Executive Summary

The lack of baseline primary data on energy consumption in Brunei Darussalam is one of the main drivers for carrying out a national survey on energy consumption in the residential sector and assessing energy performance of commercial and public sector buildings. The study outlines policies to improve residential, commercial, and public energy efficiency.

Residential Energy Consumption

Electricity represented about 76% of total residential energy demand. Natural gas accounted for about 11% and liquefied petroleum gas (LPG) for 13%. They were mainly used for cooking and water heating. Natural gas was available mainly in Belait district because it is close to gas fields and processing plants.

Table ES 1: Share of Household Electricity Consumption by Appliance Type

Appliances	Brunei Darussalam	Districts			
		Brunei-Muara	Tutong	Kuala Belait	Temburong
Air Conditioners	59.5%	60.5%	57%	59.5%	54%
Electric Fans	3%	3%	4%	3%	3%
Refrigerators	18%	16.5%	19%	19%	25%
Lighting (Indoor)	3.5%	4%	4%	2%	3%
Lighting (Outdoor)	3.5%	3%	4%	4%	4%
Water Heaters	6%	7%	6%	6%	5%
Washing Machines	1%	1%	0.5%	1%	1%
TVs	3%	3%	3%	3%	2%
Rice Cookers	2.5%	2%	2.5%	2.5%	3%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Source: Author (2019).

Air conditioning represented almost 60% of national average household electricity demand, with its share varying from 60.5% in Brunei-Muara district (highest income) to 54% in Temburong district (lowest income) (Table ES 1). Other major electricity-consuming services were refrigeration (18% of national household electricity demand), lighting (7%), and water heating (6%). Households in high-income districts had higher electricity demand shares of air conditioning and water heating than those in low-income ones. Conversely, the share of

refrigeration tended to be higher in low-income than in high-income districts because low-income people owned more refrigerators than air conditioners.

Amongst household electrical appliances, air conditioners were used most intensively, accounting for 2,637 kWh per unit per year (Table ES 2). Other energy-intensive appliances were water heaters, consuming 1,146 kWh per unit per year, and refrigerators, 947 kWh. Rice cookers consumed about 300 kWh per unit per year, TV sets 200 kWh, and outdoor lighting 100 kWh. Washing machines and indoor lighting consumed less than 100 kWh per unit per year. These variations depended on usage time and power rating of appliances. On average, per unit electricity consumption of appliances was highest in Temburong (the lowest-income district) and lowest in Brunei-Muara. One reason was that a high-income household owned multiple appliances (e.g. more than three air conditioners) but a low-income household may have had only one or none. Low-income households used appliances longer than high-income households, resulting in higher electricity consumption per appliance.

Air conditioners, water heaters, refrigerators, and lighting consumed about 94% of total household electricity. Replacing them with more efficient versions could save about 73 gigawatt hours (GWh) per year and could be the priority of an energy-efficiency policy.

Table ES 2: Electricity Consumption per Appliance (kWh/unit/year)

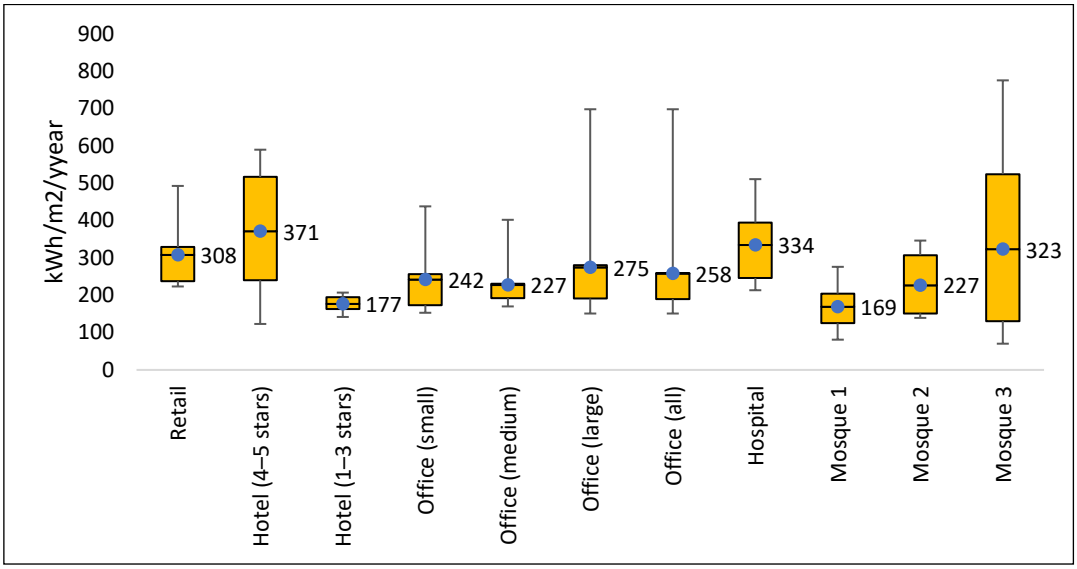
Appliance Type	Brunei Darussalam	Districts			
		Brunei-Muara	Tutong	Kuala Belait	Temburong
Air Conditioner	2,637	2,580	2,599	2,826	2,896
Electric Fan	131	125	150	128	151
Refrigerator	947	923	990	968	994
Lighting (Indoor)	41	41	43	37	53
Lighting (Outdoor)	128	115	154	140	185
Water Heater	1,146	1,069	1,187	1,424	1,507
Washing Machine	72	70	72	77	74
TV	239	253	215	223	203
Rice Cooker	357	366	312	361	385

Source: Author (2019).

Energy Performance of Commercial and Public Buildings

The building survey used building energy intensity (BEI) as the index (kWh/m^2/year) to assess the energy performance of commercial and public buildings (Figure ES 1). The 4–5-star hotels were the most energy intensive, consuming 371 kWh/m^2/year. Other energy-intensive buildings with BEI values above 300 kWh/m^2/year were hospitals (334), large mosques (323), and retail buildings (308). Buildings with BEIs of about 200 kWh/m^2/year were office buildings (average of 258) and medium-sized mosques (227). The 1–3-star hotels had a BEI of 177 kWh/m^2/year and small mosques and prayer rooms 169. Small mosques had a lower average BEI because they used much less air conditioning than other types of buildings. Because of the small sampling size, however, the explanation for the lower average BEI value of 1–3-star hotels is not conclusive.

Figure ES 1: Building Energy Intensity Survey Results



Source: Author (2019).

In general, the average BEI values derived from the Commercial Buildings – Brunei Darussalam Energy Consumption Survey were much higher than the target BEI values under the green building certification schemes in Malaysia and Singapore.[1] Savings opportunities exist since the BEIs of buildings in Brunei Darussalam were much higher than the more efficient ones in neighbouring countries, which have similar climatic conditions.

Policy Action Plans

The government's main challenge is how to exploit the savings potential identified in the residential and commercial and public sector building studies. Policy intervention measures to improve residential and building energy efficiency are proposed in Table ES 3.

[1] Singapore and Malaysia are the comparators since Brunei Darussalam has not yet implemented a national green building rating scheme.

Table ES 3: Energy Efficiency Improvement Action Plans

Time Horizon	Residential	Commercial and Public Building Sector
Short Term	• Technical guidelines for passive measures • Minimum energy performance standards • Information and awareness campaign	• Technical guidelines for passive measures • Minimum energy performance standards • Information and awareness campaign • Benchmarking study • Capacity building to increase the number of energy managers
Medium Term	• Standard and labelling system for appliances • Building energy intensity labelling for commercial and public buildings • Technical guidelines for active measures	• Technical guidelines for active measures • Expansion of the green building rating scheme • Setting up energy efficiency and conservation laws
Long Term	• Home energy management systems • Technology road mapping	• Building energy management systems • Technology road mapping

Source: Author (2019).

In the short term, the government could launch technical guidelines for passive measures and minimum energy performance standards (MEPS) for electrical appliances. Often, these schemes are accompanied with information and awareness campaigns. The measures could benefit both the residential and building sectors. The government could collect more information on buildings' energy consumption through a benchmarking study, and the scope of current training for building managers could be broadened to include the private sector.

In the medium term, the government could formulate the standard and labelling system for imported appliances, with an inspection laboratory and technical guidelines for active measures for households. Technical guidelines for active measures and the application of a green building rating system, including BEI labelling localised to Brunei Darussalam under EEC laws or regulations, are suggested for commercial and public buildings.

Energy management systems for buildings and residences could be promoted in the long term. The government could carry out a technology road-mapping study to identify the most innovative and advanced but cost-effective technologies for development and adoption.