

NSW Electricity Information Paper No 2/2008

Reliability and quality of supply of electricity to customers in NSW

For the period from 1 July 2002 to 30 June 2007

A series of information papers on the performance of NSW electricity businesses

Introduction

This Information Paper is one of a series of papers published by the Independent Pricing and Regulatory Tribunal of NSW (IPART), which aims to ensure that all stakeholders in the distribution and retailing of electricity in NSW have ready access to some pertinent information.¹ This current paper updates Information Paper 1/2007 with data for 2006/07 financial year.

The licensing regime under which NSW electricity distributors operate requires them to publish information on reliability and quality of the supply of electricity to NSW customers.² This Information Paper summarises this information as reported by the distributors. The distributors are known as Distribution Network Service Providers (DNSPs) in the *National Electricity Rules*.

Most electricity customers are interested to know how reliable the supply of electricity is likely to be. At the very least, customers would like to know how many unexpected interruptions to supply they might face in a year, and for how long in each case.

¹Other information papers include: *Retailers' performance against customer service indicators; Distribution businesses' performance against customer service indicators; General and financial information on the electricity distributors in NSW and Demand management in the 2004 distribution review: progress to date.*

² The three distributors are Country Energy, EnergyAustralia and Integral Energy. The relevant information is published in their *Electricity Network Performance Reports* which are available for download from their websites.

Defining and measuring reliability of electricity supply

DNSPs report planned and unplanned interruptions, both their number and length. The following terminology is used to define outages and reliability standards.

- ▼ **Planned outages:** occur when a DNSP needs to disconnect supply to undertake maintenance or construction work. Under the NSW Guaranteed Customer Service Standards, which came into force on 28 July 2005, DNSPs are required to give customers a minimum of two business days' written notice of a planned outage.
- ▼ **Unplanned outages:** occur when equipment failures cause the supply of electricity to be disrupted unexpectedly. The principal causes of unplanned outages are external factors related to such things as lightning strikes, trees falling, birds or possums, vehicles crashing and vandalism. Unplanned outages can also be caused by equipment failure, due to overload and general deterioration. The impact of unplanned outages on the reliability of supply is further influenced by weather conditions, the design of the network, maintenance practices and the time taken by a DNSP to restore supply after a power interruption.
- ▼ **Momentary interruptions:** are outages which are reduced to only momentary interruptions due to auto-close devices being installed on the network to restore supply. The alternative to experiencing a momentary interruption would be an extended outage requiring supply to be restored by an operator.

To measure outages and interruptions in a consistent and precise manner, the DNSPs calculate the following indices:

- ▼ **SAIDI:** System Average Interruption Duration Index. This index measures the length of time (in minutes) that customers are without electricity in a given year relative to the total number of customers connected to the network. It is a measure of interruptions (in minutes) per customer. It includes planned and unplanned outages but excludes momentary interruptions (one minute or less duration).
- ▼ **SAIFI:** System Average Interruption Frequency Index. This measures the *number of interruptions* customers experienced in a given year relative to the total number of customers on the network. Again, it includes both planned and unplanned outages but excludes momentary interruptions.
- ▼ **CAIDI:** Customer Average Interruption Duration Index. This index measures the time taken to restore supply relative to the total number of customer interruptions, or duration of interruptions per customer. It is simply measured by dividing SAIDI by SAIFI. The DNSPs' licence conditions do not require them to report on CAIDI.
- ▼ **MAIFI:** Momentary Average Interruption Frequency Index. This measures the number of momentary interruptions customers experienced in a year relative to the total number of customers connected to the network, or number per customer. The DNSPs' licence conditions do not require them to report on MAIFI.

System Average Interruption Duration Index (SAIDI)

DNSPs report the System Average Interruption Duration Index (SAIDI) for overall, planned, unplanned and normalized interruptions.

Planned and unplanned outages have been defined above. Normalised interruptions are measured to exclude interruptions caused by events beyond the control of the DNSPs (known as 'excluded events').

There has been a significant increase in the total number of outages in 2006/07 compared with the previous four years. However, the higher numbers were largely due to severe wind and electrical storms in September 2006 and February and June in 2007 (Table 1). The normalised level of interruptions

reported by the DNSPs, which excludes these events, is broadly consistent with reported figures for 2005/06. The exception is EnergyAustralia's normalized index which shows a slight increase in 2006/07.

Table 1 Duration (minutes) of interruptions per customer (SAIDI)

	2002/03	2003/04	2004/05	2005/06	2006/07
EnergyAustralia					
Overall	120	148	154	117	435
Planned	5	6	6	6	6
Unplanned	113	142	143	111	429
Normalised	84	99	90	90	102
Integral Energy					
Overall	219	426	211	130	263
Planned	35	30	29	31	22
Unplanned	182	396	176	99	241
Normalised	121	126	93	99	94
Country Energy					
Overall	308	371	355	413	333
Planned	48	67	52	53	53
Unplanned	239	295	296	350	260
Normalised	306	262	299	304	242

Notes:

1. From 2005/06, Country Energy data include Australian Inland data. The two DNSPs merged on 1 July 2005.
2. Total interruptions may be higher than the sum of planned and unplanned interruptions because they include outages that were actually caused within the transmission system.
3. Under the new licence conditions, reliability data using the normalised distribution network for the years 2005/06 and onwards will be based on the Institute of Electrical and Electronics Engineers (IEEE) standard 1366-2003, rather than the Standing Committee on National Regulatory Reporting Requirements (SCNRRR) standard. SCNRRR excludes natural events with a SAIDI impact of greater than three minutes, while the IEEE standard excludes natural events which are more than 2.5 standard deviations greater than the mean of the log normal distribution of five years' SAIDI data. In practice, there is a difference of around +/- 5% to 10% between the two measures. This applies to Tables 2, 3 and 4.
4. The normalised SAIDI values are those reported by the DNSPs in their 2006/07 Network Performance Reports using the 2.5 Beta methodology. These figures may differ those reported in the 2007 information paper on Reliability and Quality of Supply due to the use of the 2.5 Beta methodology as outlined in note 3.

Source: Electricity network performance reports published by the DNSPs.

Different customer types had different average interruption experiences. In general, rural customers faced much longer (Table 2) and more frequent (Table 3) interruptions than either central business district (CBD) or urban customers. Not surprisingly, the length of interruptions is highest for rural customers whose feeder supply lines are long. Due to wind storm and flooding the reported figures by EnergyAustralia and Integral Energy on rural long feeder indicate that these customers experienced significant increases in the duration of outages in 2006/07 compared with recent years.³

³ Integral Energy advised that its rural long category was only one feeder that supplies 240 customers and would not be statistically valid to draw any inference of general performance trends.

Table 2 Duration (minutes) of interruptions by feeder category (normalised SAIDI)

	2002/03	2003/04	2004/05	2005/06	2006/07
EnergyAustralia					
CBD	49	106	9	13	13
Urban	66	75	76	69	78
Rural - short	288	351	245	337	290
Rural - long	481	818	953	342	1,093
Organisation ^a	84	99	90	90	102
Integral Energy					
CBD	na	na	na	na	na
Urban	77	81	54	67	66
Rural - short	129	202	170	184	175
Rural - long ^b	116	116	900	856	1,491
Organisation ^a	121	126	93	99	94
Country Energy					
CBD	na	na	na	na	na
Urban	163	124	158	109	114
Rural - short	338	293	276	317	239
Rural - long	418	373	625	578	497
Organisation ^a	306	262	299	304	242

Note: na = not applicable or not available.

^aThe 'Organisation' in Tables 2 to 5 refers to the overall measure for the DNSP representing the percentage weighting of their CBD, urban and rural feeders.

^b Integral Energy has only one rural long feeder that supplies 240 customers and would not be a statistically valid sample to draw any indication of general performance trend.

Source: 2006/07 Electricity Network Performance Reports published by the DNSPs.

Box 1 Feeder category definitions

CBD	A feeder supplying Sydney CBD as determined from zone substation coverage maps.
Urban	A feeder, which is not a CBD feeder, with load density greater than 0.3MVA/km.
Short Rural	A feeder, which is not a CBD or urban feeder, with total length less than 200km.
Long Rural	A feeder, which is not a CBD or urban feeder, with total length greater than 200km.

Note: Short rural feeders include feeders in urban areas with low load densities.

System Average Interruption Frequency Index (SAIFI)

The overall SAIFI has shown a slight improvement for Country Energy and remained stable for EnergyAustralia and Integral Energy.

In recent years, the number of interruptions per customer was generally less than one in CBD and urban areas. Generally, customers in rural areas experienced between 2 to 9 interruptions a year (Table 3).

Table 3 Number of interruptions by feeder category (normalised SAIFI)

	2002/03	2003/04	2004/05	2005/06	2006/07
EnergyAustralia					
CBD	0.17	0.17	0.09	0.20	0.17
Urban	0.91	1.07	1.07	0.96	0.96
Rural - short	3.54	3.75	2.73	3.32	2.76
Rural - long	5.01	8.14	6.74	3.30	5.64
Organisation	1.11	1.28	1.20	1.15	1.15
Integral Energy					
CBD	na	na	na	na	na
Urban	0.90	1.10	0.80	0.90	0.90
Rural - short	1.20	2.20	2.10	2.00	2.00
Rural - long ^a	1.00	0.80	4.30	5.10	3.70
Organisation	1.40	1.50	1.20	1.20	1.20
Country Energy^b					
CBD	na	na	na	na	na
Urban	1.90	1.90	2.30	1.28	1.36
Rural - short	3.02	2.86	2.51	2.71	2.47
Rural - long	3.21	3.18	4.88	4.06	3.82
Organisation	2.77	2.67	2.82	2.55	2.39

^a Integral Energy has only one rural long feeder that supplies 240 customers and would not be a statistically valid sample to draw any indication of general performance trend.

^b Data for Country Energy for 2005/06 and thereafter incorporates former Australian Inland feeders and reallocation of customers amongst feeder classes and therefore not comparable to the data reported prior to 2005/06.

Source: 2006/07 Electricity Network Performance Reports published by the DNSPs.

Other measures of system reliability

In addition to SAIDI and SAIFI, there are two other measures of reliability: CAIDI (customer average Interruption duration index) and MAIFI (momentary average interruption frequency index). These measures are not required to be reported by the DNSPs under the current licensing conditions on design, reliability and performance. However, CAIDI can be calculated by dividing the reported SAIDI (Table 2) by the reported SAIFI (Table 3).

Table 4 presents the CAIDI calculated for each DNSP from 2002/03 to 2006/07. Even though DNSPs are not required to report this information it is useful for customers as it provides an indication of the average time taken to restore supply following an outage. However, as a combination of both SAIDI and SAIFI measures it can mask trends evident in those measures and should not be looked at in isolation.

Overall, EnergyAustralia and Integral Energy took 75 minutes to 89 minutes to restore supply for their customers in recent years (Table 4). In comparison, Country Energy took slightly longer time primarily due to its larger operating area.

Table 4 Customer Average interruption duration (minutes) (CAIDI)

	2002/03	2003/04	2004/05	2005/06	2006/07
EnergyAustralia					
CBD	288	624	100	65	77
Urban	73	70	71	72	81
Rural - short	81	94	90	102	105
Rural - long	96	100	141	104	194
Organisation	76	77	75	78	89
Integral Energy					
CBD	na	na	na	na	na
Urban	86	74	68	74	73
Rural - short	108	92	81	92	88
Rural - long ^a	116	145	209	168	403
Organisation	86	84	78	83	78
Country Energy^b					
CBD	na	na	na	na	na
Urban	86	65	69	85	84
Rural - short	112	102	110	117	97
Rural - long	130	117	128	142	130
Organisation	110	98	106	119	101

^a Integral Energy has only one rural long feeder that supplies 240 customers and would not be a statistically valid sample to draw any indication of general performance trend.

^b Data for Country Energy for 2005/06 and thereafter incorporates former Australian Inland feeders and reallocation of customers amongst feeder classes and therefore not comparable to the data reported prior to 2005/06.

Measuring reliability against standards of performance

It is important to monitor both average and minimum performance standards. This is so because improvements to *average* performances standards can be incentivised while *minimum* performance standards can be guaranteed.

The new licence conditions imposed by the Minister on 1 August 2005 set *minimum* reliability performance standards for the DNSPs⁴. These standards are shown in the columns headed 'SAIDI standard' and 'SAIFI standard' in Table 5. In 2006/07, all three DNSPs generally performed better than standards, both for duration and frequency of interruptions, for all feeder categories, except one. The exception is EnergyAustralia's long rural SAIDI which was severely impacted by flooding in Central Coast and Hunter regions.

⁴ The new licence conditions have also rationalised the existing reporting requirements. For example, there is no longer a requirement on the DNSPs to publish reliability of electricity supply *by region* so this information is no longer included in this information paper.

Table 5 Comparison of actual reliability in 2006/07 and standards (normalised)

	SAIDI standard	SAIDI actual	% better (+)/worse(-) than standard	SAIFI standard	SAIFI actual	% better (+)/worse(-) than standard
EnergyAustralia						
CBD	57	13	337%	0.34	0.17	100%
Urban	88	78	13%	1.28	0.96	33%
Rural short	380	290	31%	4.20	2.76	52%
Rural long	860	1,093	-21%	8.00	5.64	42%
Integral Energy						
CBD	na	na	na	na	na	na
Urban	88	66	33%	1.28	0.90	42%
Rural short	292	175	67%	2.76	2.00	38%
Rural long ^a	na	1,491	na	na	3.70	na
Country Energy						
CBD	na	na	na	na	na	na
Urban	137	114	20%	1.96	1.36	44%
Rural short	332	239	39%	3.24	2.47	31%
Rural long	740	497	49%	4.90	3.82	28%

Note: na = not available or not applicable. Percentage changes have been calculated based on unrounded numbers

^a The Minister did not set SAIDI and SAIFI standards for Integral Energy rural long feeders. Integral Energy has only one rural long feeder that supplies 240 customers and would not be a statistically valid sample to draw any indication of general performance trend.

Source: Electricity network performance reports published by the DNSPs

Defining and measuring the quality of supply

DNSPs investigate customer complaints and categorise valid ones into: 'quality of supply', 'reliability of supply' and 'network safety'.⁵

The 'quality of supply' of electricity is measured by its 'voltage', its 'current' and 'other quality' measures:

- ▼ 'voltage' is multi-dimensional. It includes a number of technical measures such as sustained over-voltage, sustained under-voltage, voltage fluctuations, voltage dips, switching transients and other measures
- ▼ 'current' also has several dimensions, namely direct current, harmonic content and inter-harmonics
- ▼ 'other quality' includes mains signalling reliability, noise and interference, level of supply capacity, supply frequency and others.⁶

Table 6 presents the number of valid complaints and the percentage which were valid for the quality of supply from 2002/03 to 2006/07 for the DNSPs. For 2006/07, there was a decline in the number of complaints reported by all three DNSPs compared with the previous four years. EnergyAustralia reported the most significant decline. EnergyAustralia attributed this to improved reliability for customers resulting from its continued infrastructure investment across its network, in particular in areas that were historically affected by poorly performing feeders.⁷

⁵A complaint is valid if the circumstances indicate non-compliance with published service and network standards.

⁶ All of these measures of quality are set out in the *Electricity network performance reports* published by each DNSP.

⁷ *EnergyAustralia Network Performance Report, 2006/07*, p 8.

Table 6 Valid complaints concerning the quality of electricity supply

	2002/03	2003/04	2004/05	2005/06	2006/07
Energy Australia					
Voltage	174	616	114	406	83
Current	-	5	1	-	-
Other quality	14	176	4	49	1
Total	188	797	119	455	84
<i>% valid</i>	<i>23%</i>	<i>24%</i>	<i>50%</i>	<i>25%</i>	<i>25%</i>
Integral Energy					
Voltage	499	454	439	607	248
Current	1	1	-	-	-
Other quality	190	101	85	52	-
Total	690	556	524	659	248
<i>% valid</i>	<i>np</i>	<i>np</i>	<i>30%</i>	<i>np</i>	<i>42%</i>
Country Energy					
Voltage	146	168	163	97	99
Current	-	-	-	-	-
Other quality	38	60	41	32	5
Total	184	228	204	129	104
<i>% valid</i>	<i>63%</i>	<i>88%</i>	<i>53%</i>	<i>52%</i>	<i>53%</i>

Note: np means not provided. na means not applicable

Source: Electricity network performance reports of the DNSPs