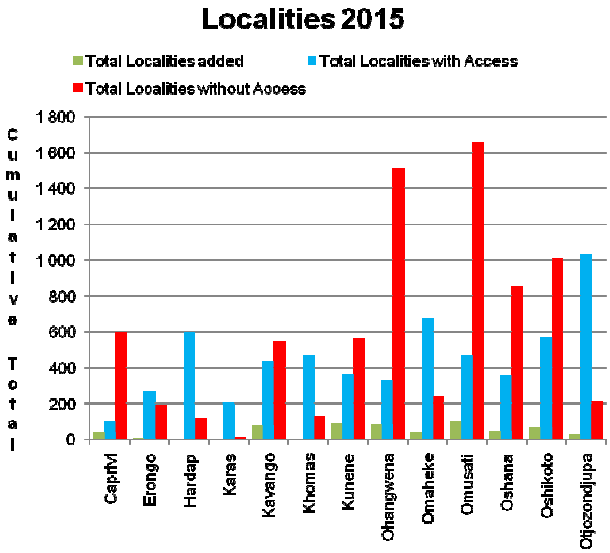


Figure 38: Total number of Localities added per region from 2010 to 2015, showing the resulting number of Localities with and without Access to Electricity in 2015

Table 24: Total number of Localities added per region from 2015 to 2020, showing the resulting number of Localities with and without Access to Electricity in 2020

LOCALITIES 2020			
REGION	Total Localities added	Total Localities with Access	Total Localities without Access
Caprivi	60	159	536
Erongo	9	281	183
Hardap	5	607	117
Karas	5	214	10
Kavango	104	540	446
Khomas	0	472	129
Kunene	97	460	470
Ohangwena	110	441	1,403
Omaheke	41	716	199
Omusati	142	614	1,518
Oshana	63	424	795
Oshikoto	135	704	877
Otjozondjupa	16	1,051	200
	787	6,683	6,883

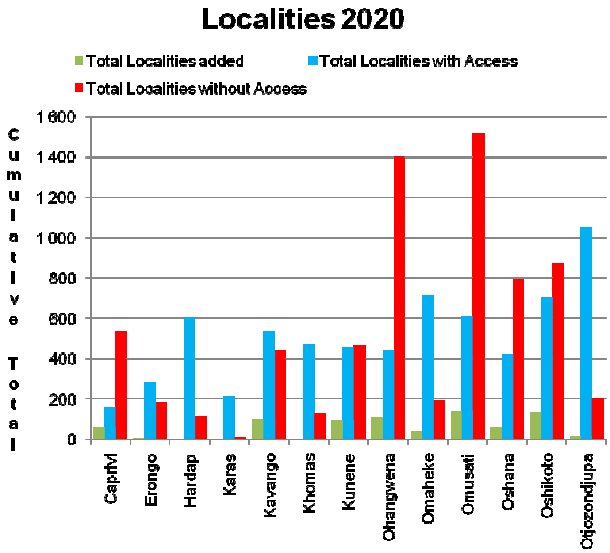


Figure 39: Total number of Localities added per region from 2015 to 2020, showing the resulting number of Localities with and without Access to Electricity in 2020

Table 25: Total number of Localities added per region from 2020 to 2025, showing the resulting number of Localities with and without Access to Electricity in 2025

LOCALITIES 2025			
REGION	Total Localities added	Total Localities with Access	Total Localities without Access
Caprivi	86	245	450
Erongo	7	288	176
Hardap	4	611	113
Karas	5	219	5
Kavango	104	644	342
Khomas	0	472	129
Kunene	87	547	383
Ohangwena	100	541	1,303
Omaheke	41	757	158
Omusati	128	742	1,390
Oshana	65	489	730
Oshikoto	124	828	753
Otjozondjupa	22	1,073	178
	773	7,456	6,110

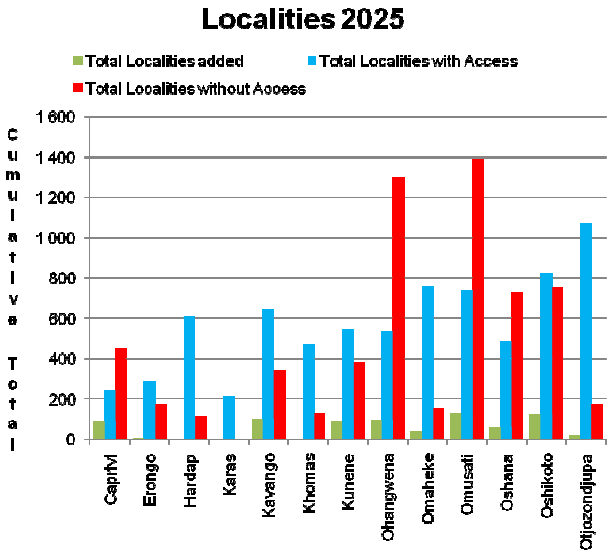


Figure 40: Total number of Localities added per region from 2020 to 2025, showing the resulting number of Localities with and without Access to Electricity in 2025

Table 26: Total number of Localities added per region from 2025 to 2030, showing the resulting number of Localities with and without Access to Electricity in 2030

LOCALITIES 2031			
REGION	Total Localities added	Total Localities with Access	Total Localities without Access
Caprivi	88	333	362
Erongo	8	296	168
Hardap	0	611	113
Karas	1	220	4
Kavango	81	725	261
Khomas	0	472	129
Kunene	93	640	290
Ohangwena	110	651	1,193
Omaheke	43	800	115
Omusati	77	819	1,313
Oshana	72	561	658
Oshikoto	128	956	625
Otjozondjupa	18	1,091	160
	719	8,175	5,391

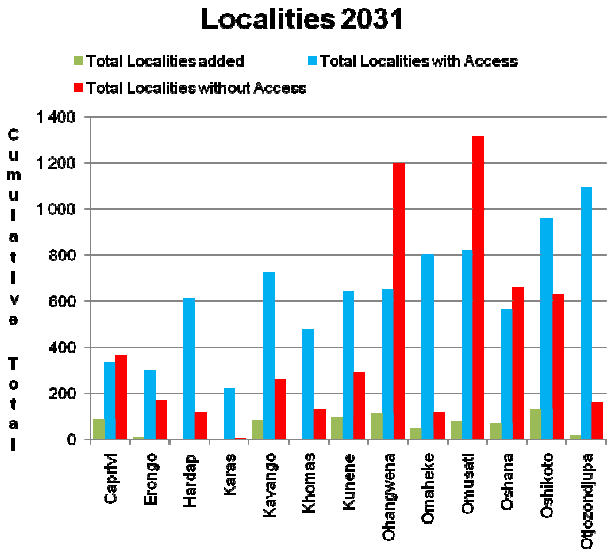


Figure 41: Total number of Localities added per region from 2025 to 2030, showing the resulting number of Localities with and without Access to Electricity in 2030

7.3.2 Total Infrastructure added in 5-Year Intervals

The total infrastructure added in Rural Areas under the 2010 REDMP, amounts to 740 Government buildings and 59,774 homesteads. This represents all Government buildings, and 21% of all existing rural homesteads identified during this REDMP Study. The electrification programme developed to reach this target in the coming 20 years, is presented in Tables 27 to 30, and further illustrated in Figures 42 to 45.

Noteworthy is the total infrastructure electrified in each of the 5-year intervals (2015, 2020, 2025 and 2030), as shown in the second column of Tables 27 to 30. Even though the overall progress in terms of the total infrastructure with and without Access to Electricity may seem negligible, these total additions illustrate the significant advances that are in actual fact achieved through implementation of the programme.

Table 27: Total infrastructure (Government buildings and homesteads) added per region from 2010 to 2015, showing the resulting infrastructure with and without Access to Electricity in 2015

INFRASTRUCTURE 2015			
REGION	Total Infrastructure added	Total Infrastructure with Access	Total Infrastructure without Access
Caprivi	3,236	6,201	24,592
Erongo	103	1,355	6,361
Hardap	36	2,030	6,565
Karas	61	208	2,479
Kavango	2,183	10,514	16,063
Khomas	33	2,054	3,815
Kunene	2,050	5,340	17,045
Ohangwena	1,221	4,839	36,165
Omaheke	771	3,266	6,931
Omusati	1,284	6,295	43,764
Oshana	719	4,706	16,848
Oshikoto	1,367	9,295	30,735
Otjozondjupa	369	4,388	8,284
	13,433	60,491	219,647

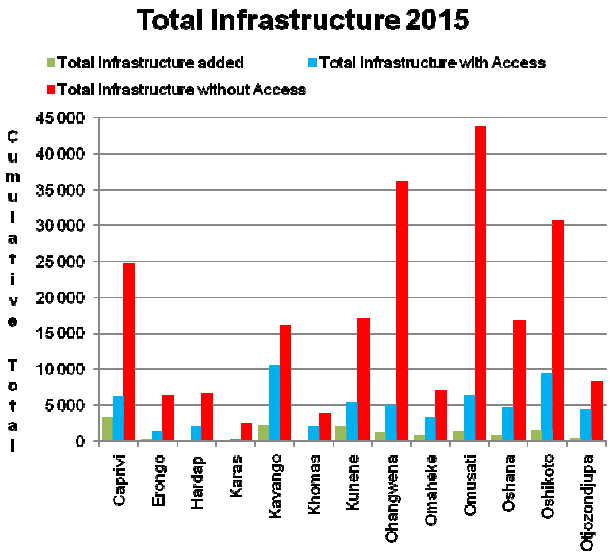


Figure 42: Total infrastructure (Government buildings and homesteads) added per region from 2010 to 2015, showing the resulting total infrastructure with and without Access to Electricity in 2015

Table 28: Total infrastructure (Government buildings and homesteads) added per region from 2015 to 2020, showing the resulting infrastructure with and without Access to Electricity in 2020

INFRASTRUCTURE 2020			
REGION	Total Infrastructure added	Total Infrastructure with Access	Total Infrastructure without Access
Caprivi	4,871	11,072	19,721
Erongo	194	1,549	6,167
Hardap	55	2,085	6,510
Karas	99	307	2,380
Kavango	3,399	13,913	12,664
Khomas	0	2,054	3,815
Kunene	1,644	6,984	15,401
Ohangwena	1,942	6,781	34,223
Omaheke	626	3,892	6,305
Omusati	2,672	8,967	41,092
Oshana	975	5,681	15,873
Oshikoto	1,887	11,182	28,848
Otjozondjupa	402	4,790	7,882
	18,766	79,257	200,881

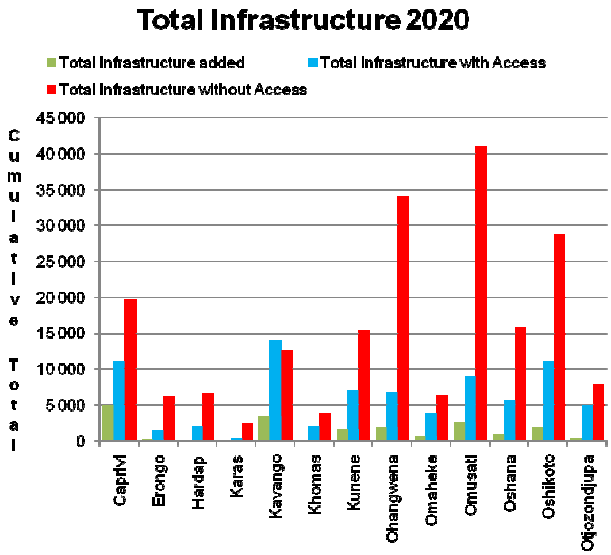


Figure 43: Total infrastructure (Government buildings and homesteads) added per region from 2015 to 2020, showing the resulting total infrastructure with and without Access to Electricity in 2020

Table 29: Total infrastructure (Government buildings and homesteads) added per region from 2020 to 2025, showing the resulting infrastructure with and without Access to Electricity in 2025

INFRASTRUCTURE 2025			
REGION	Total Infrastructure added	Total Infrastructure with Access	Total Infrastructure without Access
Caprivi	4,448	15,520	15,273
Erongo	170	1,719	5,997
Hardap	49	2,134	6,461
Karas	74	381	2,306
Kavango	1,899	15,812	10,765
Khomas	0	2,054	3,815
Kunene	1,778	8,762	13,623
Ohangwena	1,679	8,460	32,544
Omaheke	606	4,498	5,699
Omusati	2,136	11,103	38,956
Oshana	982	6,663	14,891
Oshikoto	1,655	12,837	27,193
Otjozondjupa	381	5,171	7,501
	15,857	95,114	185,024

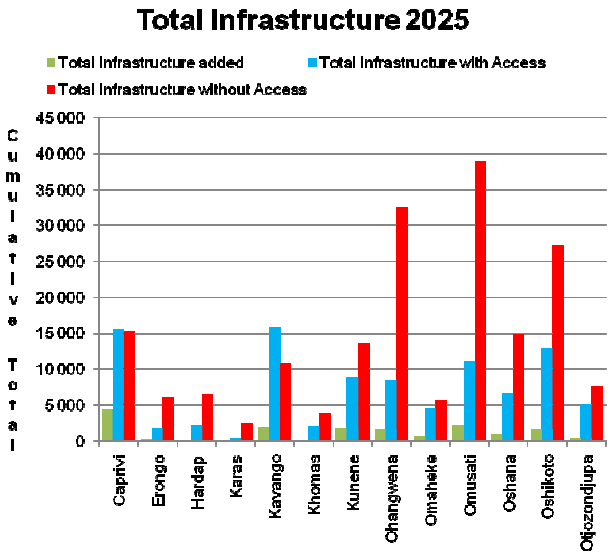


Figure 44: Total infrastructure (Government buildings and homesteads) added per region from 2020 to 2025, showing the resulting total infrastructure with and without Access to Electricity in 2025

Table 30: Total infrastructure (Government buildings and homesteads) added per region from 2025 to 2030, showing the resulting infrastructure with and without Access to Electricity in 2030

INFRASTRUCTURE 2031			
REGION	Total Infrastructure added	Total Infrastructure with Access	Total Infrastructure without Access
Caprivi	3,800	19,320	11,473
Erongo	154	1,873	5,843
Hardap	0	2,134	6,461
Karas	10	391	2,296
Kavango	960	16,772	9,805
Khomas	0	2,054	3,815
Kunene	1,425	10,187	12,198
Ohangwena	1,520	9,980	31,024
Omaheke	662	5,160	5,037
Omusati	1,375	12,478	37,581
Oshana	1,056	7,719	13,835
Oshikoto	1,502	14,339	25,691
Otjozondjupa	241	5,412	7,260
	12,705	107,819	172,319

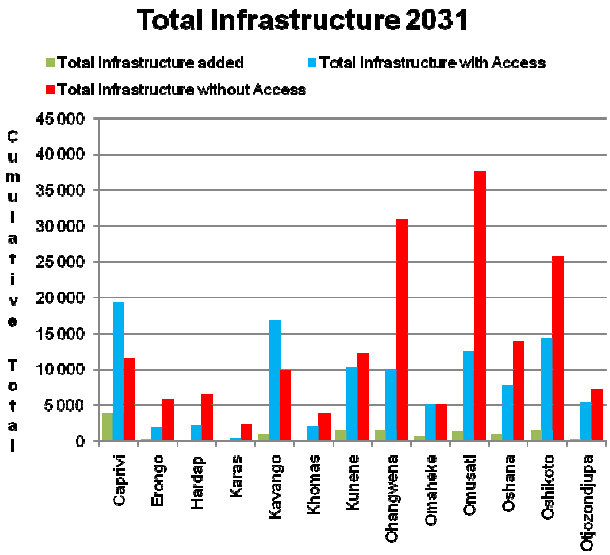


Figure 45: Total infrastructure (Government buildings and homesteads) added per region from 2025 to 2030, showing the resulting total infrastructure with and without Access to Electricity in 2030

7.3.3 Schools added in 5-Year Intervals

The MME set the explicit target that all Government buildings, and especially schools, are to be electrified in the next 20 years. The 2010 REDMP identified 642 rural schools throughout the country, which are prioritised for electrification as shown in the 5-yearly programmes in Tables 31 to 34, and further illustrated in Figures 46 to 49 below.

As is shown in Table 34 and Figure 49, the electrification of these schools within the next 20 years is made possible if the REDMP is fully implemented, with the number of schools in all regions without Access to Electricity dropping to zero in 2030.

For regions Erongo, Hardap and Khomas, all identified schools are electrified within the first 5-year period, as is evident from the last column in Table 31, and Figure 46.

Table 31: Total number of schools added per region from 2010 to 2015, showing the resulting number of schools with and without Access to Electricity in 2015

SCHOOLS 2015			
REGION	Total Schools added	Total Schools with Access	Total Schools without Access
Caprivi	30	61	25
Erongo	2	12	0
Hardap	1	23	0
Karas	1	10	2
Kavango	52	199	109
Khomas	3	11	0
Kunene	16	32	28
Ohangwena	65	162	50
Omaheke	12	20	1
Omusati	84	201	33
Oshana	21	87	6
Oshikoto	50	135	37
Otjozondjupa	7	12	7
	344	965	298

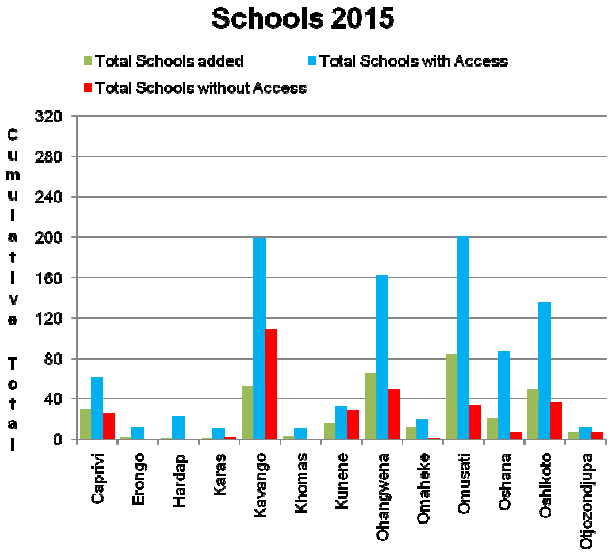


Figure 46: Total number of schools added per region from 2010 to 2015, showing the resulting number of schools with and without Access to Electricity in 2015

Table 32: Total number of schools added per region from 2015 to 2020, showing the resulting number of schools with and without Access to Electricity in 2020

SCHOOLS 2020			
REGION	Total Schools added	Total Schools with Access	Total Schools without Access
Caprivi	2	63	23
Erongo	0	12	0
Hardap	0	23	0
Karas	2	12	0
Kavango	8	207	101
Khomas	0	11	0
Kunene	15	47	13
Ohangwena	23	185	27
Omaheke	1	21	0
Omusati	16	217	17
Oshana	6	93	0
Oshikoto	22	157	15
Otjozondjupa	5	17	2
	100	1,065	198

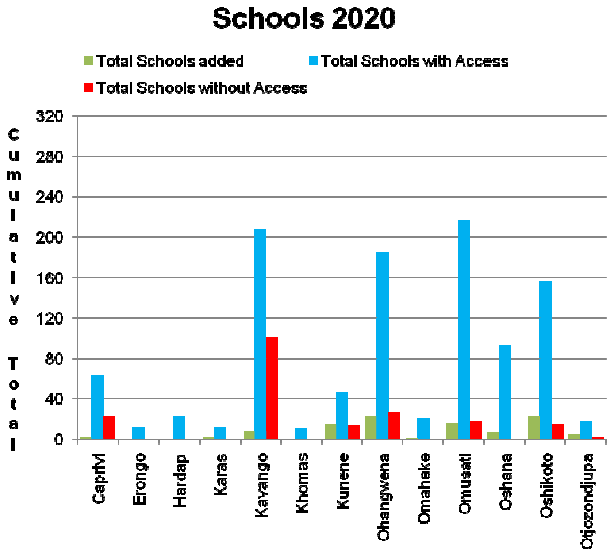


Figure 47: Total number of schools added per region from 2015 to 2020, showing the resulting number of schools with and without Access to Electricity in 2020

Table 33: Total number of schools added per region from 2020 to 2025, showing the resulting number of schools with and without Access to Electricity in 2025

SCHOOLS 2025			
REGION	Total Schools added	Total Schools with Access	Total Schools without Access
Caprivi	3	66	20
Erongo	0	12	0
Hardap	0	23	0
Karas	0	12	0
Kavango	43	250	58
Khomas	0	11	0
Kunene	11	58	2
Ohangwena	17	202	10
Omaheke	0	21	0
Omusati	6	223	11
Oshana	0	93	0
Oshikoto	10	167	5
Otjozondjupa	2	19	0
	92	1,157	106

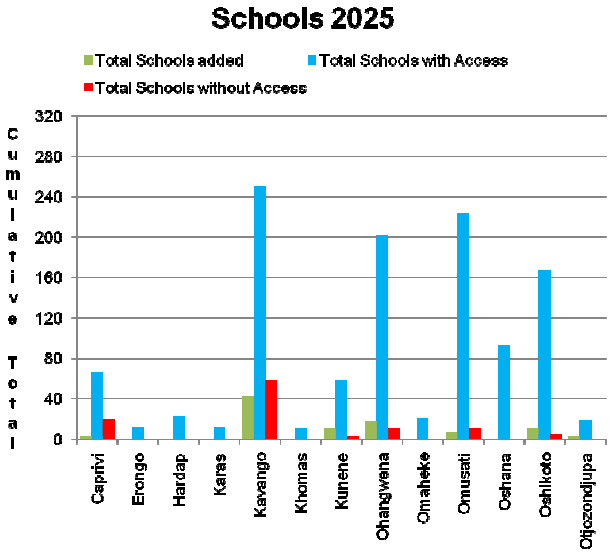


Figure 48: Total number of schools added per region from 2020 to 2025, showing the resulting number of schools with and without Access to Electricity in 2025

Table 34: Total number of schools added per region from 2025 to 2030, showing the resulting number of schools with and without Access to Electricity in 2030

SCHOOLS 2031			
REGION	Total Schools added	Total Schools with Access	Total Schools without Access
Caprivi	20	86	0
Erongo	0	12	0
Hardap	0	23	0
Karas	0	12	0
Kavango	58	308	0
Khomas	0	11	0
Kunene	2	60	0
Ohangwena	10	212	0
Omaheke	0	21	0
Omusati	11	234	0
Oshana	0	93	0
Oshikoto	5	172	0
Otjozondjupa	0	19	0
	106	1,263	0

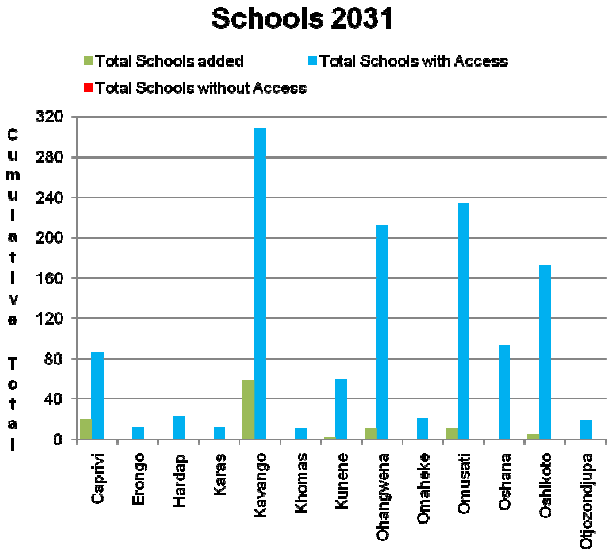


Figure 49: Total number of schools added per region from 2025 to 2030, showing the resulting number of schools with and without Access to Electricity in 2030

7.3.4 Government Buildings added in 5-Year Intervals

Apart from rural schools, the electrification of other Government buildings has also been a main priority of the MME. Once again, the target of electrifying all Government buildings (total 740, including schools) in the next 20 years is achieved, provided the REDMP programme is followed as presented in Tables 35 to 38, and Figures 50 to 53 shown below.

Table 38 and Figure 53 illustrate the 20-year progress made as foreseen by the REDMP, with the number of Government buildings in rural Namibia without Access to Electricity dropping to zero in 2030. Again, it can be seen from Table 35 and Figure 50 that all Government buildings in regions Erongo, Hardap and Khomas are electrified within the first 5 years, and all Government buildings in regions Karas, Omaheke and Oshana (for a total of 6 regions, as seen in Table 36 and Figure 51) within the first 10 years.

Table 35: Total number of Government buildings (including schools) added per region from 2010 to 2015, showing the resulting number of Government buildings with and without Access to Electricity in 2015

GOVERNMENT BUILDINGS 2015			
REGION	Total GRN Buildings added	Total GRN Buildings with Access	Total GRN Buildings without Access
Caprivi	37	111	34
Erongo	5	17	0
Hardap	1	25	0
Karas	1	12	2
Kavango	81	618	123
Khomas	3	13	0
Kunene	19	42	32
Ohangwena	68	186	54
Omaheke	12	21	1
Omusati	90	241	37
Oshana	22	96	6
Oshikoto	55	153	42
Otjozondjupa	7	13	8
	401	1,548	339

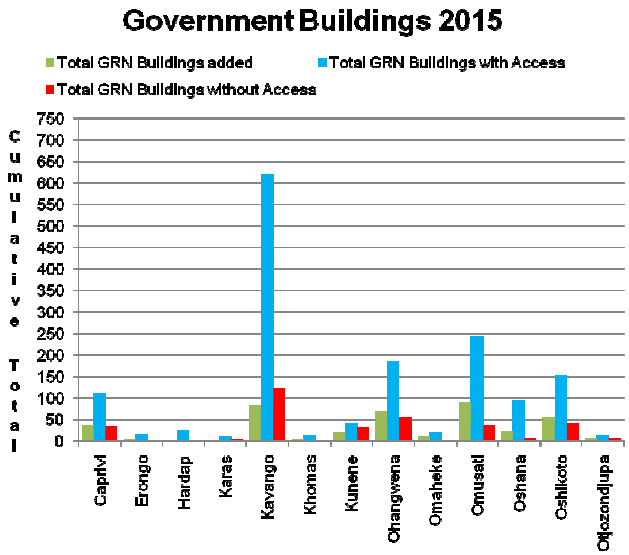


Figure 50: Total number of Government buildings (including schools) added per region from 2010 to 2015, showing the resulting number of Government buildings with and without Access to Electricity in 2015

Table 36: Total number of Government buildings (including schools) added per region from 2015 to 2020, showing the resulting number of Government buildings with and without Access to Electricity in 2020

GOVERNMENT BUILDINGS 2020			
REGION	Total GRN Buildings added	Total GRN Buildings with Access	Total GRN Buildings without Access
Caprivi	3	114	31
Erongo	0	17	0
Hardap	0	25	0
Karas	2	14	0
Kavango	9	627	114
Khomas	0	13	0
Kunene	18	60	14
Ohangwena	26	212	28
Omaheke	1	22	0
Omusati	16	257	21
Oshana	6	102	0
Oshikoto	24	177	18
Otjozondjupa	6	19	2
	111	1,659	228

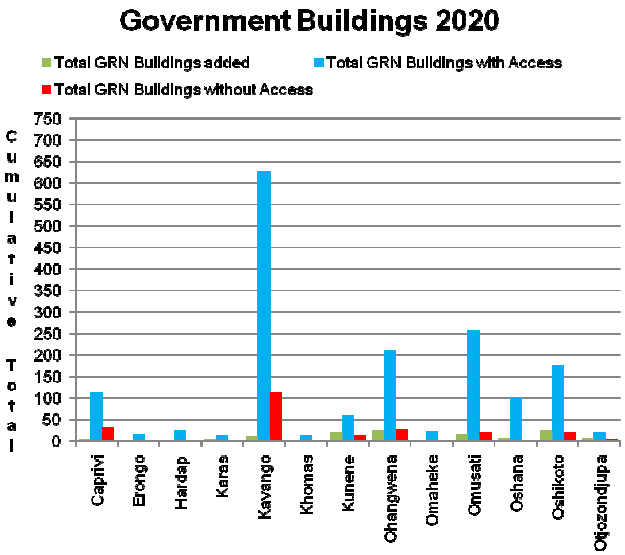


Figure 51: Total number of Government buildings (including schools) added per region from 2015 to 2020, showing the resulting number of Government buildings with and without Access to Electricity in 2020

Table 37: Total number of Government buildings (including schools) added per region from 2020 to 2025, showing the resulting number of Government buildings with and without Access to Electricity in 2025

GOVERNMENT BUILDINGS 2025			
REGION	Total GRN Buildings added	Total GRN Buildings with Access	Total GRN Buildings without Access
Caprivi	3	117	28
Erongo	0	17	0
Hardap	0	25	0
Karas	0	14	0
Kavango	54	681	60
Khomas	0	13	0
Kunene	12	72	2
Ohangwena	17	229	11
Omaheke	0	22	0
Omusati	7	264	14
Oshana	0	102	0
Oshikoto	11	188	7
Otjozondjupa	2	21	0
	106	1,765	122

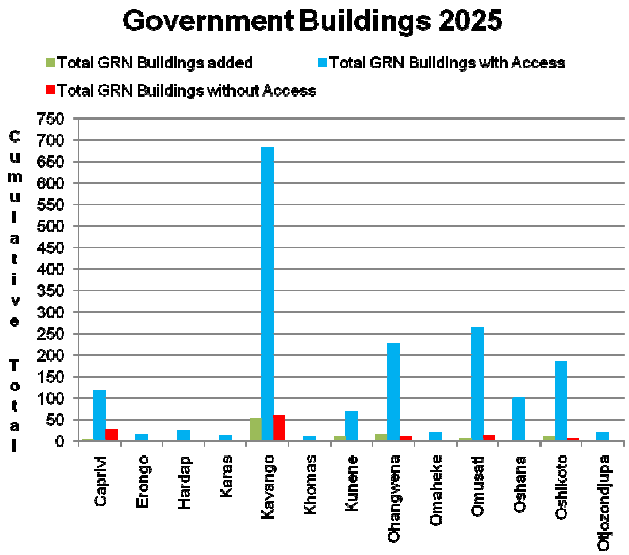


Figure 52: Total number of Government buildings (including schools) added per region from 2020 to 2025, showing the resulting number of Government buildings with and without Access to Electricity in 2025

Table 38: Total number of Government buildings (including schools) added per region from 2025 to 2030, showing the resulting number of Government buildings with and without Access to Electricity in 2030

GOVERNMENT BUILDINGS 2031			
REGION	Total GRN Buildings added	Total GRN Buildings with Access	Total GRN Buildings without Access
Caprivi	28	145	0
Erongo	0	17	0
Hardap	0	25	0
Karas	0	14	0
Kavango	60	741	0
Khomas	0	13	0
Kunene	2	74	0
Ohangwena	11	240	0
Omaheke	0	22	0
Omusati	14	278	0
Oshana	0	102	0
Oshikoto	7	195	0
Otjozondjupa	0	21	0
	122	1,887	0

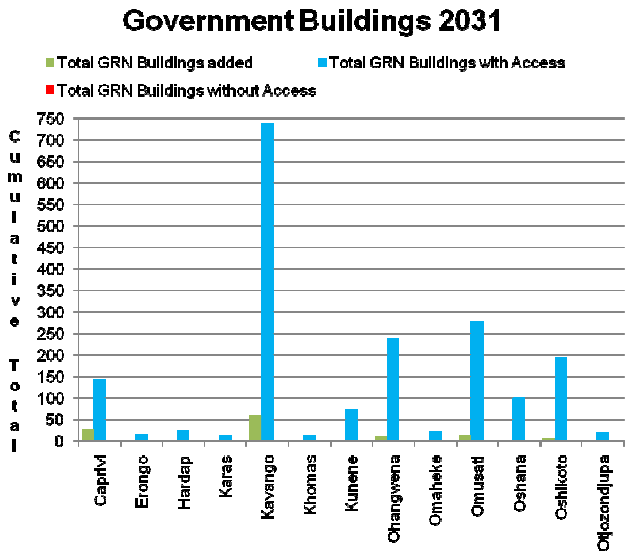


Figure 53: Total number of Government buildings (including schools) added per region from 2025 to 2030, showing the resulting number of Government buildings with and without Access to Electricity in 2030

7.3.5 Homesteads added in 5-Year Intervals

A total of 275,859 rural homesteads are identified in the REDMP Study, of which 44,588 is classified to currently (status 2010) have Access to Electricity. The 2010 REDMP delivers electricity connections to 59,774 rural homesteads, and increases the number with Access to Electricity from an initial 16% to 38% in the next 20 years.

The electrification programme in 5-year intervals is presented in Tables 39 to 42, and further illustrated in Figures 54 to 57.

Table 39: Total number of homesteads added per region from 2010 to 2015, showing the resulting number of homesteads with and without Access to Electricity in 2015

HOMESTEADS 2015			
REGION	Total homesteads added	Total homesteads with Access	Total homesteads without Access
Caprivi	3,155	5,784	24,173
Erongo	98	1,338	6,353
Hardap	35	2,004	6,565
Karas	60	194	2,476
Kavango	2,093	9,431	15,890
Khomas	30	2,041	3,815
Kunene	2,031	5,218	16,774
Ohangwena	1,135	4,455	36,083
Omaheke	759	3,245	6,884
Omusati	1,188	5,797	43,613
Oshana	696	4,518	16,766
Oshikoto	1,311	9,141	30,687
Otjozondjupa	362	4,375	8,239
	12,953	57,541	218,318

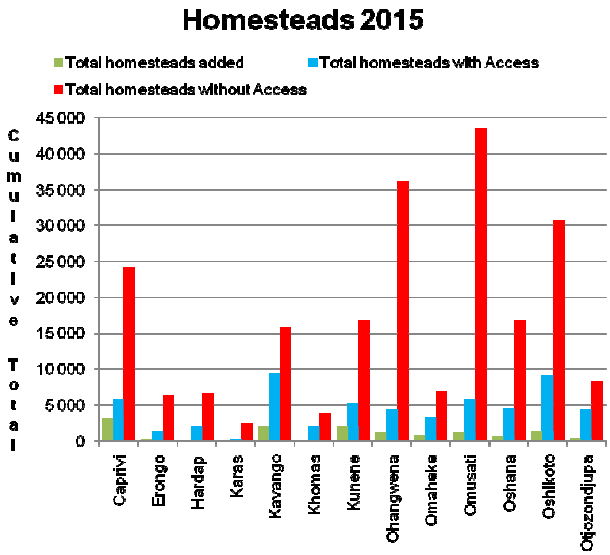


Figure 54: Total number of homesteads added per region from 2010 to 2015, showing the resulting number of homesteads with and without Access to Electricity in 2015

Table 40: Total number of homesteads added per region from 2015 to 2020, showing the resulting number of homesteads with and without Access to Electricity in 2020

HOMESTEADS 2020			
REGION	Total homesteads added	Total homesteads with Access	Total homesteads without Access
Caprivi	4,851	10,635	19,322
Erongo	194	1,532	6,159
Hardap	55	2,059	6,510
Karas	97	291	2,379
Kavango	3,387	12,818	12,503
Khomas	0	2,041	3,815
Kunene	1,626	6,844	15,148
Ohangwena	1,901	6,356	34,182
Omaheke	625	3,870	6,259
Omusati	2,652	8,449	40,961
Oshana	969	5,487	15,797
Oshikoto	1,863	11,004	28,824
Otjozondjupa	396	4,771	7,843
	18,616	76,157	199,702

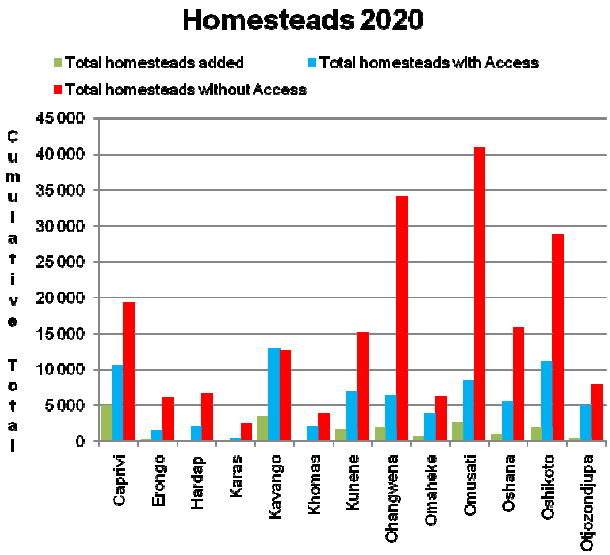


Figure 55: Total number of homesteads added per region from 2015 to 2020, showing the resulting number of homesteads with and without Access to Electricity in 2020

Table 41: Total number of homesteads added per region from 2020 to 2025, showing the resulting number of homesteads with and without Access to Electricity in 2025

HOMESTEADS 2025			
REGION	Total homesteads added	Total homesteads with Access	Total homesteads without Access
Caprivi	4,426	15,061	14,896
Erongo	170	1,702	5,989
Hardap	49	2,108	6,461
Karas	74	365	2,305
Kavango	1,838	14,656	10,665
Khomas	0	2,041	3,815
Kunene	1,765	8,609	13,383
Ohangwena	1,650	8,006	32,532
Omaheke	606	4,476	5,653
Omusati	2,125	10,574	38,836
Oshana	978	6,465	14,819
Oshikoto	1,643	12,647	27,181
Otjozondjupa	379	5,150	7,464
	15,703	91,860	183,999

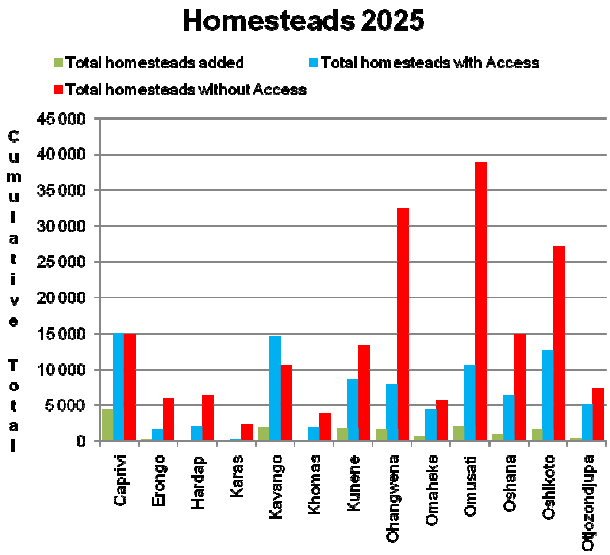


Figure 56: Total number of homesteads added per region from 2020 to 2025, showing the resulting number of homesteads with and without Access to Electricity in 2025

Table 42: Total number of homesteads added per region from 2025 to 2030, showing the resulting number of homesteads with and without Access to Electricity in 2030

HOMESTEADS 2031			
REGION	Total homesteads added	Total homesteads with Access	Total homesteads without Access
Caprivi	3,717	18,778	11,179
Erongo	154	1,856	5,835
Hardap	0	2,108	6,461
Karas	10	375	2,295
Kavango	887	15,543	9,778
Khomas	0	2,041	3,815
Kunene	1,423	10,032	11,960
Ohangwena	1,509	9,515	31,023
Omaheke	662	5,138	4,991
Omusati	1,358	11,932	37,478
Oshana	1,047	7,512	13,772
Oshikoto	1,494	14,141	25,687
Otjozondjupa	241	5,391	7,223
	12,502	104,362	171,497

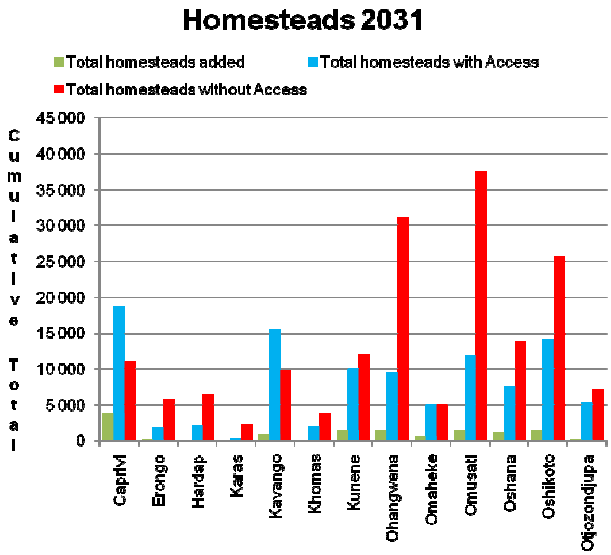


Figure 57: Total number of homesteads added per region from 2025 to 2030, showing the resulting number of homesteads with and without Access to Electricity in 2030

7.3.6 Rural Electricity Distribution and Projected Demand in the coming 20 Years

Tables 43 and 44 provide a projection of how the distribution networks and conditions are expected to change as a result of the implementation of the 20-year REDMP.

Noteworthy is the drop in average distances between rural homesteads to transformer points (Table 43).

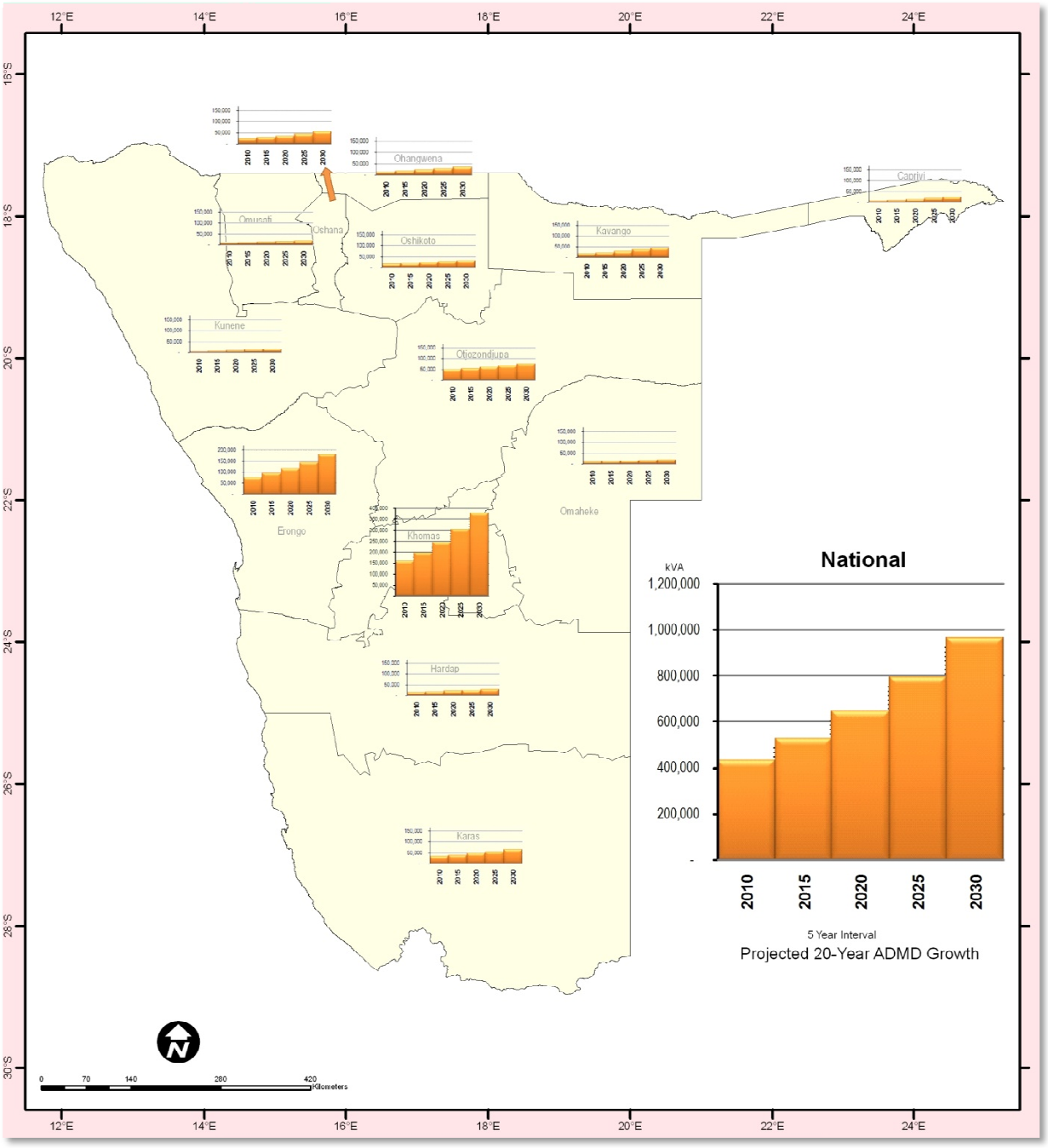
Table 43: 20-Year distribution networks, REDMP 2010

REGION	DX Network Length 2010 [km]	DX Network Length 2030 [km]	Average Homestead - Trfr Distance 2010 [km]	Average Homestead - Trfr Distance 2030 [km]
Caprivi	437.17	990.04	11.4	1.1
Erongo	1,164.91	1,438.84	12.7	7.9
Hardap	3,667.32	3,833.63	15.8	15.0
Karas	1,637.23	1,848.03	28.5	23.8
Kavango	3,197.61	4,587.83	5.7	1.4
Khomas	2,230.67	2,230.67	-	-
Kunene	1,460.27	3,750.99	21.2	5.7
Ohangwena	811.04	1,975.94	5.6	1.8
Omaheke	3,554.76	4,720.46	17.5	6.3
Omusati	1,024.87	1,950.47	6.1	2.7
Oshana	716.79	1,126.33	3.8	2.2
Oshikoto	1,971.89	3,265.62	7.2	1.8
Otjozondjupa	4,865.27	5,472.58	18.9	12.4
	26,739.80	37,191.43	12.86	6.84

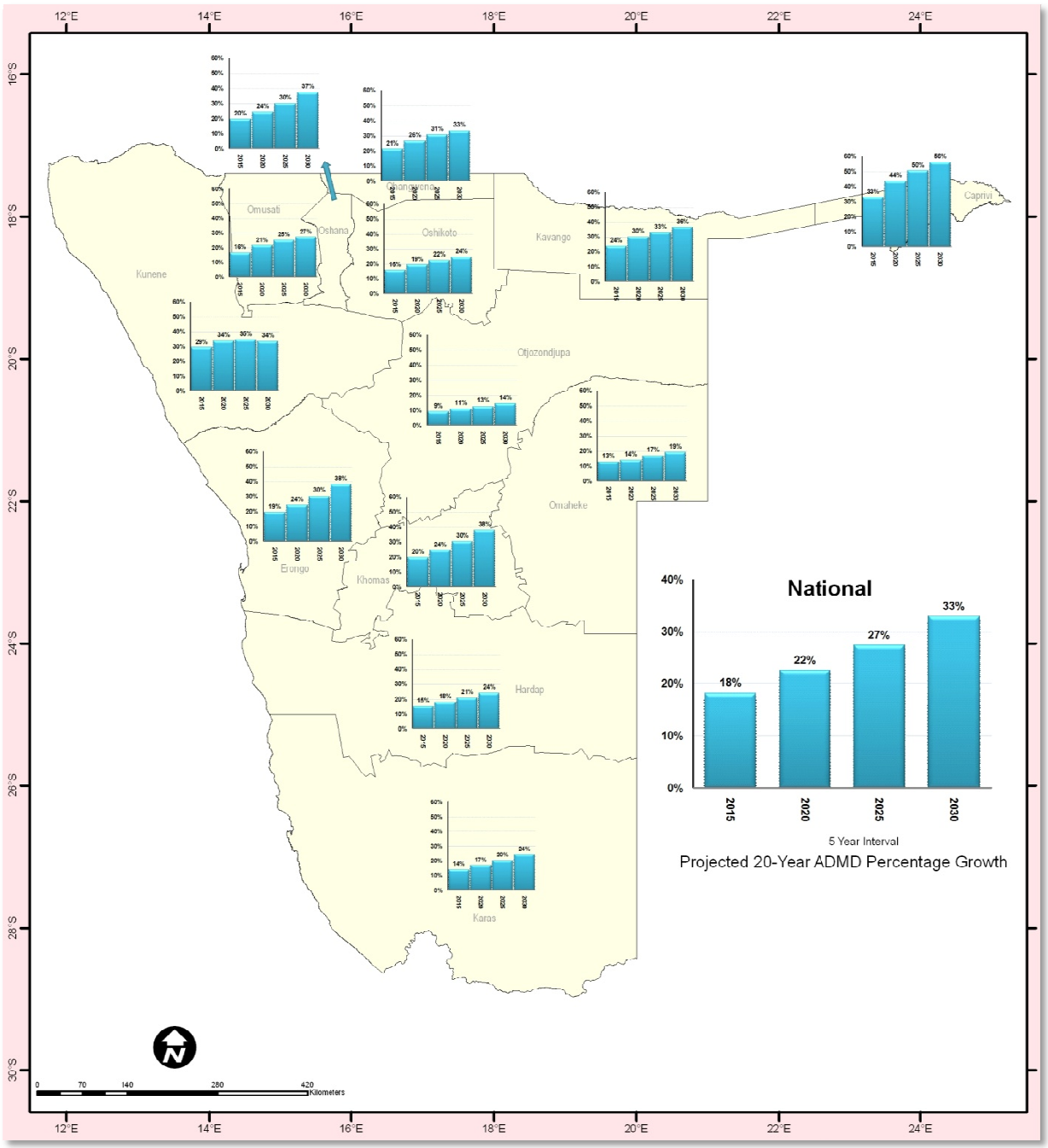
Table 44 shows the total estimated regional ADMD and energy consumed for the coming 20 years. It is again noted that the ADMD and energy use statistics include the regional urban areas which are otherwise excluded from the Study, while mining operations are excluded. Maps 28 and 29 are based on the regional projected 5-yearly ADMD growth, as shown in Table 44. Growth is also expressed as a percentage value in Map 29, to illustrate that even though the expected ADMD for a specific region may not be the highest, it may have grown by the highest percentage.

Table 44: Estimated ADMD and energy usage in the coming 20 years, REDMP 2010

REGION	ADMD 2010 [kVA]	ADMD 2015 [kVA]	ADMD 2020 [kVA]	ADMD 2025 [kVA]	ADMD 2030 [kVA]	Energy 2010 [MWh]	Energy 2030 [MWh]
Caprivi	6,465	9,601	13,791	18,625	24,016	34,206,705	113,825,068
Erongo	75,381	93,575	116,296	144,681	180,158	404,180,049	961,575,637
Hardap	15,092	17,757	20,955	24,657	28,927	80,225,613	153,329,764
Karas	34,208	39,756	46,447	54,480	64,125	186,668,679	340,876,278
Kavango	16,887	22,118	28,754	36,045	44,104	89,762,493	229,948,182
Khomas	158,139	196,660	244,629	304,366	378,759	816,909,639	1,954,978,569
Kunene	5,017	7,094	9,507	11,964	14,354	26,483,932	69,649,461
Ohangwena	14,092	17,891	22,632	28,102	34,078	74,609,051	176,610,995
Omaheke	11,129	12,753	14,530	16,684	19,105	58,615,174	99,838,520
Omusati	8,256	9,878	11,986	14,472	17,139	43,190,128	88,625,195
Oshana	22,917	28,476	35,360	43,917	54,567	118,070,784	280,275,242
Oshikoto	16,456	19,527	23,286	27,674	32,455	86,913,216	169,570,036
Otjozondjupa	49,584	54,541	60,484	67,384	75,231	277,199,863	425,527,190
	433,623	529,627	648,657	793,051	967,018	2,297,035,326	5,064,630,137



Map 28: Projected 20-year ADMD growth per region (including cities, towns, villages and Rural Areas), REDMP 2010



Map 29: Projected 20-year ADMD percentage growth per region (including cities, towns, villages and Rural Areas), REDMP 2010

7.4 Off-Grid Localities

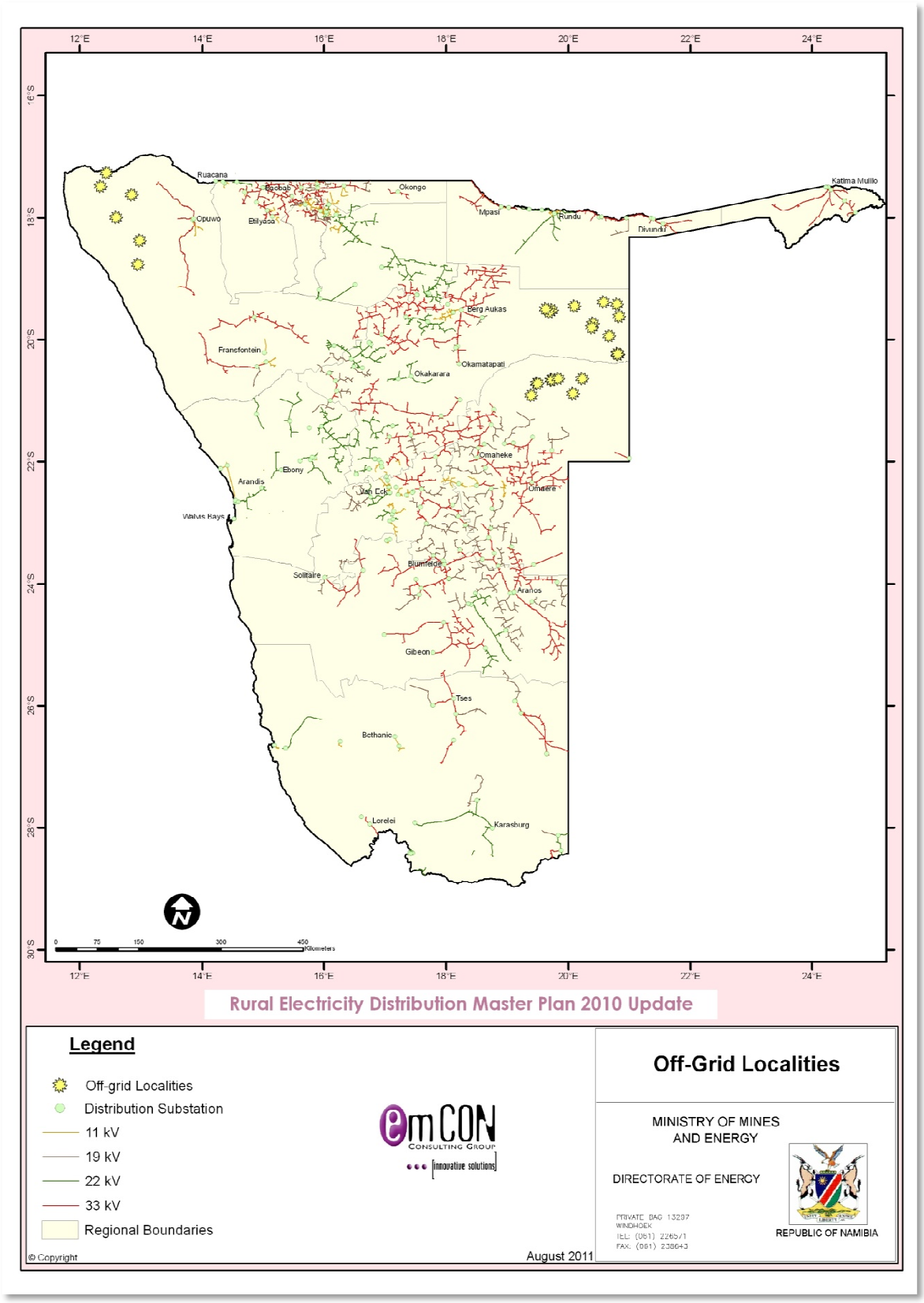
The 2010 REDMP identifies a number of Localities for Off-Grid electrification[14]. Generally, such Localities are situated in remote parts of the country, are often disproportionally costly to electrify and face additional technical constraints. As such, Off-Grid Localities are unlikely to be provided with a conventional grid connection in the foreseeable future.

A total of 27 Localities having 17 schools are earmarked for Off-Grid electrification. Detailed information about these Off-Grid Localities is provided in Table 45 and Map 30.

Table 45: Identified Off-Grid Localities, REDMP 2010

Locality Name	Region	Constituency	No. of Schools	No. of Government buildings	No. of Homesteads	Distance from MV Grid [km]	Longitude	Latitude
Orumue	Kunene	Epupa	1	1		101	-17.4899760	12.3398019
Onjuva	Kunene	Opuwo	1	1	4	133	-18.0003501	12.5979654
Otjitanda	Kunene	Epupa	1	1	9	51	-17.6297761	12.8512566
Otjinungwa	Kunene	Epupa	1	1	3	92	-17.2649811	12.4368606
Okonjombo	Kunene	Opuwo	1	1	0	68	-18.3774178	12.9802119
Puros	Kunene	Opuwo	1	1	33	82	-18.7724322	12.9529031
Mangeti Duin	Otjozondjupa	Tsumkwe	1	1	143	121	-19.5185220	19.7362802
Kukurushe	Otjozondjupa	Tsumkwe	1	1	15	115	-19.5504713	19.6950517
MKata	Otjozondjupa	Tsumkwe	1	1	19	110	-19.5035565	19.6333214
Asvoelnes	Otjozondjupa	Tsumkwe	1	1	16	159	-19.4542283	20.1065989
//XA/Oba	Otjozondjupa	Tsumkwe	1	1	5	213	-19.3897401	20.5841086
!Sawase	Otjozondjupa	Tsumkwe	1	1	4	231	-19.4222431	20.7991046
Baraka	Otjozondjupa	Tsumkwe	1	1	14	234	-19.6239336	20.8349791
Den/ui	Otjozondjupa	Tsumkwe	1	1	5	190	-19.7395960	20.4079172
N!aemjo	Otjozondjupa	Tsumkwe	1	1	4	189	-19.8064805	20.3884410
//Auru	Otjozondjupa	Tsumkwe	1	1	12	220	-19.9409507	20.6698664
Gam03	Otjozondjupa	Tsumkwe	1	1	26	240	-20.2465424	20.8249425
Gam01	Otjozondjupa	Tsumkwe	-	-	23	239	-20.2353003	20.8068941
Gam02	Otjozondjupa	Tsumkwe	-	-	115	239	-20.2407621	20.8133625
Ombujomungondo	Omaheke	Epukiro	-	-	17	70	-20.9178395	19.3971981
Ombujahamutue01	Omaheke	Epukiro	-	-	20	89	-20.7206601	19.4878236
Ombujahamutue02	Omaheke	Epukiro	-	-	15	91	-20.7210734	19.5027968
Otuindjo01	Omaheke	Epukiro	-	-	22	114	-20.6656016	19.7243585
Otuindjo01	Omaheke	Epukiro	-	-	21	118	-20.6645864	19.7336889
Ondjora	Omaheke	Epukiro	-	-	11	126	-20.6458504	19.8403480
Otjeparu	Omaheke	Otjombinde	-	-	15	162	-20.6435262	20.2304491
Dromvlei	Omaheke	Otjombinde	-	-	21	140	-20.8866603	20.0810929
			17	17	592			

[14] Even though outside the scope of the 2010 REDMP, renewable energy sources and associated technologies are regarded as an integral part of Namibia's rural electrification strategy which aims to improve access to safe, affordable and energy to all.



Map 30: Location of Localities earmarked for Off-grid electrification, REDMP 2010

8 RECOMMENDATIONS

This section covers important considerations of relevance to the successful implementation of the 2010 REDMP.

It is essential that the REDMP remains relevant. The 2005 REDMP was reviewed in Section 5, to identify focus areas for the present master plan, and determine whether the implementation of the plan has yielded the desired results. It was shown that, to a large extent, the 2005 REDMP was not followed. This is evidenced by substantial deviations in the Localities identified for electrification versus those that were actually electrified, as well as the timing of the electrification effort versus the year when electrification actually happened. In addition, significant deviations were identified in the budgeted amount envisaged for rural electrification in a given year, versus the actual expenditure per year. These findings illustrate the importance of regular annual updates of the REDMP, as are further discussed in Section 8.1.

Fundamental to successfully achieve the 20-year rural electrification targets is that electrification programmes are implemented and completed to standard, and within the specified time frame. Section 8.2 discusses some practical constraints that have been identified in this regard, and also provide recommendations in regard to possible alternatives. Section 8.3 provides some guidelines to ensure the rigorous implementation of future electrification projects.

The impact and relevance of the REDMP can best be determined by way of a continuous monitoring and evaluation programme which accompanies the electrification projects throughout the country, as and when they are implemented. A monitoring and evaluation programme would also provide a platform on which the plan can be updated and/or amended in a timely and relevant manner, long before the next review is undertaken. In this way, improvements and adjustments of the plan can be made, based on actual field experience during the roll-out of the plan, and in regular consultation and following the feedback from relevant stakeholders. Key aspects regarding the proposed monitoring and evaluation process are described in Section 8.4.

8.1 Annual Revision of the REDMP

It is recommended that the REDMP is to be updated on an annual basis, to reflect the electrification projects that were initiated and completed in a given year. Monitoring the progress of electrification projects undertaken in one year significantly determines how the following year's electrification effort is to be developed. This close coupling between the evaluation of the results achieved in one year, and the re-planning of the electrification programmes for the next year, will also ensure that targets can be met on a year-on-year basis, and thus improve the likelihood that the set 20-year targets can be met in all regions. Annual updates will also ensure that the electrification programmes are aligned with changing priorities, and thus achieve the best results for the resources that are to be invested every year.

It is recommended that the key steps in an annual review include:

- acquiring all reports and as-built drawings of electrification projects completed[15]
- capturing the actual networks that were built and Localities electrified in GIS
- removing the Localities electrified from the 'still to be electrified' dataset
- if required, re-developing networks for the remaining period, based on progress made during the previous years[16]
- exporting the updated GIS database files to the priority model to determine the new prioritised building sequence
- determining the required budget from the priority model, based on refined cost estimates
- consulting with the MME and relevant stakeholders (e.g. regional councils) to discuss the year's electrification programmes, and to ascertain whether any changes in priorities and/or Localities have to be incorporated before finalising projects
- if required, re-modelling and simulating the networks in case significant changes were made to the building sequence which would require additional network strengthening
- finalising the current year's electrification programmes by applying the planned networks to the priority model, and
- generating optimised building sequences for the remainder of the REDMP period.

It is expected that the benefit of maintaining an optimised master plan on an ongoing basis (i.e. annually reviewed and updated) far outweighs the cost of conducting such an annual update.

8.2 Implementation Constraints and Challenges

Past experience has shown that there are several constraints affecting the ongoing implementation of electrification projects in Namibia, especially in rural areas. It is important to be cognisant and learn the lessons from past constraints and challenges, which are likely to lead to improvements of the roll-out of electrification programmes in the country.

One of the most evident constraints facing rural electrification in Namibia is the limited capacity and/or capability of contractors active in the sector. The industry is served by a limited number of well-established contractors with proven track-record. It is therefore recommended that smaller and start-up businesses be considered for rural electrification projects in future, to increase the capacity of operators active in the sector and to ensure that projects are completed as per each year's electrification programme.

[15] Refer to Appendix E for the detailed as-built information that is required.

[16] If all Localities are electrified according to the electrification concept designs, routes and programme, the sequence for the following year should remain unchanged.

It is recognised that there are challenges associated with the above recommendation. The following proposals are offered to address these challenges:

- Past experience has shown that small contractors can often not adequately undertake de-bushing in the country's north, or drill in the south of the country. In many cases, this is the result of such contractors not having the required equipment, or necessary funds, or lacking both.

  Proposal: Government could purchase drills and bull-dozers, and rent these out at a cost, included in the preliminary (P's) and general (G's) conditions of the consultant's tender document. Maintenance cover should be provided by the supplier of the equipment, and included in the rental cost. Breakage costs should be covered by insurance, paid for by the contractor, but also allowed for under the consultant's tender document's P's and G's. It will be necessary that small contractor are adequately defined, in order to determine who qualifies for such equipment loans.

- New and upcoming contractors often do not have sufficient start-up capital, and often find it difficult to meet the required 10% surety on projects. The surety issue has in many cases proven to be too stringent.

  Proposal: The MME could show more flexibility on the issue of surety, and encourage partnerships between experienced and newer contractors.

- In general, suppliers demand payment guarantees from new and unfamiliar contractors who have little or no industry track-record. If such contractors cannot provide the required guarantee, suppliers are often not willing to merely supply on order.

  Proposal: The MME could consider guaranteeing direct payments to suppliers.

- In creating opportunities for new and upcoming contractors, it is important to ensure that they are adequately upskilled, and that these skills are retained in the sector. In many cases, skills development and the retaining the skills required in rural electrification projects has become the responsibility of the larger, well-established and experienced contractors.

  Proposal: Training could be provided by experienced contractors. New contracting companies should be obliged to undergo in-house training with a capable well-established contractor, for a period of at least 6 months. The MME could make available capacity building funds to finance the contractors' salary while also providing an incentive and/or covering the costs of the contractor doing the training. Tender requirements should stipulate minimum training requirements and/or having provided training to upcoming contractors.

The above-mentioned challenges and proposed solutions relate specifically to smaller and new contractors. Other, more general issues that have been identified are listed below. Guidelines on how the services of contractors can be improved are also included:

- If electrification projects are planned for a specific year, consultants should be appointed in the previous financial year.

- Projects are sometimes only put out on tender very late in a financial year, which does not allow reasonable time for contractors to complete such projects on time. This results in the appointed consultant having to estimate final costs before the project is finalised. These

estimates are likely to be inaccurate due to incorporated contingencies. In addition, in finalising payment before actual project completion, the incentive from the contractors' viewpoint is quite often lost, and projects consequently tend to drag on to completion, resulting in significant delays.

- All required as-built information should be handed over on completion of projects. A detailed list of the required information is given in Appendix E, which includes as-built drawings, MV spanning sheets, GPS coordinates and practical completion reports. It is essential that as-built data remains fully updated and as accurate as possible.

8.3 Procedures for Individual Project Implementation

It is recommended that the MME adopts a set of implementation guidelines for each electrification project that it initiates, including but not limited to:

- a detailed survey and engineering design for the proposed electrification project
- alternative technology to keep pace with technological developments
- a competitive tender process for the construction of the electrification project (or several such projects if they are geographically clustered)
- a communication and awareness programme to keep rural residents informed and respond to their queries and concerns, with the support of the regional councils
- the establishment of customer services (metering, billing, prepayment sales, complaints management), and appropriate prices for electricity supplied to rural households
- addressing asset ownership and management, to ensure the long-term viability of the programme
- final project commissioning, and
- a post-implementation report on the project, presenting the final costs, connections and arrangements concluded for the project (i.e. all relevant as-built information).

8.4 Monitoring and Evaluation

It is important that procedures for ongoing monitoring and evaluation become part of the overall rural electrification programme. The MME and the ECB both have an interest in understanding the impacts of the national rural electrification programme, and how the relevant utilities and consumers are affected by it.

In this regard, the following recommendations are made:

- The impact and relevance of the REDMP can best be determined by way of a continuous monitoring and evaluation programme. In this regard, post-implementation reports should be submitted to the MME for each project undertaken. A sheet containing the type of information to be submitted on completion of a given rural electrification project is included in Appendix E.
- The entity contracted to operate the networks and provide customer services should provide annual reports on the operations undertaken. Such reports should provide information on the number and status of connections, consumption, financial results, and special issues and/or aspects that may have arisen during the year.
- A monitoring and evaluation programme should also be used as a platform on which the REDMP can be regularly updated. In this way, improvements and adjustments of the REDMP are regularly available, and are based on actual field experience made during the implementation of the plan.

For an initiative as significant as the MME's REDMP, it is appropriate and considered international best practice that the programme is regularly monitored and evaluated. Namibia has conducted several evaluations of its rural electrification effort in the past. These have provided useful information to the Government on the one hand, as well as providers of grant and/or loan funding. Establishing a regular monitoring and evaluation process is an important part of improving rural electrification in Namibia, while it will also ensure that the gains made in the past years can continue to generate benefits for the country's ongoing development.