BASIX Monitoring Report
Electricity Consumption for 2007-08 and 2008-09

June 2010

Prepared by EnergyAustralia for the NSW Department of Planning as part of the BASIX Energy Monitoring Project

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1 Executive Summary

The BASIX policy introduced in 2004 by the NSW Department of Planning is one of the NSW Government's key planning policies and requires all new homes in NSW to be designed to produce up to 40% less greenhouse gas emissions than the average NSW home.

The BASIX Water and Energy Monitoring Project is a joint study between the NSW Department of Planning and NSW Water and Energy utilities with the aim to monitor the performance of occupied BASIX homes. For the purposes of the BASIX Water and Energy Monitoring Project the NSW Department of Planning (DoP) and EnergyAustralia established a data sharing agreement to allow the passing of non-personal de-identified data from the DoP to EnergyAustralia.

This report summarises the results of a preliminary analysis of electricity consumption, conducted by EnergyAustralia for a sample of BASIX new homes in EnergyAustralia's electricity distribution area. The homes used in this analysis included a sample of 2,835 BASIX single dwellings generated in the first three years of the policy (2004-05, 2005-06 and 2006-07). The quarterly billed electricity consumption for the identified sample sets were obtained for the two year period from 1 July 2007 to 30 June 2009, and converted into an annual consumption amount for each of the two years studied.

It was found that there was significant regional variation in the annual consumption of the dwellings studied even when the average bedroom size and predicted occupancy values appeared to be similar. This suggests that other socio-demographic, climatic or appliance factors have a significant influence on the electricity consumption. This conclusion is consistent with broader electricity consumption data across EnergyAustralia's network area.

An analysis of average bedroom size and the existence of large electric appliances also showed that the BASIX dwellings on average had larger homes (around one bedroom larger) and a higher percentage of large air conditioning systems when compared to survey data from the Australian Bureau of Statistics for existing dwellings.

An estimate of the greenhouse gas emissions from a sample of all-electric households was calculated from actual electricity consumption data and the median percentage greenhouse reduction was found to be around 10 percent lower than the BASIX benchmarks for those dwellings. A further estimate was made of the percentage greenhouse reduction for dwellings with gas and calculated using the actual electricity consumption data and predicted gas consumption data from the BASIX calculation tool. This analysis indicated a higher reduction in greenhouse gas emissions when compared to the BASIX benchmarks with median values ranging between 13 to 22 percent, depending on which BASIX certificate years were analysed.

A further analysis of the estimated reduction in greenhouse gas emissions using a corrected BASIX benchmark is also presented in this report. Corrections to the benchmark in this analysis include revised occupancy figures from Sydney Water survey data collected in the Sydney region as well as an increase in the per person greenhouse gas emissions benchmark. These corrections resulted in a further 4 to 6 percent reduction in greenhouse gas emissions when compared to the corrected benchmarks, which emphasises the importance of setting appropriate baselines and benchmarks.

The three main areas of further work needed to improve the analysis are:

1. Survey households to obtain the actual occupancy, occupation date and other main appliance details.
2. Obtain gas consumption data for calculating greenhouse gas emissions for a sample of dwellings with gas appliances.
3. Further investigation into the baseline and benchmark methodology.

2 Background

The BASIX policy was introduced in 2004 and is the NSW Government's key planning policy requiring all new homes to be designed to use up to 40% less potable water and produce up to 40% fewer greenhouse gas emissions than the average NSW home.

BASIX is an online assessment tool, where the user is asked a broad range of questions related to the design of a new home and this information is used to assess whether the design meets the BASIX water, energy and thermal comfort targets. The BASIX Water and Energy targets are based on the State's average water and energy per capita consumptions from 2002-03. Once the design passes these targets, the user prints a BASIX Certificate and submits this, with the development application to council.

The BASIX scheme has been introduced in stages according to housing type and location as summarized below:

1 July 2004: Single dwellings in Sydney

1 July 2005: All single dwellings in NSW

1 October 2005: All multi-units dwellings in NSW

1 October 2006: Major renovations in NSW

The BASIX Water and Energy Monitoring Project is a joint study between the NSW Department of Planning and NSW Water and Energy utilities with the aim to monitor the performance of occupied BASIX homes. The primary objective is to investigate whether the water and energy consumption of new BASIX homes has achieved the reduction targets planned.

This report contains the results of a preliminary analysis of the electricity consumption for several sample sets of BASIX single homes (not including multi-units). The electricity consumption period studied covered a two year period from 1 July 2007 to 30 June 2009 for samples of BASIX homes located within EnergyAustralia's network distribution area (see Appendix A).

The sample sets for this study were obtained from BASIX certificate data passed to EnergyAustralia for the first three years of the policy 2004/05, 2005/06 and 2006/07.

2.1 Data Sharing Agreement

For the purposes of the BASIX Water and Energy Monitoring Project the NSW Department of Planning (DoP) and EnergyAustralia established a data sharing agreement to allow the passing of non-personal de-identified data from the DoP to EnergyAustralia.

This non-personal information was used to link a BASIX single dwelling to the quarterly billed electricity consumption for that dwelling over a certain billing period.

This report summarises the first findings of this assessment project. The sample of BASIX homes used in this report included a sample of BASIX single dwellings with BASIX certificates generated in the first three years of the policy (2004-05, 2005-06 and 2006-07).

The quarterly billed electricity consumption for this identified sample set was obtained for the 2007-08 and 2008-09 years, and converted into an annual consumption amount for each of the two years studied.

2.2 Methodology

In order to establish a sample set of BASIX homes to be used for the study, the original dataset passed to EnergyAustralia underwent a series of filtering and checking processes so that it could be used as the final sample set for the analysis in this report.

The following procedure was followed for each year of BASIX data to establish a sample set of homes that could be used for the electricity consumption study:

1. All homes in the original DoP data sets were linked to homes in EnergyAustralia's databases using the Australia Post Delivery Point Identification number.

2. Any returned addresses were checked for duplicates and filtered for inactive installations and installation dates that were before the commencement of the BASIX policy (1 July 2004).

3. The individual filtered addresses were then re-matched against the original BASIX addresses and any non-matching addresses or duplicate addresses were excluded.

4. The current status of all installations was then checked and any businesses or any addresses identified as a temporary building service were excluded.

This process was used to finalise a list of National Metering Identification (NMI) numbers for obtaining quarterly billing electricity consumption information.

5. The pro-rata monthly consumption amounts calculated from the quarterly billing information was obtained for the periods of 1 July 2007 to 30 June 2008 (FY0708) and from 1 July 2008 to 30 June 2009 (FY0809). The summation of the pro-rata monthly amounts for each year was used to estimate the actual electricity consumption amounts for each consumption year.

6. The final sample set used for each electricity consumption year was determined by filtering out any non-residential consumption amounts during each analysis year. If a NMI did not have residential consumption for the first month of a consumption year then it was excluded.

7. A further check was performed on the consumption data for each individual NMI to identify any inconsistent consumption patterns, and a further set of dwellings were excluded from the sample set.

No attempt was made to survey the customers to obtain further information such as an occupation date of each dwelling or the number of occupants. This was considered out of scope for this preliminary study.

3 Electricity Consumption Analysis

This section of the report presents results from the analysis of the actual electricity consumption for a sample of BASIX new homes in EnergyAustralia's electricity distribution area (See Appendix A). The methodology for choosing and refining the sample set from the original BASIX Certificate data is outlined in section 2.2.

An overview of the total number of BASIX homes in the sample set is shown in the table below by the BASIX Certificate Year and the Electricity Consumption Year.

Overall sample size

BASIX Year	Electricity Consumption Year	
	FY0708	**FY0809**
2004-05	961	1,123
2005-06	247	431
2006-07	296	1,281
Totals	**1,504**	**2,835**

The electricity consumption results were also analysed by other household factors including the number of bedrooms, regional location and main appliances in the home.

3.1 Overall annual electricity consumption

The average annual electricity consumption was calculated for each of the sample BASIX certificate years over the two electricity consumption years (FY0708 and FY0809) and the overall results from this analysis are shown in the table below.

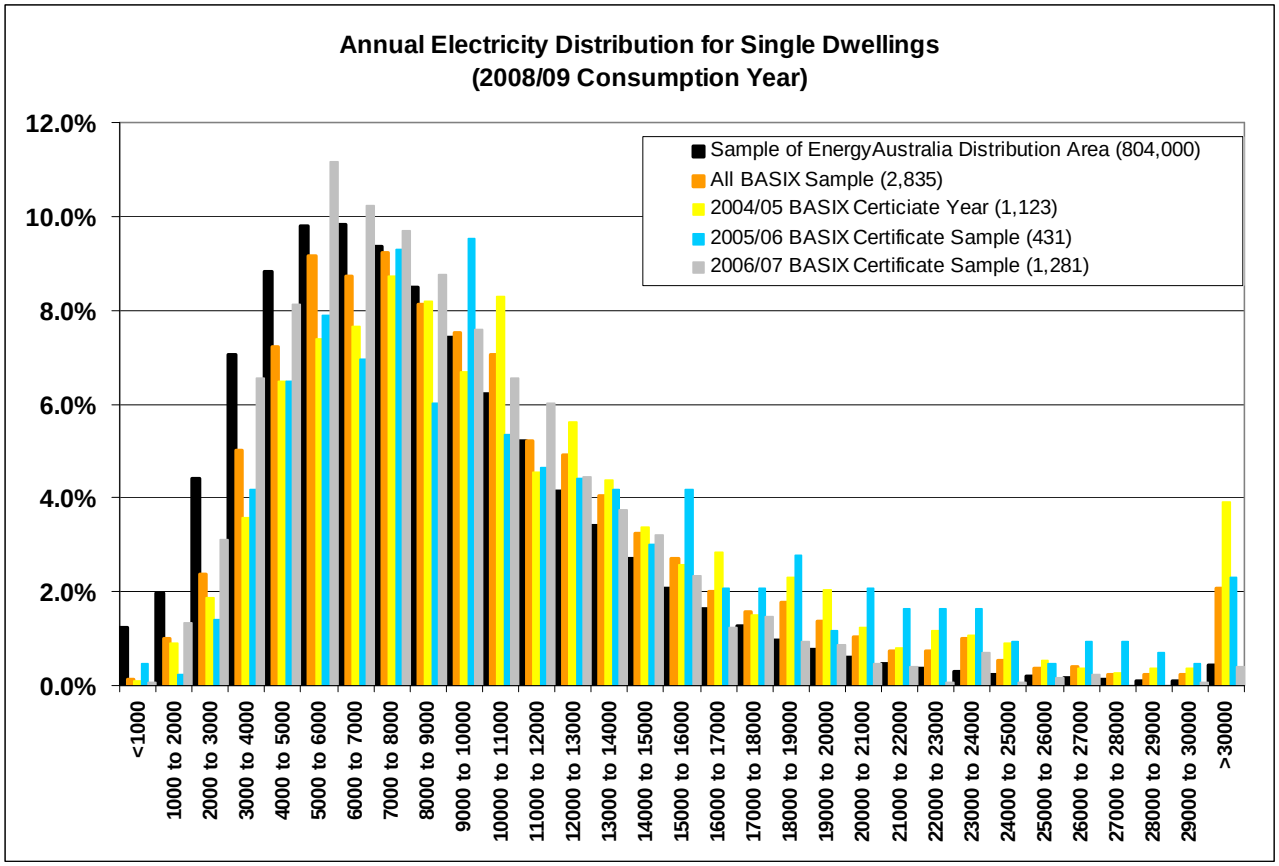
Average annual electricity consumption

BASIX Certificate Year	Electricity Consumption Year			
	FY0708		**FY0809**	
	Sample Size	*Average (kWh)*	*Sample*	*Average (kWh)*
2004-05	961	10,796	1,123	11,727
2005-06	247	10,239	431	11,907
2006-07	296	7,651	1,281	8,888
Totals (BASIX Samples)	**1,504**	**10,086**	**2,835**	**10,472**
Totals (EA Network)			**804,283**	**8,655**

There is a noticeable difference in the average annual consumption results between the 2006-07 BASIX Certificate Year sample, and the other two BASIX Certificate Years (2004-05 and 2005-06). This is most likely due to the 2004-05 and 2005-06 BASIX Certificate Years containing only households in the Sydney area, where as the 2006-07 BASIX Year sample contains a significant amount of dwellings in the Central Coast and Lower Hunter region. Regional influence of electricity consumption data will be discussed further in section 3.3.

The comparison sample of EnergyAustralia network single dwellings was derived from all identified residential customers in the EnergyAustralia network area that did not have a supplement entry in their address (for example, no unit or apartment identifier). The EnergyAustralia network sample includes all regions as defined in the map in Appendix A.

The following frequency distribution shows the annual electricity consumption for FY0809 comparing the three BASIX Certificate Years to the EnergyAustralia network sample.



There is a noticeable difference in the percentages of sample dwellings with large electricity consumption (>15,000 kWh per year) when compared to the EnergyAustralia network sample. This is particularly noticeable for the 2004-05 and 2005-06 BASIX Certificate Years which consist of new homes in the Sydney region. The sample set from the 2006-07 BASIX Certificate Year, is most similar to the overall EnergyAustralia network sample, because it includes a full geographic spread across the EnergyAustralia network area. A summary table showing the percentages of large electricity consumers for the various sample sets is shown below for the electricity consumption year of FY0809.

Sample Set	% of Sample (> 15 MWh pa)	% of Sample (> 30 MWh pa)
All BASIX	17.0%	2.1%
BASIX 2004-05	22.3%	3.9%
BASIX 2005-06	26.0%	2.3%
BASIX 2006-07	9.4%	0.4%
EA Network	9.9%	0.4%

The higher percentages of large electricity consumers for the first two years, is most likely due to the samples being focused in the more affluent Sydney region of EnergyAustralia's network. Other considerations that might explain the difference between the first two years of BASIX Certificates and the third year (2006-07) include:

- A higher uptake of retrofit appliances for BASIX new homes that have been established for longer.
- A higher actual occupancy for BASIX new homes that have been established for longer, taking into consideration some initial time for householders to fully occupy a new home.

3.2 Number of bedrooms

The occupancy of a home is considered one of the major factors influencing energy consumption, and the number of bedrooms is often used as a proxy for household occupancy. The number of bedrooms can also be considered as a proxy for household size which also influences the energy consumption requirements of a home mainly through increased heating and cooling requirements.

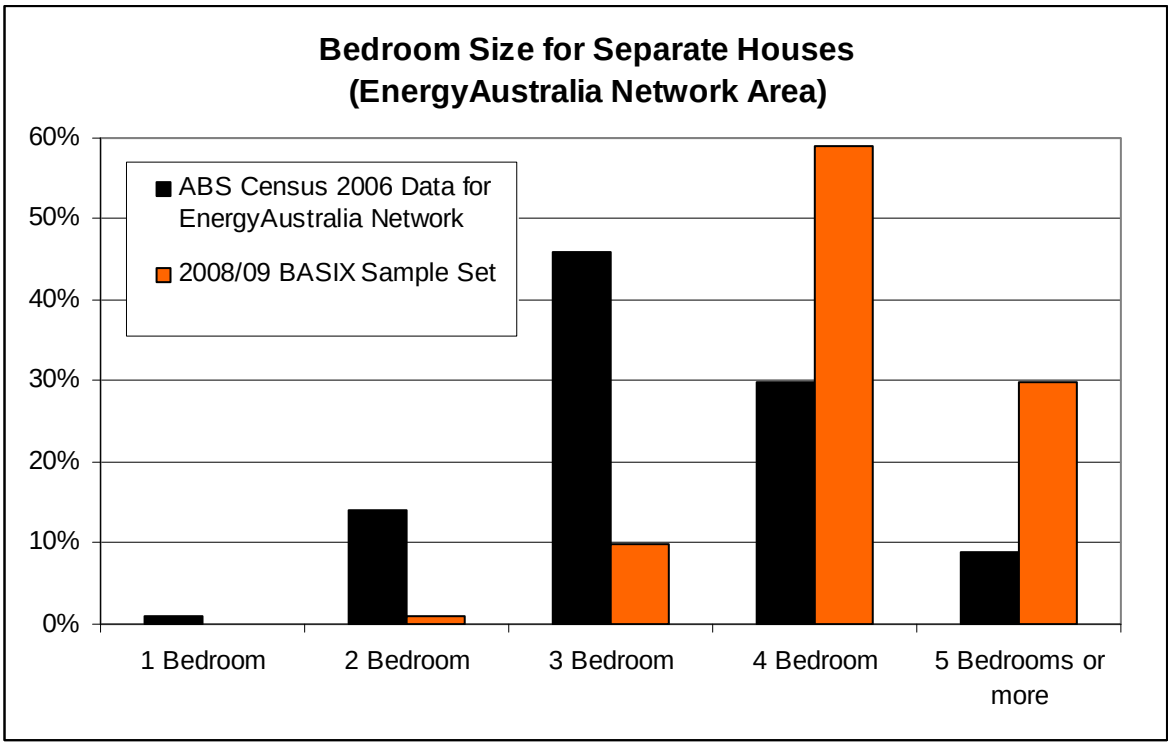
The following section presents results from an analysis of the average bedroom number of the dwellings in the BASIX sample sets when compared to the EnergyAustralia network figures.

3.2.1 Average number of bedrooms

The average number of bedrooms is estimated to be 3.30 for existing single dwellings in the EnergyAustralia Network Area, using ABS Census 2006 figures for the Local Government Areas within the EnergyAustralia Network Area (listed in Appendix A). The BASIX sample set used for this analysis had an average bedroom number of 4.26, which compares to the average bedroom number for all BASIX Certificates from 1 July 2005 to 30 June 2008 of 4.2 for Sydney and 3.7 for Regional NSW[1]. The table below shows the comparison of overall average bedroom number for the various sample sets.

Sample Set	Average Number of Bedrooms
All BASIX	4.26
BASIX 2004-05	4.25
BASIX 2005-06	4.35
BASIX 2006-07	4.24
EA Network	**3.30**

The below distribution shows the number of bedrooms for the existing single dwellings in the EnergyAustralia Network Area, derived from ABS Census 2006 data, compared to the sample set of BASIX homes in the 2008/09 electricity consumption year. It is estimated from the above results that the average bedroom number of the homes in the BASIX sample set is around one bedroom larger than the EnergyAustralia network average for single dwellings.



When the number of bedrooms for the sample set of BASIX homes in this study is compared to all BASIX Certificates from 1 July 2005 to 30 June 2008, it is found that the figures are more similar to the Sydney region than the regional NSW results[1].

Based on the bedroom number an occupancy of these homes can be estimated using ABS Census 2006 data, which is shown in the below table. Based on the percentages of homes with different bedroom numbers a weighted occupancy can be calculated for homes in the sample sets.

Bedroom Number	Estimated occupancy factors - ABS Census 2006	Percentage of single dwellings in EA Network	Percentage of single dwellings in BASIX Sample
1 Bedroom	1.46	1%	0%
2 Bedroom	1.95	14%	1%
3 Bedroom	2.68	46%	10%
4 Bedroom	3.40	30%	59%
5 Bedrooms or more	4.07	9%	30%
Weighted Occupancy		**2.91**	**3.52**

Using the weighted occupancy factors by bedroom number from ABS Census 2006 data, the occupancy for the BASIX dwellings would be estimated to be around 3.5 compared to 2.9 for all single dwellings in the EnergyAustralia network area. The actual occupancy for new homes may be even higher, as a survey conducted by Sydney Water[2] of 1,703 BASIX occupied dwellings revealed that the average survey occupancy was 3.8.

This suggests that new single dwellings are generally larger and more highly occupied than existing single dwellings, and that a comparison to broad electricity consumption figures for single dwellings may not be an appropriate comparison. A more appropriate baseline comparison control group would be recent new homes built in the 5 years prior to the introduction of BASIX with similar bedroom numbers and occupancy characteristics. Defining a baseline control group with similar characteristics to the new BASIX homes was beyond the scope of this preliminary analysis, but would be recommended for future work for assessing the effectiveness of the BASIX policy.

3.2.2 Annual electricity consumption by number of bedrooms

The annual electricity consumption for the total sample set for the 2-year period, 1 July 2007 to 30 June 2009 is shown in the below table.

Analysis of average electricity consumption by bedroom number

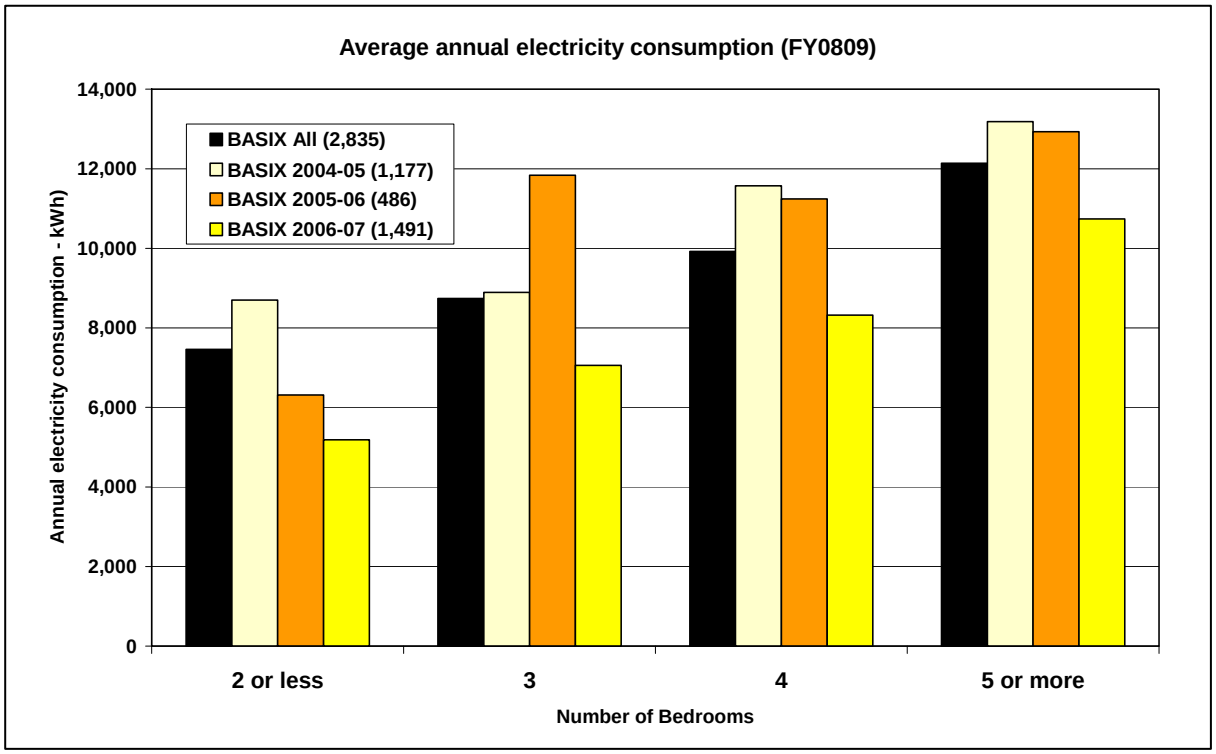
Number of Bedrooms	Electricity Consumption Year			
	FY0708		**FY0809**	
	Sample Size	*Average (kWh)*	*Sample*	*Average (kWh)*
2 or less	13	6,295	21	7,461
3	157	7,849	286	8,736
4	868	9,766	1,651	9,926
5 or more	466	11,540	877	12,137
Totals	**1,504**	**10,086**	**2,835**	**10,472**

Taking into consideration the variation in average electricity consumption between the three different BASIX Certificate Years, a further analysis was performed by bedroom number showing the averages for each individual BASIX Certificate Year. The results from this analysis are shown in the following table, for the FY0809 electricity consumption year.

Analysis of average electricity consumption by bedroom number and BASIX year for FY0809

Bedroom Number	2004-05 BASIX Year		2005-06 BASIX Year		2006-07 BASIX Year	
	Sample	*Mean (kWh)*	*Sample*	*Mean (kWh)*	*Sample*	*Mean (kWh)*
2 or less	12	8,697	5	6,313	4	5,190
3	134	8,891	49	11,835	103	7,060
4	626	11,574	210	11,240	815	8,321
5 or more	351	13,187	167	12,935	359	10,740
Totals	**1,123**	**11,727**	**431**	**11,907**	**1,281**	**8,888**

The following chart shows the distribution of average annual electricity consumption for the samples by number of bedrooms. The small sample sizes of dwellings with 2 bedrooms or less needs to be taken into consideration when using these figures.



3.2.3 Geographic location

The dwellings in the sample set were assigned Local Government Areas based on their physical address. A full list of the Local Government Areas in the EnergyAustralia Network Area can be found in Appendix A. Each Local Government Area was also assigned to a broader geographic region according to the following table:

Region	Local Government Areas
Central Coast	Gosford, Wyong
Lower Hunter	Cessnock, Lake Macquarie, Maitland, Newcastle, Port Stephens
Upper Hunter	Muswellbrook, Singleton, Upper Hunter
Sydney North	Hornsby, Hunters Hill, Ku-Ring-Gai, Lane Cove, Manly, Mosman, North Sydney, Pittwater, Ryde, Warringah, Willoughby
Sydney South - Sutherland	Sutherland
Sydney South - Other	Ashfield, Auburn, Bankstown, Botany Bay, Burwood, Canada Bay, Canterbury, Hurstville, Kogarah, Leichhardt, Marrickville, Rockdale, Strathfield, Sydney
Sydney East	Randwick, Waverley, Woollahra

Below is a summary of the average annual electricity consumption by region for all BASIX homes in the sample set for the 2008-09 electricity consumption year.

Regional average annual electricity consumption

Region	Sample	Average Annual Consumption (KWh)	Average Bedroom Number
Central Coast	287	8,371	4.16
Lower Hunter	491	8,223	4.11
Sydney East	121	13,963	4.07
Sydney North	783	12,234	4.38
Upper Hunter	75	12,397	4.16
Sydney South - Sutherland	223	12,076	4.24
Sydney South - Other	855	9,773	4.31
Total	**2,835**	**10,472**	**4.26**

The variation in average annual consumption by region is noticeable and is most likely attributable to a combination of socio-demographic, climate and dwelling-type factors that vary from region to region.

3.2.4 Main appliances

Appliance data obtained from the submitted BASIX certificates was used to analyse trends in the average consumption of dwellings in the sample set. The main appliances analysed were the existence of three phase ducted air conditioning, a pool and electric hot water systems (ie solar-electric boosted and heat pump).

Analysis of average electricity consumption by bedroom number and main appliances for FY0809

Bedroom Number	Total Sample		Main appliances					
			Three phase Air-conditioning for Heating the Living Room		With a Pool		Electric water heating	
	Sample	*Average*	*Sample*	*Average*	*Sample*	*Average*	*Sample*	*Average*
3 bedroom	286	8,736	76	9,093	19	12,938	56	8,691
4 bedroom	1651	9,926	708	10,871	147	16,281	344	10,671
5 bedrooms or more	877	12,137	505	12,128	112	19,598	157	13,290
Totals	**2814**	**10,494**	**1289**	**11,259**	**278**	**17,389**	**557**	**11,210**

The average annual electricity consumption of samples with three phase air conditioning or electric water heating were slightly higher than the average consumption of the total sample set. However, the largest difference in average consumption was the sample of dwellings that had a pool, with an average annual consumption higher by around 7,000 kWh. This difference may not be attributable solely to the energy consumption associated with the pool equipment, but other factors such as larger and more affluent households that use more electricity in general.

3.3 Analysis of large electricity consumers

Results presented in Section 3.1 showed that a higher than anticipated proportion of the BASIX dwellings studied were consuming above 15,000 kWh of electricity per year. These customers were studied further to analyse factors that might be contributing to their large electricity consumption. This analysis was based on the full sample of BASIX homes in the 2008-09 electricity consumption year and there were a total of 483 homes, or 17% of the total BASIX sample above 15,000 kWh per year electricity consumption.

3.3.1 Average number of bedrooms

The first factor considered for analysis was average bedroom number for these dwellings. This is summarised in the below table and in general the average bedroom number was larger by approximately 0.2 to 0.3 when compared to the average bedroom number for the whole sample.

Large electricity consumption – average bedroom number

BASIX Certificate Year	Annual Electricity Consumption			
	> 15,000 kWh		**> 30,000 kWh**	
	Sample Size	*Average Bedrooms*	*Sample Size*	*Average Bedrooms*
2004-05	250	4.38	44	4.52
2005-06	112	4.54	10	4.4
2006-07	121	4.60	5	5.4
Totals (BASIX Samples)	**483**	**4.47**	**59**	**4.58**

3.3.2 Main Appliances

Appliance data obtained from the submitted BASIX certificates was used to analyse the main appliances for dwellings that had over 15,000 kWh per year electricity consumption. The main results for hot water system type, pool appliances and heating system types are shown in the following tables:

Large electricity consumption – hot water system type

Hot Water System	Whole BASIX Sample	Dwellings above 15,000 kWh pa
Electric heat pump	9.7%	11.6%
Other - electric	0.4%	0.4%
Solar electric boost	9.7%	11.4%
Total electric	**19.8%**	**23.4%**
Gas instantaneous	27.1%	33.3%
Gas storage	46.0%	27.5%
Solar (gas boosted)	7.2%	15.7%
Total gas	**80.2%**	**76.6%**

Large electricity consumption – heating systems

Heating System	*Whole BASIX Sample*		*Dwellings above 15,000 kWh pa*	
	Living Room	**Bedroom**	**Living Room**	**Bedroom**
Three phase air-conditioning	45.5%	48.1%	54.9%	60.0%
Single phase air-conditioning	10.3%	7.3%	8.5%	8.5%
Gas heating	10.4%	2.6%	16.8%	5.2%
Air-conditioning ducting only	4.6%	4.9%	4.1%	4.3%
Electric floor heating	0.1%	0.2%	0.6%	0.8%
Other	0.6%	0.2%	1.0%	0.4%
No active heating or heating to be installed	28.5%	36.6%	14.1%	20.7%

Large electricity consumption – pools

	Whole BASIX Sample	Dwellings above 15,000 kWh pa
Pools without heating	**4.4%**	**10.8%**
Pools with heating	**5.5%**	**18.2%**
Electric Heat Pump	0.1%	0.0%
Solar only	4.4%	14.1%
Solar (electric boost)	0.1%	0.4%
Solar (gas boost)	0.3%	1.0%
Gas	0.7%	2.7%
Total % dwellings with pools	**9.9%**	**29.0%**

The results of the appliance analysis show that the large electricity consumers have a higher percentage of electric hot water systems and air-conditioners used to heat the living area and bedrooms. A large percentage (over 50%) of the dwellings indicated that they use air-conditioning systems to heat the living area and bedrooms. This is higher than the latest ABS statistics, which indicates that around 30% of dwellings in NSW use reverse cycling air-conditioners as their main heater, with only 11% of these being ducted systems[3].

There was also a significant difference in the number of dwellings that have a pool, with 29% of dwellings with over 15,000 kWh owning a pool. In addition, 18% of all dwellings above 15,000 kWh annul consumption heated their pool with a solar system or other form of heating. Running a pool filtration system or pool heating system can add a significant amount of electricity consumption each year, and may by a contributing factor to the large electricity consumption of these dwellings.

3.3.3 Regional location

The regional location of the dwellings that had an annual electricity consumption over 15,000 kWh per year was also analysed. The following table shows the percentage of the sample set(s) in the various regions:

Large electricity consumption – regional location

Region	Whole BASIX Sample	Dwellings above 15,000 kWh pa	Percentage Change
Central Coast	10.1%	4.8%	-5.4%
Lower Hunter	17.3%	5.0%	-12.4%
Sydney East	4.3%	8.1%	3.8%
Sydney North	27.6%	40.6%	13.0%
Upper Hunter	2.6%	5.2%	2.5%
Sydney South - Sutherland	7.9%	10.8%	2.9%
Sydney South - Other	30.2%	25.7%	-4.5%

The results show that the large electricity consumption dwellings were more prevalent in the Sydney North, Sydney East, Upper Hunter and Sutherland regions and less prevalent in the Central Coast, Lower Hunter and other Sydney South regions. This is also reflected in the overall average electricity consumption figures by region in section 3.3.

4 Greehouse Gas Emissions of BASIX Dwellings

The BASIX Energy Score that is calculated using the online BASIX tool takes into account the predicted greenhouse gas emissions from both electricity and gas consumption based on the dwelling details entered into the online form. The BASIX Energy Score is an estimate of the percentage reduction in greenhouse gas emissions for the details of the BASIX dwelling compared to an overall benchmark.

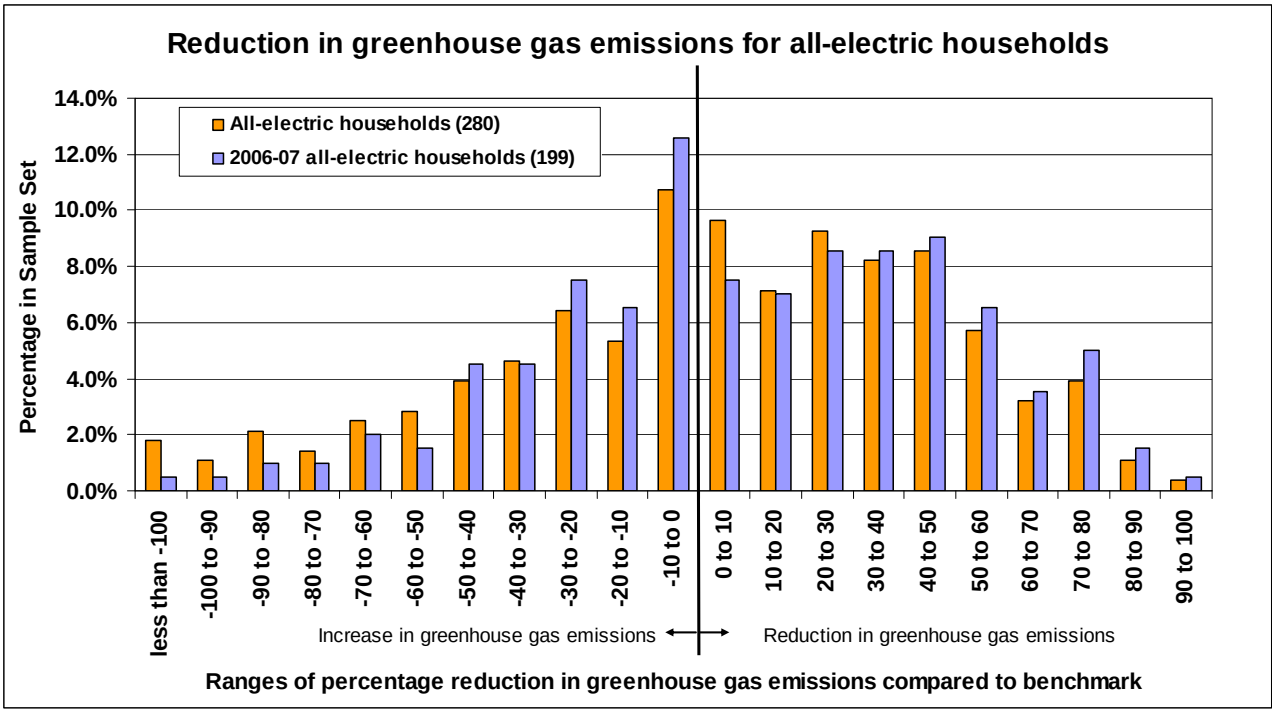
The following sections present results for two sample sets of BASIX dwellings against the original greenhouse gas emission benchmarks used in the BASIX tool as well as corrected benchmarks calculated using an alternative methodology developed by the Department of Planning.

4.1 Comparison to original benchmarks

The original benchmark used by the BASIX tool was 3,292 kg of greenhouse gas emissions per person, based on 2002-03 data for electricity and gas consumption for the residential sector in New South Wales. To convert the per person benchmark figure into a benchmark for each dwelling, the Department of Planning uses an estimated occupancy which is calculated from the number of bedrooms and the geographic location of the dwelling.

4.1.1 All electric dwellings

For homes with all-electric appliances, it was possible to calculate an annual greenhouse gas emission figure from the electricity consumption, using a greenhouse factor of 1.012 kg/kWh, as supplied by the Department of Planning. The all-electric appliance homes were identified in the data as homes with no gas prediction value and no gas appliances detailed in the original BASIX Certificate (no gas hot water, heating or cooking appliances). The results estimating the percentage reduction in greenhouse gas emissions when compared to the BASIX benchmarks are shown below, and include dwellings from the first three years of the BASIX policy with the third year (2006-07) presented separately.



The effect of bedroom number was also analysed for these sample sets and the results presented in the below tables.

Greenhouse gas emissions for all-electric households by number of bedrooms

Bedrooms	Sample	Actual Greenhouse Gas Emissions (CO_2-e)		Benchmark Greenhouse Gas Emissions (CO_2-e)		% Greenhouse Reduction from Benchmark	
		Average	*Median*	*Average*	*Median*	*Average*	*Median*
3	20	8,676	7,029	9,217	9,368	6	25
4	179	11,076	10,651	11,455	11,708	3	8
5 or more	81	12,791	12,153	13,426	13,670	5	9
Totals	**280**	**11,401**	**10,666**	**11,865**	**11,708**	**4**	**9**

Greenhouse gas emissions for all-electric households for 2006-07 sample by number of bedrooms

Bedrooms	Sample	Actual Greenhouse Gas Emissions (CO_2-e)		Benchmark Greenhouse Gas Emissions (CO_2-e)		% Greenhouse Reduction from Benchmark	
		Average	*Median*	*Average*	*Median*	*Average*	*Median*
3	11	5,501	6,336	9,094	9,368	39	32
4	128	10,226	10,075	11,354	11,080	10	10
5 or more	60	12,808	12,548	13,341	13,670	4	6
Totals	**199**	**10,743**	**10,552**	**11,828**	**11,708**	**10**	**11**

These results show that there is an overall reduction in the estimated greenhouse gas emissions for BASIX homes when compared to the original BASIX benchmark figures. The estimated median greenhouse reduction for the overall sample set was 9 with a slightly higher figure of 11 for the 2006-07 sample set. There were some noticeable differences in the reduction of greenhouse gas emissions for the different bedroom numbers which are also shown in the tables.

It should be noted, that these results are for a sample of all-electric dwellings and does not include any dwellings with gas, which make up the majority of single dwellings in NSW built under the BASIX policy. In general, consumption of gas for hot water, heating and cooking end-uses results in less greenhouse gas emissions than using electricity for these same end-uses. These preliminary results may be considered to be a lower bound of greenhouse savings when compared to the BASIX benchmarks.

It is recommended that further work is needed in obtaining the actual gas consumption data for a sample of dual fuel dwellings.

4.1.2 Dwellings with gas

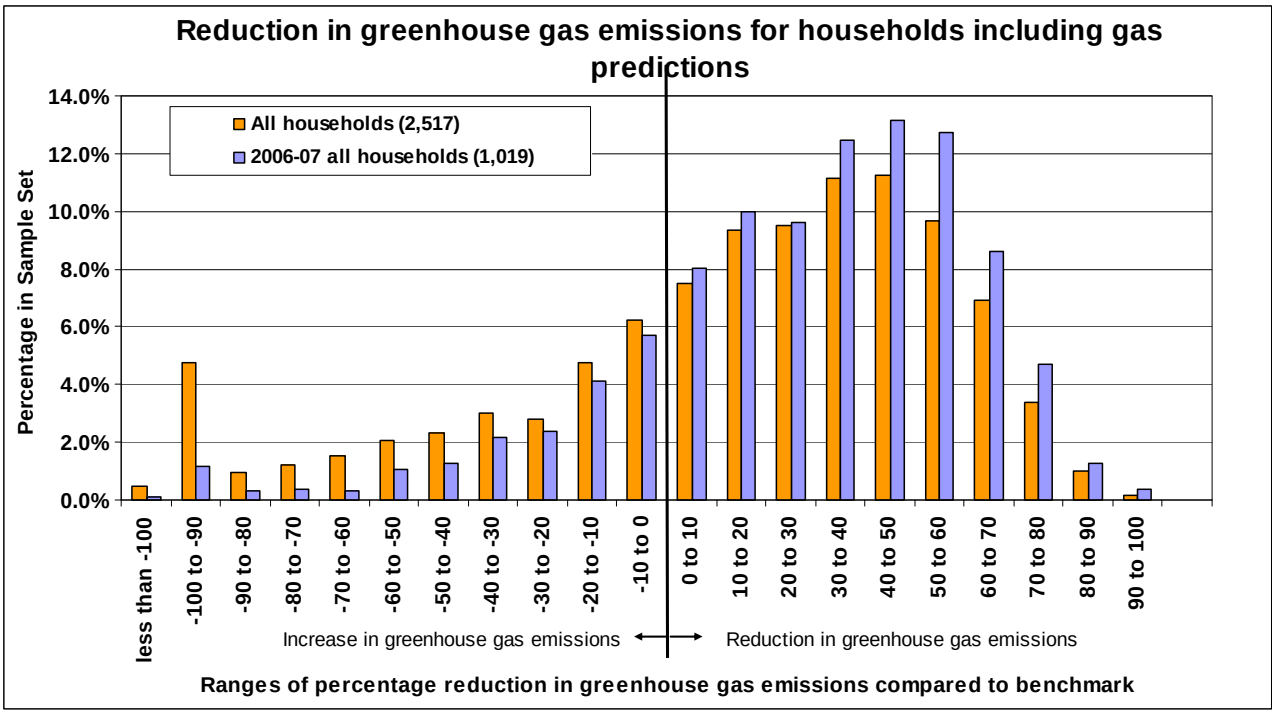
In order to estimate the greenhouse gas emissions for dwellings with gas, both the electricity and gas consumption is needed. As an electricity distribution network service provider, EnergyAustralia does not have access to gas consumption data. Given that around 80% of homes in the BASIX sample set in this study have some form of gas hot water (section 3.4.2), it is difficult to assess the greenhouse gas emissions for the total sample set without knowing the gas consumption.

However, an attempt is made in this section to estimate the greenhouse gas emissions for a sample of dwellings, including those with gas using the **actual** electricity consumption for the household in the FY0809 consumption year and the **predicted** gas consumption of the dwellings from the BASIX calculation tool. A sample of 2,517 single dwellings with actual electricity consumption and a predicted gas consumption figure were identified which also included the all-electric homes from the analysis in the previous section. The 2006-07 BASIX year dwellings was also separated out and analysed separately, and consisted of a sample of 1,019 dwellings.

Although this is not considered a thorough assessment of the greenhouse gas emissions of the dwellings with gas, it does give an overall indication as to whether the dwellings, including those

with gas generally have a higher or lower greenhouse gas reduction when compared to the all-electric dwelling sample.

The greenhouse gas emissions attributed to the consumption of natural gas for these dwellings was estimated using the predicted annual gas consumption figures (MJ/year) calculated from the BASIX calculation tool and applying the 2002-03 greenhouse gas factor of 0.0719 kg CO_2 per MJ for natural gas. The results estimating the percentage reduction in greenhouse gas emissions are shown below and include a sample of households from all three years of BASIX certificates and those from the 2006-07 BASIX certificate year.



The effect of bedroom number was also analysed for these sample sets and the results presented in the below tables:

Greenhouse gas emissions for households including gas prediction by number of bedrooms

Bedrooms	Sample	Actual Greenhouse Gas Emissions (CO_2-e)		Benchmark Greenhouse Gas Emissions (CO_2-e)		% Greenhouse Reduction from Benchmark	
		Average	*Median*	*Average*	*Median*	*Average*	*Median*
3	264	9,844	8,813	9,257	9,368	-6	5
4	1443	11,300	9,758	11,572	11,708	3	15
5 or more	791	13,681	12,052	13,597	13,670	-1	11
Totals	**2498**	**11,874**	**10,188**	**11,925**	**11,708**	**0**	**13**

Greenhouse gas emissions for households for 2006-07 including gas prediction sample by number of bedrooms

Bedrooms	Sample	Actual Greenhouse Gas Emissions (CO_2-e)		Benchmark Greenhouse Gas Emissions (CO_2-e)		% Greenhouse Reduction from Benchmark	
		Average	*Median*	*Average*	*Median*	*Average*	*Median*
3	89	7,873	7,385	9,037	9,368	13	21
4	635	9,246	8,582	11,399	11,708	19	24
5 or more	291	11,820	10,804	13,471	13,670	12	20
Totals	**1015**	**9,847**	**9,060**	**11,762**	**11,708**	**16**	**22**

These results show that there is a higher reduction in greenhouse gas emissions compared to the BASIX benchmark figures when the dwellings with gas are included in the analysis. The estimated median percentage reduction in greenhouse gas emissions was 13% for the full sample set and 22% for the 2006-07 sample set. The average reductions in greenhouse gas emissions were noticeably lower for both sample sets and this is due to the influence of the larger electricity consuming dwellings in the sample set on the overall results.

Consistent with other results, there was a noticeable difference in the reduction of greenhouse gas emissions for the 2006-07 sample year when compared to the total sample set.

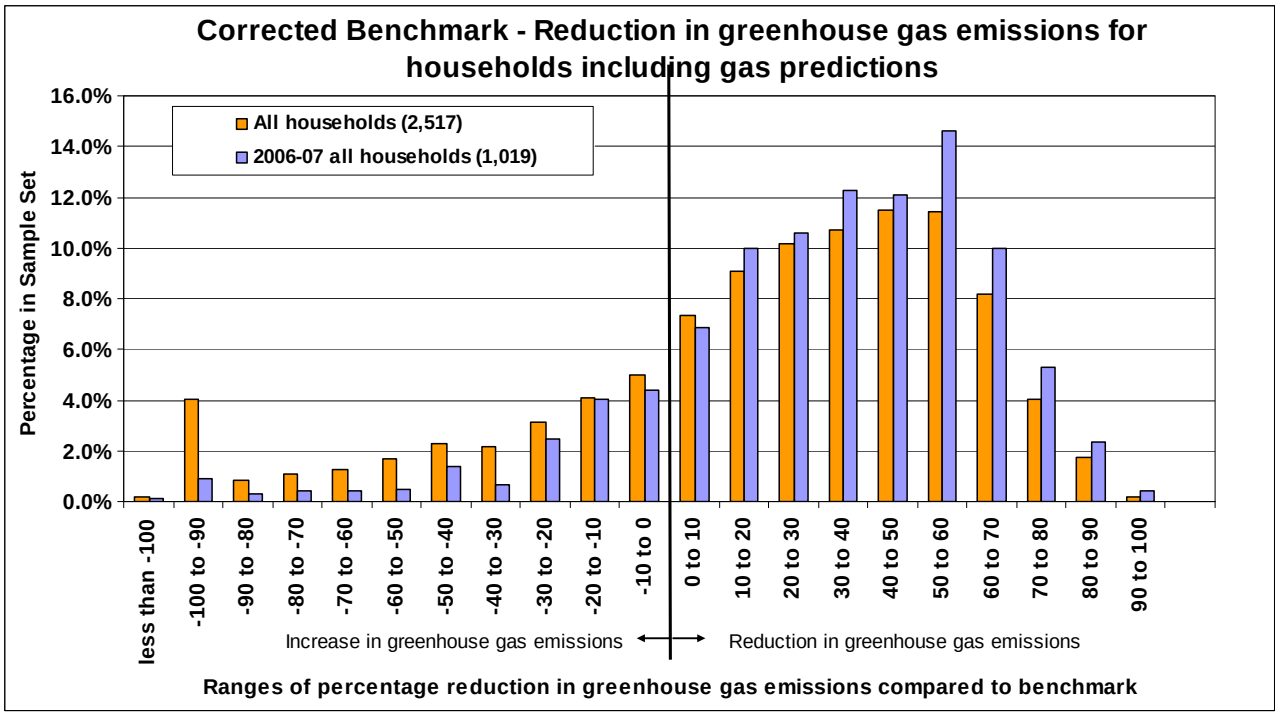
4.2 Comparison to corrected benchmarks

Further analysis of the reduction in greenhouse gas emissions was performed using a revised benchmark figure, taking into account two corrections.

The first was a correction to the per person greenhouse gas emissions benchmark, with the inclusion of an additional 116 kg CO_2 per person of greenhouse gas emissions, resulting in a corrected benchmark figure of 3,408 kg CO_2 per person. This increase was included at the request of the Department of Planning, and is an estimate of the predicted increase in the electricity consumption due to plug-in electric appliances such as computers and televisions since the BASIX tool was developed.

The second correction to the benchmark was the inclusion of revised occupancy figures based on the Sydney Water survey of BASIX homes[2] in the Sydney region. These revised occupancy figures were included in the calculation of the corrected benchmark figures for BASIX dwellings in the Sydney region for 3, 4 and 5 bedroom homes.

The results estimating the percentage reduction in greenhouse gas emissions for dwellings, including those with gas compared to the corrected benchmark are shown below.



The effect of bedroom number was also analysed for these sample sets and the results presented in the below tables:

Corrected Benchmark - Greenhouse gas emissions for households including gas prediction by number of bedrooms

Bedrooms	Sample	Actual Greenhouse Gas Emissions (CO_2-e)		Benchmark Greenhouse Gas Emissions (CO_2-e)		% Greenhouse Reduction from Benchmark	
		Average	*Median*	*Average*	*Median*	*Average*	*Median*
3	264	9,844	8,813	9,740	9,883	-1	10
4	1443	11,300	9,758	12,363	12,610	9	20
5 or more	791	13,681	12,052	14,222	14,314	4	15
Totals	**2498**	**11,874**	**10,188**	**12,628**	**12,610**	**6**	**18**

Corrected Benchmark - Greenhouse gas emissions for households for 2006-07 including gas prediction sample by number of bedrooms

Bedrooms	Sample	Actual Greenhouse Gas Emissions (CO_2-e)		Benchmark Greenhouse Gas Emissions (CO_2-e)		% Greenhouse Reduction from Benchmark	
		Average	*Median*	*Average*	*Median*	*Average*	*Median*
3	89	7,873	7,385	9,459	9,883	17	25
4	635	9,246	8,582	12,050	12,610	23	28
5 or more	291	11,820	10,804	14,064	14,314	16	24
Totals	**1015**	**9,847**	**9,060**	**12,375**	**12,610**	**20**	**26**

The results presented in these tables show a general increase in the estimate of greenhouse reductions of 4% to 6%, primarily due to the higher per person greenhouse gas emissions in the corrected benchmark

These results demonstrate the importance of the benchmark and baseline metrics, and the sensitivity of the greenhouse reduction estimates due to baseline setting. To effectively assess the energy performance of residential buildings built under the BASIX policy, further work is needed to determine appropriate baseline and benchmark figures. This could include the consideration of using an appropriate control group of dwellings built before the implementation of the BASIX Policy (during the years of 2000 to 2004 for example).

5 Conclusions

This report contains the results of a preliminary analysis of the electricity consumption for several sample sets of BASIX single dwellings (not including multi-units). The electricity consumption period studied covered a two year period from 1 July 2007 to 30 June 2009 for samples of BASIX homes located within EnergyAustralia's network distribution area (see Appendix A) for the first three years of the BASIX policy.

The main findings from this preliminary analysis are:

- The electricity consumption distribution for the BASIX sample in this study, although similar in shape to the EnergyAustralia network area, has a higher percentage of large electricity customers (greater than 15,000 kWh per year) than anticipated.
- The average number of bedrooms in the sample of BASIX homes in this study (and for all BASIX homes[1]), is higher by around one bedroom, than the average for existing single dwellings in the EnergyAustralia network area.
- The annual electricity consumption for single dwellings in the 2006/07 BASIX certificate year demonstrates a noticeable difference when compared to the first two years. This is most likely due to the inclusion of regional NSW (outside Sydney region) to the 2006/07 sample year, with the first two years of BASIX certificates being concentrated in the Sydney region.
- There is a distinct regional variation in electricity consumption for the sample set used, which is similar to the overall statistics for regions within EnergyAustralia's electricity distribution network area. This variation is most likely due to a set of socio-demographic, geographic, appliance and dwelling-type factors.
- An analysis of the larger electricity consumption dwellings in the sample (>15,000 kWh pa) revealed that these dwellings had a higher than average bedroom number, and more electric appliances including a higher percentage of pools, air-conditioners and electric hot water systems.
- The reduction in greenhouse gas emissions for a sample of all-electric dwellings when compared to the BASIX benchmarks showed a median reduction of around 10 percent.
- The reduction in greenhouse gas emissions for a sample of dwellings that included dwellings with gas was higher when compared to the BASIX benchmarks. The median reduction was estimated to be around 13 to 22 percent reduction when compared to the BASIX benchmarks.
- An analysis using a corrected BASIX benchmark figure showed that the estimate in the reduction in greenhouse gas emissions was most sensitive to the assumed greenhouse gas emissions per person. There was also sensitivity to the assumed occupancy figures for the dwellings, which can only be established by surveying the dwellings to obtain actual occupancy data.

To improve the data analysis in this report, and to more accurately assess the energy component of the BASIX policy, the following work could be undertaken:

1. Survey the households in the existing sample set to establish the actual occupancy and occupation date of the dwellings and other key appliance details.
2. Obtain gas consumption data from households to more accurately assess the greenhouse gas emissions for dwelling with gas.
3. Further investigate the benchmark or baseline methodology. This could be through using the most up-to-date energy consumption data or establishing an appropriate control group of households built before the implementation of the BASIX Policy (during the years of 2000 to 2004 for example).

6 References

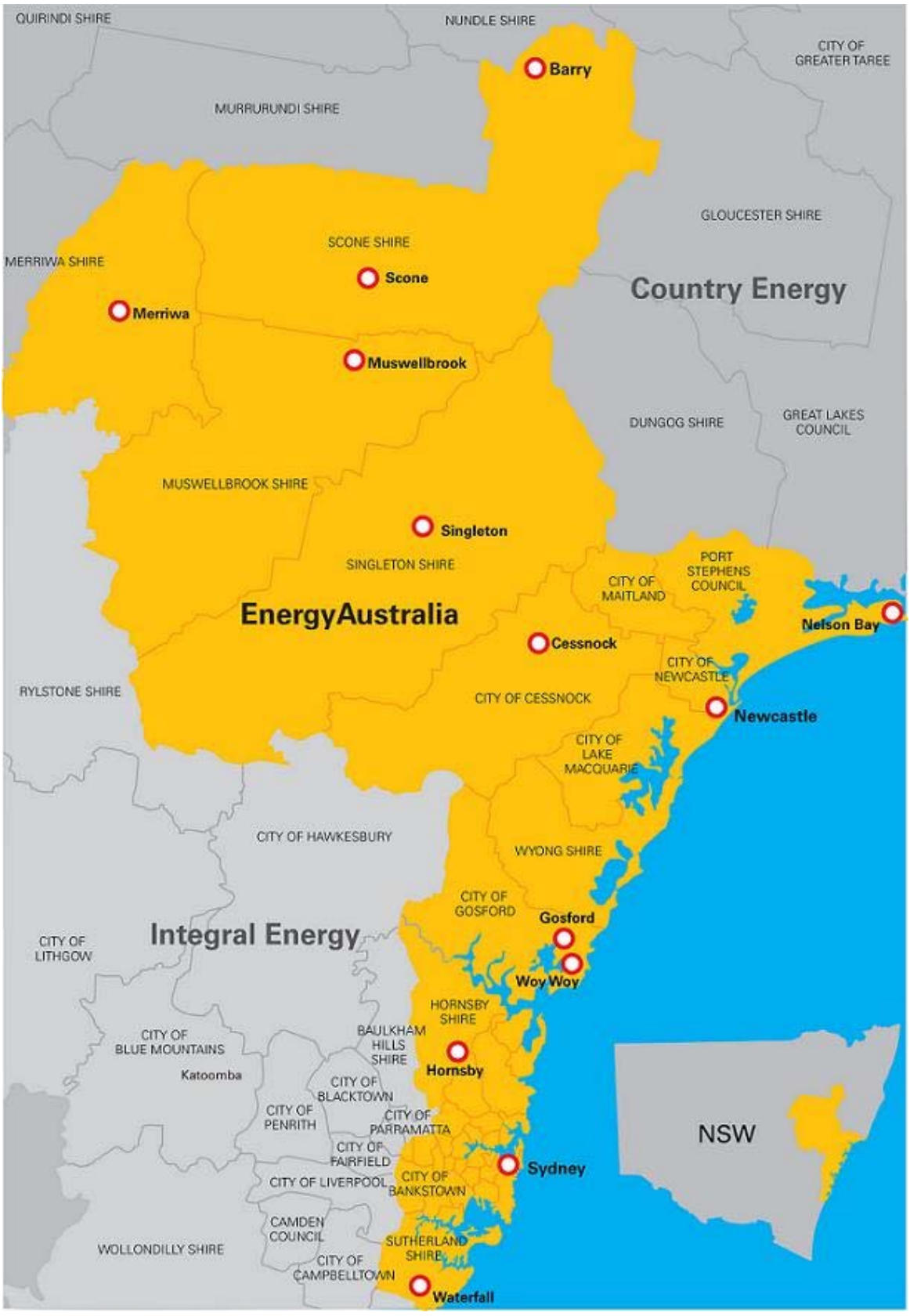
[1]*Single Dwelling Outcomes 05-08 BASIX Ongoing Monitoring Program*, NSW Government Department of Planning,

[2]*BASIX Monitoring Report – Water savings for 2007-08, Final Report,* Sydney Water, November 2008

[3]ABS 4602.0.55.001 - Environmental Issues: Energy Use and Conservation, Australian Bureau of Statistics, March 2008

[4]*Energy Use in the Australian Residential Sector 1986 - 2020*, Department of the Environment, Water, Heritage and the Arts, Commonwealth of Australia, 2008

APPENDIX A – EnergyAustralia Network Area



APPENDIX B – Occupancy and Household Size

To obtain the average occupancy and average number of bedrooms of all single dwellings in the EnergyAustralia network area, ABS Census 2006 data was downloaded for each Local Government Area in the EnergyAustralia network area. A summary table is contained below:

Geographical Area	Average number of bedrooms	Average occupancy for various household sizes				
		1 Bedroom	2 Bedroom	3 Bedroom	4 Bedroom	5 Bedrooms or more
EnergyAustralia Network	**3.30**	**1.46**	**1.95**	**2.68**	**3.40**	**4.07**
Ashfield (A)	3.17	1.58	2.17	2.81	3.53	4.20
Auburn (A)	3.12	1.40	2.35	3.24	4.06	4.79
Bankstown (C)	3.20	1.62	2.10	2.95	3.78	4.44
Botany Bay (C)	3.11	1.55	2.04	2.92	3.65	4.33
Burwood (A)	3.31	1.70	2.06	2.89	3.61	4.23
Canada Bay (A)	3.16	1.49	1.96	2.78	3.52	4.21
Canterbury (C)	3.11	1.54	2.19	3.03	3.79	4.48
Cessnock (C)	3.06	1.57	1.85	2.61	3.41	4.04
Gosford (C)	3.29	1.44	1.77	2.50	3.22	4.01
Hornsby (A)	3.59	1.45	2.00	2.71	3.37	4.04
Hunter's Hill (A)	3.50	1.52	1.93	2.67	3.34	4.10
Hurstville (C)	3.27	1.33	2.02	2.78	3.54	4.18
Kogarah (A)	3.35	1.66	2.06	2.79	3.50	4.06
Ku-ring-gai (A)	3.79	1.59	1.91	2.63	3.28	3.92
Lake Macquarie (C)	3.21	1.47	1.84	2.56	3.28	4.00
Lane Cove (A)	3.46	1.36	1.94	2.74	3.42	3.99
Leichhardt (A)	2.83	1.35	1.96	2.67	3.30	3.91
Maitland (C)	3.34	1.48	1.79	2.55	3.33	4.07
Manly (A)	3.40	1.63	2.00	2.70	3.40	3.90
Marrickville (A)	2.93	1.40	2.08	2.79	3.53	4.26
Mosman (A)	3.68	1.31	1.78	2.61	3.34	3.97
Muswellbrook (A)	3.27	1.45	1.80	2.56	3.35	3.94
Newcastle (C)	3.02	1.38	1.82	2.52	3.35	4.03
North Sydney (A)	3.07	1.29	1.84	2.51	3.26	3.75
Pittwater (A)	3.43	1.45	1.99	2.66	3.26	3.90
Port Stephens (A)	3.31	1.40	1.76	2.45	3.19	3.85
Randwick (C)	3.34	1.46	2.04	2.71	3.50	4.12
Rockdale (C)	3.15	1.69	2.12	2.92	3.71	4.26
Ryde (C)	3.33	1.41	2.03	2.71	3.48	4.12
Singleton (A)	3.40	1.76	2.03	2.64	3.35	4.20
Strathfield (A)	3.53	1.50	2.18	2.88	3.57	4.17
Sutherland Shire (A)	3.50	1.63	1.97	2.71	3.46	4.11
Sydney (C)	2.76	1.34	2.09	2.67	3.67	4.00
Upper Hunter Shire (A)	3.23	1.39	1.73	2.41	3.06	3.55
Warringah (A)	3.51	1.46	2.06	2.73	3.36	4.06
Waverley (A)	3.24	1.31	1.95	2.74	3.51	4.06
Willoughby (C)	3.41	1.72	2.02	2.71	3.38	3.95
Woollahra (A)	3.63	1.40	1.90	2.53	3.33	3.90
Wyong (A)	3.24	1.43	1.76	2.48	3.25	4.05