

South Africa - Domestic Electrical Load Metering 1994-2014

Eskom, Stellenbosch University, University of Cape Town

Report generated on: July 8, 2026

Visit our data catalog at: <https://www.datafirst.uct.ac.za/dataportal/index.php>

Identification

SURVEY ID NUMBER

zaf-eskom-uct-us-delm-1994-2014-v1

TITLE

Domestic Electrical Load Metering 1994-2014

COUNTRY

Name	Country code
South Africa	ZAF

STUDY TYPE

Administrative Data

ABSTRACT

This dataset contains the electricity metering data from the NRS Load Research Programme collected at 5 minute intervals. From 1994 to 2008 electricity meters were installed at households to measure the voltage and current. From 2009 to 2014 loggers were upgraded and the current, voltage, real and reactive power and power frequency of households were metered.

The NRS Load Research Programme was started in 1994 to provide inputs towards policy development and technical design guidelines for the domestic electricity distribution business in South Africa. The programme was overseen by the National Rationalised Specification (NRS) 034 Working Group at Eskom. Under this programme the Domestic Electrical Load (DEL) Study (also referred to as the Domestic Load Research Project) was designed and managed to collect electricity meter readings and conduct an annual socio-demographic survey of metered households. The resulting DEL data collection and research outputs present a collaborative, multi-party public-academic-private collaboration.

Initiated by Dr Ron Herman (Stellenbosch University) and Prof. Trevor Gaunt (University of Cape Town), the study was promoted by the NRS 034 Working Group established within Eskom for this purpose. Early funders and collaborators included the Department of Minerals and Energy Affairs (now Department of Energy), the Council for Scientific and Industrial Research, as well as Stellenbosch, eThekweni and Nelson Mandela Bay Municipalities. From 1994 to 2009 eight municipalities contributed to data collection. Eskom Research, Testing and Development became actively involved in the study in 1997. From 2001 onwards Eskom was the major data contributor and funder of the study. Prior to 1994, the National Energy Council and Development Bank of Southern Africa funded the development of the data loggers used in the study, as well as early research efforts by Dr Ron Herman and J.J. Kritzinger that influenced the study.

This study made a major contribution to the electrification of South African households and enabled the development of planning tools and applications that Eskom and municipalities to accurately forecast and right-size new power transmission and distribution infrastructure. The research outputs that emerged from the data collected in this study, such as the Hermann-Beta distribution and the Geo-based Load Forecasting Standard, informed the design of South Africa's power system and have been used in the design of power grids in other developing countries.

KIND OF DATA

Process-produced data

UNIT OF ANALYSIS

Households

Version

VERSION DESCRIPTION

v1: edited dataset available as licensed use data.

VERSION DATE

2019-05-15

VERSION NOTES

Version 1

Scope

NOTES

The scope of the secure South African Domestic Electrical Load Metering data includes:

CURRENT: Amperes (A) at 5 minute cadence

VOLTAGE: Volt (V) at 5 minute cadence

REAL POWER: kilo-Watt-hour (kWh) at 5 minute cadence

REACTIVE POWER: kilo-Volt-Ampere (kVA) at 5 minute cadence

FREQUENCY: Hertz (Hz) at 5 minute cadence

KEYWORDS

Keyword
current
voltage
power
real
reactive
frequency
South Africa
rural
electrification
power quality
load data
time-of-use
electrical
household
consumption
energy
electricity
domestic
residential

Coverage

GEOGRAPHIC COVERAGE

The study had national coverage.

GEOGRAPHIC UNIT

The DELMS 1994-2014 dataset does not contain geographic information but can be linked with the DELS 1994-2014 restricted access data available in DataFirst's secure research data centre. The restricted dataset includes household GPS coordinate data from 2000 onwards.

UNIVERSE

The metering study covers electrified households that received electricity either directly from Eskom or from their local municipality. Particular attention was devoted to rural and low income households, as well as surveying households electrified over a range of years, thus having had access to electricity from recent times to several decades.

Producers and sponsors

PRIMARY INVESTIGATORS

Name	Affiliation
Eskom	Government of South Africa
Stellenbosch University	
University of Cape Town	

PRODUCERS

Name	Affiliation	Role
Council for Scientific and Industrial Research	University of Cape Town	Technical assistance
Marcus Dekenah Consulting		Data collection, Technical assistance
Schalk Heunis	Enerweb	[Technical assistance in] sampling methodology/selection, data processing, data quality control, statistical analysis, data analysis (1995 - 2014)
Wiebke Toussaint	University of Cape Town	[Technical assistance in] data science, data stewardship, data archiving, data publishing (2017 - 2019)

FUNDING AGENCY/SPONSOR

Name	Abbreviation	Role
Department of Minerals and Energy Affairs (now: Department of Energy)	DMEA	Funder from 1994 - 1997
Eskom Research	Eskom	Funder from 1998 - 2014
South African National Energy Development Initiative	SANEDI	Funder in 2019 for data archiving

OTHER IDENTIFICATIONS/ACKNOWLEDGMENTS

Name	Affiliation	Role
City of Cape Town	Government of South Africa	provided data loggers and human resources for data collection (1997 - 2006)
City of Johannesburg	Government of South Africa	provided data loggers and human resources for data collection (1996 - 2000)
City of Tshwane	Government of South Africa	provided data loggers and human resources for data collection (2001 - 2003, 2005 - 2009)
eThekweni Municipality	Government of South Africa	provided data loggers and human resources for data collection (1995, 1997 - 2002, 2005, 2006)
Msunduzi Municipality	Government of South Africa	provided data loggers and human resources for data collection (1996, 1997)
Mantsopa Municipality	Government of South Africa	provided data loggers and human resources for data collection (1996, 1997)
Nelson Mandela Bay Municipality	Government of South Africa	provided data loggers and human resources for data collection (1995, 1997 - 2006)
Stellenbosch Municipality	Government of South Africa	provided data loggers and human resources for data collection (1994)

Sampling

SAMPLING PROCEDURE

The sampling procedure and sample design are described in detail in the annual NRS Load Research Reports and in particular in the Load Data Collection Guides. The sample design was reviewed annually and updated from time to time as the need arose.

SAMPLE POPULATION CHARACTERISTICS

Sampling communities were selected based on the following requirements outlined in programme reports: The target community should have a high degree of electrification, should be stable and willing to co-operate with the project. There should not be many gaps in connectivity. As first-time consumers require a period of adjustment to the use of electrical power, it was assumed that individual load patterns would be erratic for the first two years. Thus "newly electrified" communities should have had access to electricity for at least 24 months before being selected to participate in the study.

SAMPLE SIZE

70 - 100 consumers (households) were deemed a sufficient sample population for statistically significant load metering.

SAMPLE SELECTION

A random systematic method was suggested and where possible used to select households to be monitored. In general sample selection was optimised to fully utilise data loggers, meaning that loggers were installed on electrical poles that had the most connections so that all logger channels could be utilised. The approach taken at the beginning of the study was as follows:

1. List all the dwelling stand numbers from the township plans.
2. Divide the number of stands by the number of available loggers (call the resulting number *sl*)
3. Select a random starting point, say at stand *sp*.
4. Add multiples of *sl* to *sp* to give the stand numbers at which to site the loggers.
5. Check (4) to ensure that all or most of the data channels can be used at the point under consideration. If necessary move one pole forward or backward to optimise logger utilisation.
6. Repeat the process until all the loggers have been sited. Meticulous attention must now be given to identifying each monitored dwelling with its logger and channel.

Data Collection

DATES OF DATA COLLECTION

Start	End
1994	2014

TIME PERIODS

Start date	End date	Cycle
1994-06-17	1995-06-26	G1994
1996-02-09	1996-09-10	G1996
1996-09-19	1997-12-14	G1996
1998-01-24	1998-10-28	G1998
1999-05-17	1999-09-09	G1999
2000-02-12	2000-10-20	G2000
2001-03-14	2001-11-28	G2001
2002-12-11	2002-12-23	G2002
2003-12-01	2004-05-17	G2004
2004-07-16	2005-02-08	G2006
2006-02-23	2006-10-24	G2005

2007-01-05	2007-04-23	G2007
2008-01-31	2008-11-12	G2008
2009-01-29	2009-11-12	G2009
2010-01-19	2010-12-01	G2010
2010-12-15	2011-11-29	G2011
2012-01-01	2013-01-09	G2012
2013-12-31	2014-01-01	G2013
2014-08-31		G2014

DATA COLLECTION MODE

Other

DATA COLLECTION NOTES**SELECTON OF 5 MINUTE METERING CADENCE**

Based on the evidence presented in early investigations predating the NRS Load Research Programme, the data for this study was collected at 5 minute intervals so that it would be useable for 'quality of supply' analysis (see CT Gaunt. Implications of Planning and Design Decisions in Electricity Distribution. AMEU 12th Technical Meeting. Potchefstroom (1988)).

FEEDBACK LOOPS ON LOGGERS

Data collections from every month were gathered together into a feedback report where any problems with data collection at a site were communicated to the site manager and resolved. Site referencing was done on an annual basis just prior to the winter survey collection process to capture the site 'as is' with minimal likelihood of alteration due to maintenance interventions. During site referencing process the galvanic connectivity between a household or energy customer and the corresponding data logger channels was documented and updated in the database to associate a customer load with the correct questionnaire.

Questionnaires

QUESTIONNAIRES

NA

Data Processing

DATA EDITING

This dataset has been produced by extracting all electricity metering data from the original NRS Load Research SQL database using the `saveRawProfiles` function from the `delretrieve` python package (<https://github.com/wiebket/delretrieve>: release v1.0). Full instructions on how to use `delretrieve` to extract data are in the README file contained in the package.

DATA EXTRACTION AND FILE STRUCTURE

To manage data volumes, meter readings were extracted in batches and are stored in a file hierarchy arranged by metering unit (A, Hz, kVA, kW, V) and collection year (1994 - 2015).

MISSING VALUES

No post-processing was done after data extraction and all database records, including missing values, are stored exactly as retrieved.

Data Appraisal

DATA APPRAISAL**CALIBRATION** of voltages and instruments

Prior to 2009 data loggers were built inhouse and only elementary calibration was done (insufficient for commercial

standards). After 2009 all loggers were changed to commercial loggers with standard industry calibration of electricity meters.

TIME SYNCHRONISATION

Meter readings have date and time stamps. Every time data was downloaded from the logger, the meter clock was adjusted to the laptop clock, which was set before going into the field.

LOGGING ERRORS

Early logging devices had a 6 week storage capacity. When this capacity was exceeded a "data buffer full" error would occur.

Other common modes of technical failure included 'floating' data channels, readings failing to '0' load and readings failing to full scale Amps.

DATA VALIDATION MODELS

A data marking table was generated to validate profile IDs on each day against a set of data quality rules (included as external resource). Based on these rules readings were marked as 'Y' (valid) or 'N' (invalid).

SAMPLING SUFFICIENCY

Sampling sufficiency was determined by calculating the standard deviation on customer behaviour at the time of annual peak demand (ie 60 or more customers were required to contribute to the annual peak demand, within an acceptable standard deviation)

Access policy

CONTACTS

Name	Affiliation	Email	URL
DataFirst	University of Cape Town	support@data1st.org	support.data1st.org

ACCESS CONDITIONS

Access under a Creative Commons CC-BY-NC (Attribution, Non-Commercial use only) License

CITATION REQUIREMENTS

Eskom, Stellenbosch University, University of Cape Town. Domestic Electrical Load Metering 1994-2014 [dataset]. version 1. Johannesburg: Eskom, Cape Town: UCT, Stellenbosch: US [producers], 2014. Cape Town: DataFirst [distributor]. DOI: <https://doi.org/10.25828/p3k7-r965>

ACCESS AUTHORITY

Name	Affiliation	Email	URL
DataFirst	University of Cape Town	support@data1st.org	support.data1st.org

Metadata production

DDI DOCUMENT ID

DDI-ZAF-DELS-1994-v1

PRODUCERS

Name	Abbreviation	Affiliation	Role
Energy Research Centre	ERC	University of Cape Town	Metadata producer

DATE OF METADATA PRODUCTION

2024-04-05

DDI DOCUMENT VERSION

Version 3

Data Description

Data file	Cases	Variables
-----------	-------	-----------

Download related resources

Reports

The NRS National Load Research Project: 1994-1996

Title	The NRS National Load Research Project: 1994-1996
Author(s)	Marcus Dekenah
Date	1997-03-20
Country	South Africa
Language	English
Contributor(s)	This is the consultant's report on the first two rounds of the Project
Filename	nrslr-1994-1996-report.pdf

The NRS National Load Research Project 1997

Title	The NRS National Load Research Project 1997
Author(s)	Marcus Dekenah
Date	1997-10-07
Country	South Africa
Language	English
Contributor(s)	This is the consultant's report on the 1997 round.
Filename	nrslr-1997-report.pdf

Technical documents

The NRSLR Project: Note on data handling and processing

Title	The NRSLR Project: Note on data handling and processing
Author(s)	Marcus Dekenah
Date	1997-11-12
Country	South Africa
Language	English
Contributor(s)	This document provided information on data processing in the 1994-1997 rounds of the NRS National Load Research Project
Filename	nrslr-data-processing.pdf

Other materials

Analysis of National LR Project: Load and sociodemographic data:1998

Title	Analysis of National LR Project: Load and sociodemographic data:1998
Author(s)	Schalk Heunis
Date	1999-01-07
Country	South Africa
Language	English

Contributor(s) This is an analysis of the data collected by the National Load Research Project up to 1999.

Filename nlrp-analysis.pdf

[Power quality rules]

Title [Power quality rules]

Date 2019-01-01

Country South Africa

Language English

Contributor(s) This document contains the data marking rules that identify whether a sensor observation was valid or invalid. From these rules a 'valid' column was created in the database and populated with Yes/No values (converted to 0s and 1s). Typically researchers

Description Description of power quality rule set.

Filename power-quality-rules-sets.xlsx
