Powering a Modern Life? Residents' Experiences of the Electricity Supply in Tanjung Pinang

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Abstract

Access to an affordable and reliable electricity supply is vital not only for economic development but also for citizens' quality of life. Indonesia has made significant progress towards near-universal electrification, but this achievement masks vast disparities in household access to electricity. Problems with affordability and reliability of supply are experienced even in Indonesia's major cities but are far worse in remote areas and on the country's many hundreds of inhabited small islands, which are not connected to a major grid. Drawing on Indonesian government data and a survey of householders (N = 360), this article measures variations in the quantity and quality of electricity supply in different areas in Tanjung Pinang, the capital of Riau Islands province (Kepri). As this article demonstrates, interruptions in supply have a serious impact on residents' capacity to power a modern life.

Akses terhadap listrik yang murah dan dapat diandalkan adalah sesuatu yang vital, tidak hanya bagi perkembangan ekonomi, namun juga bagi kualitas hidup para penduduk. Indonesia telah membuat kemajuan yang signifikan hingga mencapai tingkat elektrifikasi yang mendekati universal, namun pencapaian ini menutup ketimpangan akses rumah tangga terhadap kelistrikan. Permasalahan terkait keterjangkauan dan keterandalan penawaran listrik dialami bahkan di kota-kota besar di Indonesia, namun jauh lebih buruk di area-area terpencil dan di ratusan pulau kecil berpenghuni di seluruh Indonesia, yang tidak terkoneksi dengan jaringan listrik besar. Dengan menggunakan data pemerintah dari survey rumah tangga (jumlah sampel 360), tulisan ini mengukur variasi pada kuantitas dan kualitas penawaran listrik di berbagai daerah di Tanjung Pinang, ibukota dari provinsi Kepulauan Riau (Kepri). Seperti yang didemonstrasikan dalam tulisan ini, gangguan listrik memiliki dampak yang serius terhadap kapasitas warga untuk mulai menikmati kehidupan modern.

Keywords: electrification, national distribution network, small islands, interruptions in supply, consumer responses, electricity supply, affordable electricity

Introduction

Access to an affordable and reliable electricity supply is vital not only for economic development but also for citizens' quality of life. In 2010 the United Nations (UN) secretary-

general's Advisory Group on Energy and Climate Change (AGECC) called on member states to commit to achieving 'universal access to modern energy sources' by 2030 (AGECC 2017, 9). This goal was reinforced at the 2015 UN summit, where world leaders adopted 17 Sustainable Development Goals (SDGs) to achieve by 2030. Goal 7 of the 17 SDGs is to 'ensure access to affordable, reliable, sustainable, and modern energy for all'.

Indonesia has taken great strides in the past several decades with regards to access to electricity, with rates of electrification rising from 43% in 1995 to 88% in 2015 (ADB 2016, 5; Dirjen Ketenagalistrikan 2016, 26). The Indonesian government's target, as recorded in the medium-term development plan released in 2015, is to reach 96.6% electrification by 2019 (ADB 2016, 10).[1] Importantly, however, a household need only have access to electric lighting, regardless of whether or not it is connected to the grid, in order to be considered 'electrified' (11). In other words, the rapid rise in the electrification rate masks vast disparities in access to electricity, ranging from 'limited service restricted to evening lighting from a couple of direct current lamps all the way through to unlimited 24-hour alternating current supply' (5). Moreover, while a household might be connected to an off-grid supply—and therefore considered electrified—there is no guarantee that the system concerned is working, since there is a high failure rate of off-grid supply (11). Thus, while households may theoretically have access to electricity, in practice they might experience frequent interruptions to that supply or indeed have no supply at all.

A key element of this variation nationally is Indonesia's geography. As Pintz and Korn (2005, 56) observe, the country's multitude of scattered islands has a 'substantial impact' on electricity supply. This impact is especially felt by those living on small islands far from the metropolitan core, the majority of which continue to rely on off-grid supply using inefficient energy sources such as diesel. However, geography is not the only variable at play: even households in the same city or district on Indonesia's main islands can have very different experiences of electrification. For example, on the fringe of the provincial capital city Bengkulu, secondary schools have no access to electricity or, indeed, running water (field observations, May 2013).

Drawing on Indonesian government data and a survey of householders (N = 360), this article measures variations in the quantity and quality of the electricity supply in different areas of Tanjung Pinang, the capital of the archipelagic province of Kepulauan Riau (Kepri) which, by definition, consists of several small islands.[2] The article begins with an overview of Indonesia's electricity policy and the ongoing challenges of guaranteeing supply, before describing the field site, the survey instrument, and the demographic characteristics of respondents. It then analyses different patterns of access to electricity and householders' perceptions of the impact of supply interruptions. As this analysis demonstrates, patterns of access can differ markedly within a single city in ways that transcend socio-economic

[1] Note that electrification is a murky concept. Different measures of electrification are used even within government. The Indonesian Ministry of Energy and Mineral Resources (MEMR) includes customers connected to the PLN (state electricity company) grid but also non-grid PLN customers (e.g., those using individual photovoltaic systems managed by PLN), and those with electricity supply from non-PLN sources (e.g., households using solar mini grids provided under the non-PLN rural electrification program). In contrast, PLN statistics are based on PLN customers (i.e., those who receive electricity from grid or non-grid PLN-managed sources (ADB 2016, 11).

[2] This research was conducted as part of a project funded by the Australia-Indonesia Centre. My thanks to Anthony Vassallo and Rajab Khalilpour, who contributed to the survey design, and to our research assistant, Tu Tu, who travelled to Batam and Bintan with me in July 2015, where he conducted interviews with representatives of PLN in Tanjung Pinang and B'right PLN in Batam.

backgrounds and other demographic factors. And where supply is unreliable, it affects not only businesses and governments but also the capacity of residents to go about their daily lives.

The national context

Increases in rates of electrification in part reflect a dramatic growth in the production of electricity. They also reflect improvements to the distribution system and policies targeting improvements in regional and rural supply. Yet, despite these advances, Indonesia still struggles to meet its electricity needs, particularly in the face of increasing demand not only from industry but also from residential consumers. In terms of access, meanwhile, the government continues to subsidise the electricity supply in regional and remote areas, as well as tariffs for small businesses and community buildings such as mosques and schools; however, it has begun to reduce subsidies for individual residential consumers (Listrik 2017). Despite political sensitivities around reducing these subsidies, the government has discussed doing so even for residents accessing the lowest category of supply, of just 450 volt-amperes (VA) (Gumelar 2017).[3] This policy shift is reflected in the budget allocation for electricity subsidies, which has been gradually reduced over time, down to Rp 44.98 trillion ($3.39 billion) for 2017 (Aziz 2016).

Growth in production

In the decade after 1971, Indonesia's electricity production grew rapidly, at an average of 17% per annum, from what remained a very low base (Adam 2017, 32). Production continued to expand in subsequent decades, reaching 183,421 gigawatt-hours (GWh) by 2011 and 239,579 GWh in 2015 (BPS 2016). In that year, the Joko Widodo government introduced a program to generate an additional 35 gigawatts (GW) of power by 2019 (Sundaryani 2017). Indonesia's population increased significantly in those decades and increases in electricity production in per-capita terms have also been significant. In 1974 Indonesia produced just 25 kilowatt-hours (kWh) per capita, at that time much lower than even China and India, which produced 127 kWh and 130 kWh per capita, respectively (McCawley 1978, 35). By 2014, Indonesia's total electricity consumption per capita had reached 811.90 kWh (World Bank 2014). Most electricity produced now is used for non-residential purposes. In 2015 the total output distributed to Indonesian household was 88,682 GWh, or an average of 347 kWh per capita (Dirjen Ketenagalistrikan 2016).[4]

The bulk of this electricity is produced by the state electricity company, PLN. Previously a monopoly provider, PLN continues to play a dominant role in electricity provision in Indonesia. Independent power producers (IPPs) were permitted to enter the market from the mid-1990s. This resulted in 26 agreements between PLN and private investors facilitating private power generation. However, relationships between PLN and these investors were badly damaged by the Asian financial crisis (AFC) of 1997–98, when agreements were renegotiated or ended, attracting criticism from the investment community and giving rise to lengthy legal disputes (Pintz and Korn 2005; Wells 2007).

[3] 450 VA in capacity is equivalent to a flow of 450 watts (W). Householders on a 450 VA plan cannot impose demand that exceeds 450 W, which means that they cannot use even moderate-demand appliances, such as a microwave, and that they must alternate the use of relatively low-demand appliances; for example, a small iron and a small refrigerator.

[4] Calculated using population projections for 2015 from the BPS website.

Another attempt at privatisation was made in Law 20/2002 on Electricity, which replaced Law 15/1985 on Electricity (Pintz and Korn 2005, 61; Sambodo 2016).[5] The preamble of the 2002 law focused strongly on the need to create a conducive business environment in the electricity sector, characterised by competition, transparency, and equitable treatment of consumers (Republik Indonesia 1985). It sought to promote these objectives by dividing the sector into non-competitive and competitive areas. The latter opened the door to private enterprise in power generation and retail, the market determination of electricity tariffs, and the establishment of the Electricity Market Supervisory Agency (PWC 2016, 19). The law also attempted to decentralise control of the sector, outlining a series of responsibilities for local government in areas where open competition had been, or could not be, implemented. These responsibilities included the transparent and accountable allocation of electricity supply business licences, or *izin usaha penyediaan tenaga listrik* (IUPTL). In areas not connected to the national grid, this task was to be the responsibility of district heads, where businesses operated in a single district or city, and of governors, where businesses operated across districts. In cases where businesses operated across provincial lines, power was to be vested in the minister. However, Law 20/2002 was annulled in December 2004 by the nation's Constitutional Court on the basis that it contravened Article 33 of the Indonesian Constitution by allocating the private sector too much control over a strategic commodity (PWC 2016; Wells 2007; Sambodo 2016). As a result of this decision, the 1985 law was re-enacted.

There were several more attempts to involve the private sector in power supply after the annulment of Law 20/2002. In the following year, Government Regulation 3/2005 on Changes to Government Regulation 10/1989 concerning the Supply and Use of Electricity again made it possible for district heads, governors, and the minister to issue licences to private providers (PWC 2016).[6] Law 30/2009 on Electricity expanded the role of regional authorities in the determination of tariffs. However, district heads were stripped of this power by Government Regulation 23/2014 on Regional Government (a revision of Government Regulation 14/2012), which transferred it to the provincial level (ADB 2016). But while Law 30/2009 on Electricity ended PLN's legal monopoly of generation, transmission, and distribution (Tharakan 2015, 19), the company continues to control much of the country's electricity production. As of 2015, around 73% of installed capacity was controlled by PLN (Purwanto et al. 2015, 309). Over half of the investment funding needed for the period from 2015 to 2019 has been assigned to the private sector, yet uncertainties over fuel supply, tariffs, and land acquisition have meant that investment has not met expectations (Tharakan 2015, 19). Nevertheless, as PLN faces huge funding gaps, the private sector is expected to play a larger role in coming years—although it remains to be seen if this can be achieved.

The distribution network

Despite these moves towards partial privatisation of production, PLN continues to have a stranglehold on distribution (Tharakan 2015). Over the past few decades, PLN has expanded and improved its distribution network, with a substantial increase in substation capacity and the length of transmission lines from the late-1980s to the mid-1990s (JICA 2002, 4). Yet, while PLN's capacity increased, rapid growth in demand outstripped the company's ability to

[5] See Tharakan (2015) for an overview of regulatory developments since 1999 and ADB (2016, 13–17) for a detailed discussion of policies on access.

[6] A series of other regulations issued in 2005 and 2006 further advanced the framework for privatisation. For details, see PWC (2016).

improve supply (World Bank 1996, 3). This situation was exacerbated by the AFC, which greatly affected the development of distribution and the expansion of the system, a lag that continued into the 2000s (Sambodo 2016, 59–60). In the decade to 2011, peak demand grew at approximately 6% per annum, while the distribution network grew by less than half that rate (ADB 2011, 1).

PLN has eight large interconnected transmission systems, but the remainder of its capacity is provided by 600 isolated mini grids (Tharakan 2015, 14). As of late 2015, the total distribution network across Indonesia had reached 890,100 kilometres of transmission/distribution circuitry (Kementerian Energi dan Sumber Daya Mineral 2016b, v). Distribution is set to further expand under the Electricity Power Supply Business Plan (RUPTL) for 2015–24. As part of this plan, the World Bank is funding a distribution project in Sumatra to extend and upgrade existing distribution lines. This project aims to add 2.85 million customers between 2015 and 2019 (Maweni 2015). Similar expansion projects are underway on other islands (ADB 2016).

For the time being, however, distribution remains uneven. Java and Bali enjoy higher availability of electricity than the outer islands, but even within Java and Bali, Jakarta fares better than other areas (Adam 2017). Moreover, Tharakan (2015, 15) reports that the network has begun to deteriorate due to a lack of upkeep, and is 'overloaded and unreliable' in areas with high load densities, including in Jakarta, but also in Bandung and Surabaya. And while the Java-Bali grid experiences transmission bottlenecks and rolling blackouts, Indonesia's more remote islands experience a 'partial or even complete lack of electricity' (Schmidt, Blum, and Wakeling 2013, 582). Indeed, a 2016 report by the Indonesian Directorate General of Electricity concluded that electricity supply is adequate in 4 of the country's 23 larger power systems: Java-Bali, West Kalimantan, South Sulawesi, Poso-Tentena, and Kupang. It is 'on alert' in five of the Sumatran systems—including Tanjung Pinang and Batam—as well as East Kalimantan, East and West Nusa Tenggara, and major population centres in Papua. However, it is in deficit in Bengkulu, Lampung, South Sumatra, Palu, Kendari, Ternate, and Ambon (PWC 2016, 7–8). While these disparities may be understandable in terms of cost structures, they do not meet the Indonesian government's own targets with regard to access equity.

Policies on access

Policies on access have been an important element in Indonesia's quest to reach near-universal electrification. The Indonesian government provides subsidies to households in two ways: the first strategy has been to provide financial incentives to PLN to improve the availability of electricity in disadvantaged regions, although the resources allocated to this endeavour have been modest, particularly in comparison with the budget for subsidies to electricity tariffs (Sambodo 2016, 165–166). In 1976 the Indonesian government increased funding for electrification programs with the launch of the Rural Electrification Program (LisDes). In the first year of operation (1977–78) the program electrified 3,800 households in 76 villages (ADB 2016, 21). Between 1981 and 1994, the number of villages with access to electricity increased eightfold (World Bank 1996, 3). The program continues to operate and received Rp 2.6 trillion ($195.8 million) in 2015. And although the ADB views its role in achieving Indonesia's target of universal access as not 'decisive', it has been important in expanding distribution to rural areas, rather than simply connecting households in areas where the grid already exists (ADB 2016, 21).

A more recent measure associated with this first strategy of improving the availability of electricity in disadvantaged regions is the allocation of central funding to disadvantaged communities (including provisions for further rural electrification) through Law 30/2009 on Electricity (Tharakan 2015). An example of the realisation of this measure includes the allocation of Rp 73.9 billion ($5.6 million) for electricity infrastructure projects in 16 districts under Ministerial Decree 175/2013 on Determination of Social Assistance for Development of Special Areas in the 2014 Budget Year (ADB 2016). In another example, Presidential Regulation 47/2017 on the Provision of Energy-Efficient Solar Lighting to Communities with No Access to Electricity provided central government funding for lighting in areas without electricity. In that year, the Indonesian government allocated Rp 332.8 billion ($25.1 million) for the installation of 95,729 solar lamps in 6 provinces, with plans to expand the program to 15 provinces in 2018 (Sujatmiko 2017).

The Indonesian government's second strategy has been to provide subsidies directly to economically disadvantaged consumers. Tariffs are determined by residents' electricity supply. The higher the VA available, the higher the cost. As of late 2017, those residents on 450 VA plans paid a subsidised tariff of 415 Rp/ kWh ($0.03/kWh). The tariff for the highest category at that time was 1,467.28 Rp/kWh ($0.11/kWh) (Listrik 2017). Although the scope of direct consumer-subsidy programs has narrowed, they remained in place until 2016 for residential consumers with connections of less than 1,300 VA (ADB 2016). In 2017, however, the government began reducing the subsidy in stages for households using 900 VA connections if it considered they had the capacity to pay (Nadlir 2017). While some residents who use 900 VA connections are still subsidised, residents in categories above this (1,300; 2,200; 3,500; 5,500; and 6,600 VA and above) are no longer supported.

Electricity subsidies for residential consumers who cannot afford unsubsidised rates continue to be provided through a number of mechanisms administered by the National Team for the Acceleration of Poverty Reduction (TNP2K) (Kementerian Energi dan Sumber Daya Mineral 2017). In 2016, the TNP2K launched a program called Electricity for the Poor (Listrik Bagi Masyarakat Miskin), which uses a corporate social responsibility (CSR) model to increase electricity access. In its test stage, TNP2K worked with Lazismu (a *zakat* organisation, which distributes tithes collected from practising Muslims), with funding from several corporations and the local government, to provide solar panels for poor residents in seven villages in East Nusa Tenggara (TNP2K 2017). These solar panels provide a small but reliable supply, which is nevertheless insufficient for mechanisation. Meanwhile, many of Indonesia's more isolated communities remain reliant on diesel.

The field site

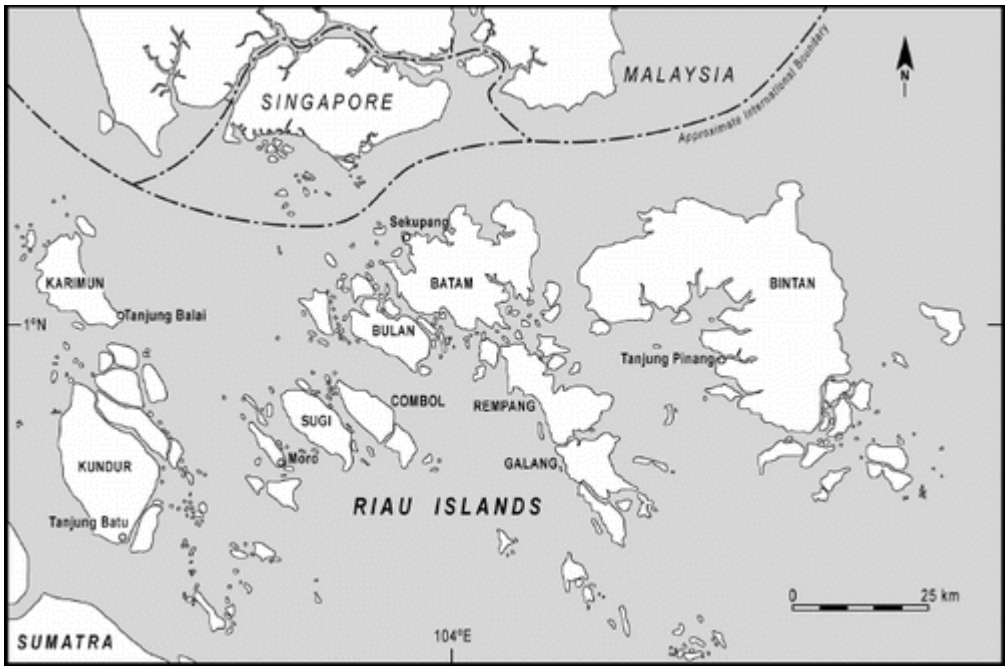
The field site for this study is Tanjung Pinang, the capital of Kepri, which became a separate province in 2002, having formerly been a relatively isolated part of the province of Riau, the capital of which is the city of Pekanbaru on the Sumatran mainland. This field site was selected because—although it is a relatively economically advanced area with a relatively developed electricity supply—it still experiences the challenges of many of Indonesia's other small islands, including isolation from a major grid.

Level of economic development

Located thousands of kilometres from Jakarta, on Indonesia's maritime border with Singapore and Malaysia, Kepri consists of the three main islands of Batam, Bintan, and

Karimun (see figure 1), as well as many other smaller islands and islets, including far-off Natuna, which lies closer to Kalimantan than other islands in the province.

FIGURE 1 Kepulauan Riau (excluding Natuna)



Kepri's location on a busy international border means that its main islands have been a focus for economic development in a way that many other smaller islands in Indonesia have not. In 1978 Batam was designated as a tax-free bonded zone. A development agreement was subsequently signed by Indonesia and Singapore in 1980, drawing domestic and foreign investors to the islands to develop Batamindo Industrial Park and its associated infrastructure (Ford and Lyons 2007). Batam, Bintan, and Karimun were subsequently incorporated into the Indonesia-Malaysia-Singapore Growth Triangle (IMS-GT) in 1989. The establishment of the IMS-GT saw the development on Batam of more industrial parks, tourist resorts, and administrative infrastructure under the stewardship of the Jakarta-controlled Batam Industrial Development Authority (BIDA). Almost one-third of Bintan was leased to Singaporean interests to establish a high-end resort zone, and a bonded factory zone was established in Lobam (Ford and Lyons 2006).

Economic development on the islands has contributed to a dramatic increase in population. In 1971 the population of Kepri was just 331,136 (Ford and Lyons 2007). By 2015 it reached almost two million, with 44.7% of people born elsewhere (see table 1). The focus of successive free trade initiatives, the island Batam has experienced a growth in population of close to two-hundredfold during this period. While neighbouring Bintan is a much longer established population centre, it too has experienced substantial population growth through internal migration. An important driver of population growth in the province was the AFC, which prompted migrants from other parts of Indonesia to flood into the border zone in search of work. This influx led to increases in the populations of Batam and Bintan of 79.5%

and 34.2%, respectively, in the three years after 1998.[7] As table 1 shows, migration rates to other parts of the province have been lower but nevertheless significant.

Table 1. Population of Kepri, 2015

City/district	Population	No. born outside Kepri	% Born outside Kepri
Batam	1,188,985	703,534	59.2
Tanjung Pinang	202,215	56,574	28.0
Bintan district	153,020	52,410	34.3
Karimun district	225,298	45,471	20.2
Other districts	203,525	23,046	11.3
Kepri	1,973,043	881,035	44.7

Source: Migration figures come from BPS Provinsi Kepulauan Riau (2016b). Population figures come from BPS Provinsi Kepulauan Riau (2016a).

Tanjung Pinang is located on Bintan Island, to the east of Batam Island. Batam is the economic powerhouse of the province, but Tanjung Pinang has a much longer history as an urban centre, first as an important pre-colonial and colonial seat of power, and briefly as the capital of Riau province in the late 1950s.[8] A mid-sized town with just over 200,000 people, Tanjung Pinang has an economy that relies heavily on construction. This accounted for almost 36% of regional GDP in 2015, in part reflecting its relatively new status as a provincial capital. Other major sources of regional GDP include retail, manufacturing, transportation, and storage, as well as government services. The regional GDP per capita in 2015 was Rp 80.56 million ($6067.64) (BPS Kota Tanjungpinang 2016).

The energy supply

Despite Kepri's relatively high level of development, it has experienced many of the same challenges as other archipelagic provinces and individual small islands, with regard to electricity supply, particularly in moving beyond small local sources of power generation. As of 2016, the electrification rate in the province was 76.37% (Kementerian Energi dan Sumber Daya Mineral 2016a, 29). However, supply is concentrated in population-dense centres. Thus, while coverage sits at over 98% in Batam (interview with B'right PLN representative, July 2015), most of Kepri's land area is yet to gain access to electricity (Head of the Kepri Regional Parliament, cited in *Jurnal Kepri*, 23 August 2017).

There are also significant differences in electricity supply, even on the province's main islands. Because of Batam's industrial zone status, special measures were taken to secure its electricity supply. In the early 1970s, electricity was first supplied by Pertamina, the state oil and gas company, using a diesel power plant. Following its designation as an industrial centre in 1978, Batam's energy capacity was expanded with the development of diesel plants in Sekupang and Batu Ampar. Management of the electricity supply was then handed over to PLN Batam Special Territory in 1993; PLN Batam was established as an independent

[7] These statistics were compiled by disaggregating the statistics for the former district of Insular Riau and recompiling them according to more recent local government boundaries.
[8] For an ethnographic account of Tanjung Pinang, see Long (2013).

subsidiary of PLN in 2000 and then rebranded as B'right PLN Batam in 2008 (B'right PLN Batam 2015, 86).

From 2004, PLN Batam began to move towards a mixed fuel strategy, with the construction of a gas-fired power plant (B'right PLN Batam 2015, 88). However, as recently as 2009, the province continued to rely heavily on diesel, which is a particularly expensive energy technology (see table 2). Diesel generation ceased in 2012 due to its high cost and low profit margin (Interview with B'right PLN representative, July 2015). Following the development of further infrastructure, the province now relies predominantly on natural gas and coal (B'right PLN Batam 2015, 183). However, the industrial parks continue to generate their own electricity. As of 2015, Batamindo, the main industrial park, was still 100% reliant on self-generated electricity—produced by 19 dual fuel-fired generators with a capacity of 130 megawatts (MW) (Gallant Venture 2017)—and many of the other industrial parks retain some self-generation capacity (Interview with PLN Batam representative, July 2015).

While Batam has been relatively well served in terms of electricity supply, the situation on neighbouring Bintan has been more tenuous. Gallant Venture, which owns the electricity infrastructure in Batamindo, has long provided electricity to Bintan Industrial Park and Bintan resorts to ensure 24-hour power supply (Gallant Venture 2013). However, until recently, most of the island's inhabitants relied on diesel generators. From 2006, supply in the island's two electricity systems, centred on Tanjung Pinang and Tanjung Uban, sat well below demand, meeting the Indonesian Directorate General of Electricity's (ESDM's) definition of a region facing an electricity crisis. This led PLN to announce plans to work with an independent power producer (IPP) to build a new generator in Galang Batang (Simangunsong 2009). Construction was delayed and the generator—managed by PT Capital Turbin Indonesia (PT CTI)—only began operating in Bintan in 2011, with an initial capacity of just 15 MW (*Antara Kepri*, 13 Nov. 2010). Despite plans to increase capacity to 30 MW, the Galang Batang generator experienced several breakdowns after it began operations (*Haluan Kepri*, 17 Mar. 2015).

These ongoing problems led the governor of Kepri to state in June 2015 that he was giving up on PT CTI and looking for other solutions to Bintan's electricity crisis, including constructing a new generator and increasing capacity of the generator at Tokojo Kijang (*Tribun Batam*, 26 June 2015). The Kijang generator, which operated on compressed gas transported from Batam to Bintan, was built in early 2014 and had an extremely modest capacity of 6 MW (*Batam Pos*, 11 Mar. 2014). Further capacity was added with the construction of a micro gas electricity generator on Dompak Island in 2015, with a maximum capacity of 9 MW (*Batam Pos*, 28 June 2016). Additional energy is supplied from diesel generators located at Suka Berenang and Air Raja (Wicaksono 2016).

The most important development, however, has been the construction of the so-called Batam-Bintan 'interconnection', which consists of an undersea cable, a 150 kilovolt (kV) high-voltage overhead transmission line (Saluran Udara Tingkat Tinggi, SUTT) between Tanjung Uban and Tanjung Pinang, and a 20 kV medium-voltage transmission line (Saluran Udara Tingkat Menengah, SUTM) between Tanjung Uban and Sri Bintan. Planning for the interconnection began in 2001, and development commenced 12 years later (Aminnudin 2016). The new system began operating in stages from late-2015, with the last power station connected in August 2016. The interconnection, which increased capacity on Bintan to 180 MW, provides relatively cheap electricity and should eventually replace rented diesel and gas generators, saving an estimated Rp 11.46 billion per month (Pemprov Kepri 2016). Supply should also be far more stable. A small number of outages occurred after

the Batam-Bintan interconnection was activated in late-2016, but Tanjung Pinang mayor Lis Darmnasyah declared in May 2017 that the city's long-standing problems with electricity had become a thing of the past (Movanita 2017).

Table 2. Capacity, generation, and distribution of electricity in Kepri

	2009	2010	2011*	2012	2013	2014	2015
Population	1,514,594	1,692,816	1,748,810	1,805,089	1,861,373	1,917,415	1,973,043
Residential customers (households)	274,050	289,509	319,387	331,836	347,892	360,038	368,115
Total installed capacity (MW)	216.64	350.03	362.97	371.43	381.21	736.48	736.80
Installed capacity (steam) (MW)	—	—	—	36.00	29.00	139.00	146.00
Installed capacity (gas) (MW)	—	181.00	83.50	83.50	83.50	184.51	178.43
Installed capacity (steam gas) (MW)	—	—	—	—	—	143.54	130.00
Installed capacity (diesel) (MW)	216.64	160.03	181.97	185.69	202.47	210.43	223.37
Installed capacity (gas machine) (MW)	—	—	—	66.24	171.86	64.89	59.00
Electricity generated (GWh)	1,001.95	1043.84	2,155.14	2,345.35	2,166.16	3,530.02	2,830.82
Electricity generated by diesel (GWh)	664.57	521.04	601.89	861.47	498.35	516.81	562.41
Electricity distributed (GWh)	1,693.76	1,877.20	2,010.30	2,190.04	2,421.92	2,618.03	2,694.79
Distance to residential cust. (GWh)	612.49	671.44	743.86	817.11	887.92	959.14	997.28

Source: BPS (2012, 2016).

* There are significant discrepancies in the figures for total installed capacity and installed gas capacity provided for 2011 in the two volumes. The figures provided by BPS (2012) have been used here.

At the time the survey was conducted, the initial additional energy sources had come online, but the system was not fully operational. As table 3 shows, the total installed capacity of the system at that time was over 100 MW but had a rated capacity of just 55.5 MW, whereas peak demand sat at 57.3 MW (Menteri Energi dan Sumber Daya Mineral 2016, 254).

Table 3. Capacity, generation and distribution in Tanjung Pinang, 2015

Factor	2015
Population	202,215
Residential customers (households)	57,289
Total installed capacity (KW)	115,357
Electricity generated (kWh)	356,167,074
Electricity distributed (kWh)	263,978,861
Electricity distributed to residential customers (kWh)[a]	113,510,910
Average per household (kWh/year)	1,981

Source: BPS Provinsi Kepulauan Riau (2016a); BPS Kota Tanjungpinang (2016).

[a] Calculated from percentage provided in BPS Kota Tanjungpinang (2016).

A final difference between residential electricity supply for residents of Tanjung Pinang and Batam is the price of supply. While PLN sells power to consumers in the rest of the country—with the exception of Tarakan Island—under a uniform national tariff, B'right PLN's separate status allows it to set its own tariffs (ADB 2016). In 2015, when the survey was conducted, the residential electricity tariff in Batam was 40% cheaper than the national tariff (interview with B'right PLN representative, July 2015). In contrast, residential consumers in Tanjung Pinang are required to pay the national rate.

Interruptions in supply

Blackouts have been a long-standing feature of life for the residents of Tanjung Pinang. Indeed, for a time, a joke among residents of one of the city's housing estates was that at least they knew that the electricity supply was an observant Muslim, since it stopped to pray as many as five times a day (field observations, September 2009). The situation reached crisis level in March 2014, whenlocal parliament held PLN to account for its promises to resolve the energy predicament (*Haluan Kepri*, 4 Mar. 2014). PLN's continued failure to deliver a consistent energy supply—rolling blackouts and a three-day outage occurred within weeks of the official opening of the new Kijang generator—prompted Tanjung Pinang's mayor to report PLN to the national Corruption Eradication Commission, citing her concerns that corruption underpinned its inability to fix ongoing problems with the electricity supply (*Haluan Kepri*, 23 June 2014). The problems persisted, prompting dozens of students to demonstrate outside the governor's office in November 2014, demanding that he solve the electricity crisis in Tanjung Pinang (*KepriSatu*, 7 Nov. 2014).

Difficulties continued in 2015, when one of the two main engines in the city's main power station failed, causing frequent blackouts for months (interview, July 2015). Dissatisfaction peaked in March 2015, when a demonstration was held outside the electricity office because of unscheduled rolling blackouts, with protestors threatening to occupy the office if the blackouts did not stop (*Batam News*, 16 March 2015). The demonstrators forced representatives of PLN to sign an agreement stating that they would limit blackouts to 1 (of up to 3 hours induration) per each 24 hours, reduce usage of lights in hotels and government offices, and delay the addition of any more commercial enterprises or residential areas to the network (*Haluan Kepri*, 17 March 2015). Under the agreement, PLN also vowed to increase capacity by 3 MW on 18 March 2015, and to add a further 18 MW in March-April of that year, after which time it was promised that there would be no more blackouts.

To keep the peace, Kepri's governor asked Tanjung Pinang residents to give PLN until 6 April 2015 to fix the problems (*Tribun News*, 18 Mar. 2015).Outages continued, however, and further protests were held on 22 April 2015 (Limahekin 2015b). These protests resulted in a second meeting between PLN management and protesters, this time in the presence of members of the armed forces, who were reportedly carrying AK-47s (*Tribun News Batam*, 23 Apr. 2015). At that meeting, a representative of PLN reported that 11 MW of capacity had been added since the agreement had been made (Limahekin 2015a). Further demonstrations were held during June 2015, wherein demonstrators complained blackouts were still occurring up to four times a day (Habibi 2015). By the time this article's survey was conducted, negative public sentiment had subsided, although continued blackouts remained a concern for the community, as the survey results show.

The survey

To gain an insight into the impact of Indonesia's erratic electricity supply on small island communities and consumer perceptions of its adequacy and reliability, a survey of 360 householders' use of electricity and experience of electricity supply was conducted in December 2015 and January 2016. The data collected were complemented by an extensive analysis of policy documents and media coverage relating to electricity use in the city.

The survey was conducted in three location types (central, urban fringe, and peri-urban) to analyse different levels of access to electricity within a single metropolitan area. It was administered face-to-face by student enumerators who had participated in a two-day training session on survey administration and research ethics before commencing the survey. They then met every evening to verify their data and to discuss their interactions with respondents. Working in teams of two, the enumerators interviewed 120 respondents in each of the three location types. The survey instrument included 88 items. Twelve of these items gathered basic demographic data, including family size, age profile, and income. Nine items gathered information about respondents' dwellings and appliances. The remainder focused on the availability and use of energy and water, experiences of blackouts, attitudes towards energy providers, and perceptions of renewable energy.

The sections of the survey that dealt with energy use guided respondents through a series of questions. Respondents were first asked how they paid for their electricity, and then how much they paid in the previous month. As electricity pricing was a concern in the city at the time of survey, many householders could immediately recall how much they had paid. They were nevertheless encouraged to refer to their payment notices to ensure accurate reporting. Additional questions regarding the electricity supply included questions about pricing, questions about awareness of usage, questions about adequacy of supply, questions about efforts to conserve electricity, and questions about willingness to pay more for electricity if it meant that there were no blackouts.[9] The first of these groups of questions focused on whether households received a subsidy; whether or not they knew the price of electricity per kWh and, if so, what it was; and whether they felt the price of electricity was reasonable. The second group of questions focused on whether they knew how much electricity they had used in a given month and, if so, how; how their electricity use was monitored by the provider; and whether they ever checked the meter. The third included questions about the amount of electricity available; whether it was sufficient to meet their household needs; and whether respondents considered the electricity usage requirements of appliances before purchasing them or could not purchase appliances they wanted because they used too much electricity.

[9] A separate part of the survey focused on renewable energy, but that part is not reported in this article.

The fourth included questions about the measures respondents had taken to reduce electricity consumption, if any, and what other fuel sources they had used. The final group of questions focused on respondents' willingness to pay more for electricity if supply was guaranteed.

A similar approach was taken with the series of questions about residents' experience of blackouts—which, in a context where blackouts are frequent—are a controversial and emotive issue, and therefore the data collected on this issue is less reliable than data collected in other parts of the survey. Variance in the reported frequency and length of blackouts can reflect substantial differences in access to supply in and across geographic areas. It may also reflect differences in perceptions, because of different levels of reliance on electricity or different levels of tolerance of supply interruptions. To minimise exaggeration, respondents were asked how many blackouts they had experienced in the week leading up to the survey. As the survey was conducted in all three location types on two occasions, data from two different weeks was collected. Additional questions included how long each of those blackouts had lasted; whether the blackouts had affected residents' daily lives; and whether they had had access to a backup supply (for example, a diesel generator). Those with access to a backup energy supply were also asked how well that backup supply had served their needs; how much it had cost them to run; and whether they had been satisfied overall with the arrangement. This data was then supplemented by analysis of government documents and media coverage of blackouts in the years leading up to survey implementation.

A final open question—on whether respondents had any other comments about the electricity supply or their use of it—was asked at the end of the survey, following 17 questions about different topics, including respondents' willingness to pay more for renewable energy, in order to minimise over-reporting on blackouts or other issues raised earlier in the survey.

Demographic data

The 360 households surveyed in December 2015 and January 2016 contained an average of just over four people. This corresponds with the average number of people in the different sub-districts of Tanjung Pinang, with the exception of the city centre, where households contain an average of five people (BPS Kota Tanjungpinang 2016). Although the number of people per household varied considerably in all three location types, the average number in each was close to the city average of four. The most populous households contained up to 11 people in urban areas, 9 people on the urban fringes, and 7 people in peri-urban areas. The median household size in all three location types was precisely four.

Like household size, the socio-economic profile of all three location types was mixed. Of the 360 respondents, 32% had household incomes of less than Rp 1.8 million ($136) per month, which is considerably below the city's monthly minimum wage for an individual working full-time, which in 2015 was set at Rp 1,955,000 ($147). As figure 2 shows, all areas had a relatively equal distribution of low-income earners. Middle income households (Rp 2.8–Rp 4.8 million, or $211–$362) were clustered in the city and on the urban fringe, while higher income earners lived either in the city centre or in peri-urban areas.

Housing types varied with socio-economic status, though the spread of housing types differed significantly between the three areas. For example, detached dwellings, including stilt houses built over the water, accounting for 95% of peri-urban dwellings but only 49% of urban dwellings. Dwellings tended to be smaller in housing estates on the urban fringe, with three-bedroom homes dominant in the urban area, and more four-or-more-bedroom homes in the peri-urban area (see figure 3).

FIGURE 2 Monthly household incomes (Rp million)

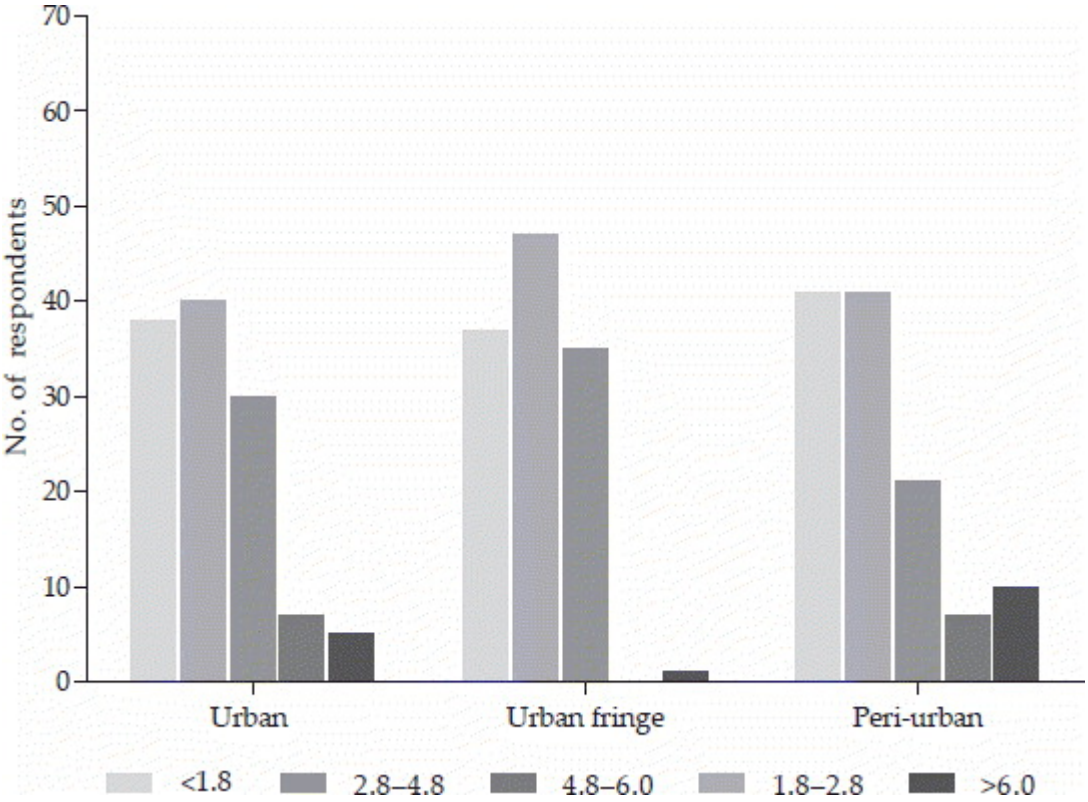
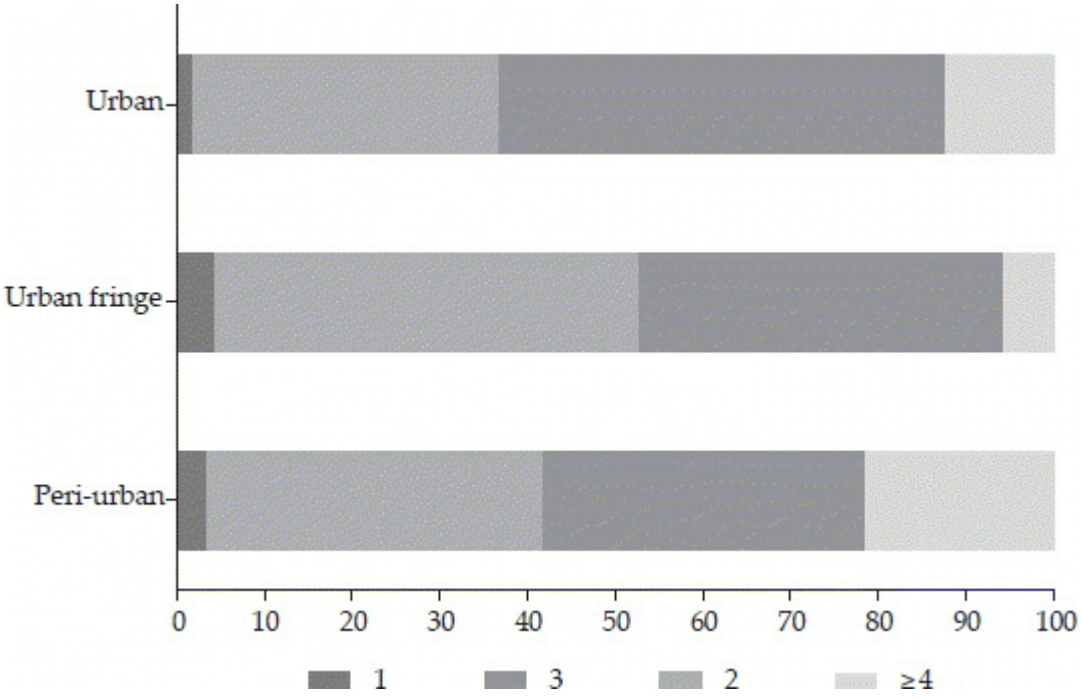


FIGURE 3 Number of bedrooms per dwelling (%)



Finally, as Wijaya and Tezuka (2013, 596) note, it is important to understand the characteristics of household electricity consumption and its driving factors, rather than simply looking at supply. The survey included an audit of the number of different household

appliances in the dwelling (see table 4), and questions about residents' use of hot water and air conditioning.

Table 4. Ownership of domestic appliances

	Urban			Urban fringe			Peri-urban		
Appliance	0	1	>1	0	1	>1	0	1	>1
Water pump	22.5	77.5	0.0	20.0	80.0	0.0	20.8	79.2	0.0
Washing machine	16.7	82.5	0.8	26.7	72.5	0.8	25.8	74.2	0.0
Refrigerator	10.8	84.2	5.0	16.7	80.0	3.3	23.3	72.5	4.2
Hot water dispenser	52.5	47.5	0.0	63.3	35.0	1.7	68.3	29.2	2.5
Microwave	90.0	8.3	1.7	94.2	5.8	1.7	93.3	5.8	1.7
Electric fan	2.5	19.2	78.3	5.8	30.8	63.3	2.5	35.0	62.5
Air conditioner	69.2	25.0	5.8	91.7	8.3	0.0	75.0	9.2	15.8
Television	1.7	59.2	39.2	1.7	77.5	20.8	0.0	71.7	28.3
Entertainment system	68.3	30.0	1.7	78.3	21.7	0.0	65.8	30.8	3.3
Desktop computer	88.3	10.0	1.7	94.2	5.0	1.7	90.8	7.5	1.7
Laptop computer	37.5	52.5	10.0	58.3	32.5	9.2	62.5	25.8	11.7

As table 4 reveals, most households owned at least one washing machine, refrigerator, and television. Urban and peri-urban dwellers were far more likely to have one or more air conditioning units than those living on the urban fringe, while urban dwellers were far more likely to have one or more computers (predominantly laptops) than those living in urban fringe or peri-urban areas. Importantly, most households in all three zones relied at least in part on a water pump—which requires electricity—for their water supply.

Residents' experiences of the electricity supply

As can be seen from this data, Tanjung Pinang residents expect to be able to use a range of modern appliances in their everyday lives. This is not an unreasonable expectation given the level of economic development on Kepri's main islands, and the town's status as the provincial capital. Yet, while residents' access to electricity is reasonably good, and appears to meet their expectations, they are concerned about the cost of electricity and the stability of supply.

Access to electricity

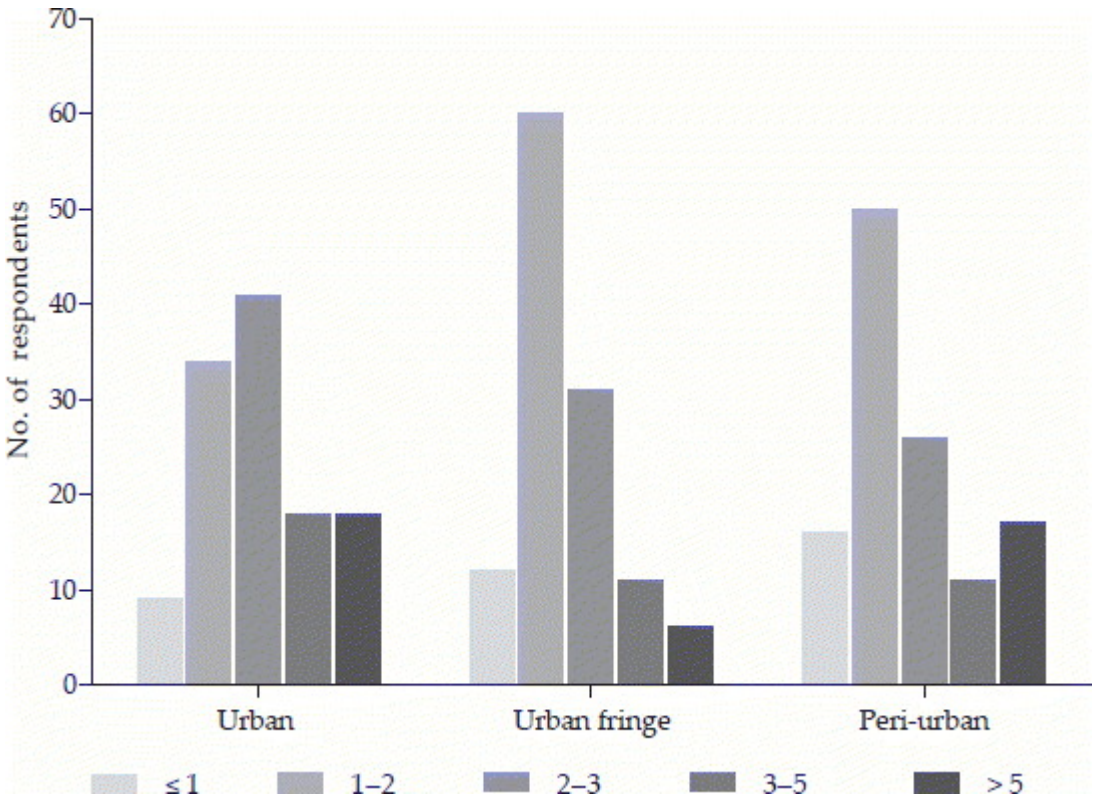
Compared with many small island communities, Tanjung Pinang has good access to electricity. As noted in table 3, households consume an average of 1,981 kWh per annum—the equivalent of 495 kWh per person. Reflecting the increasing use of modern appliances, most households have progressed in recent years to larger electricity plans. Indeed, among the households surveyed, only two were still on 450 VA plans. A total of 28% were on 900 VA plans and 60.3% were on 1,300 VA plans. The remainder had connections of 2,200 VA, and in one case a connection of significantly more. The use of 900 VA and 1,300 VA plans was spread reasonably evenly over the three location types, though peri-urban respondents were slightly more likely to be using a 900 VA plan than a 1,300 VA plan. The relatively

small number of residential consumers with 2,200 VA plans were considerably more likely to be living in peri-urban areas than elsewhere. Notably, just nine of the 360 households surveyed were not sure what plan they had.

Respondents were reasonably satisfied with the sizes of their plans, with close to 97% of them stating that they had access to enough electricity to meet their needs. They were nevertheless very concerned about their use of electricity. Nearly 84% felt concerned when they purchased electrical appliances and 98% claimed that they purposefully moderated their behaviour to reduce electricity consumption. These figures appear to reflect the cost to the consumer—close to half of respondents felt that the price of electricity was unreasonably high—rather than the amount of supply, although it is likely that poorer households have different expectations regarding the number of electrical appliances necessary to run a household. Just 13% of respondents had access to subsidised electricity, with slightly fewer households located in urban areas than in the urban fringe or peri-urban areas.

As figure 4 shows, many respondents were paying less than Rp 200,000 ($15) per month for electricity. In percentage terms, the average monthly expenditure on electricity was particularly significant relative to the average monthly income of the 32% of poorer respondents, whose total monthly income was less than Rp 1.8 million ($136) per month. At the upper end of the scale, a significant proportion of respondents paid more than Rp 500,000 ($38) per month, with 13 respondents paying over Rp 1 million ($75)—some significantly so—each month for their electricity. When asked whether the price of electricity was reasonable, 44% reported that they found it expensive. When asked whether the rising cost of the electricity supply was a concern, 95% of respondents agreed or strongly agreed.

FIGURE 4 Monthly electricity bill (Rp 100,000)

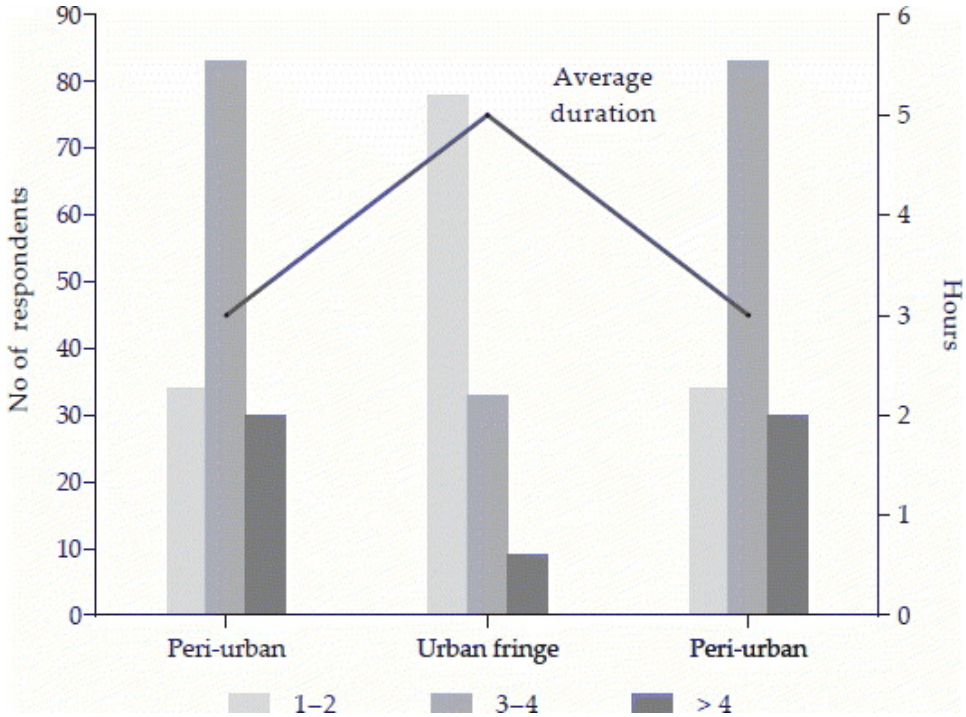


But while cost was an issue for residential consumers in Tanjung Pinang, it paled into insignificance in comparison with respondents' concerns about interruptions in supply. As shown in the discussion below, blackouts were not only a common feature of life in Tanjung Pinang at the time of the survey, but also one that caused massive disruptions within the life of the community.

Reliability of supply

While most respondents felt that they had adequate access to electricity, they had significant concerns about the reliability of that supply. All but one respondent reported having experienced one or more blackouts in the week before the survey was conducted (see figure 5). And while the majority experienced between one and four blackouts per week, a significant minority reported more than four in an average week. The average length of blackouts was 3.3 hours. However, over 10% of respondents reported an average blackout duration of eight or more hours, with four respondents on the urban fringe and one in a peri-urban area reporting that they had access to only one hour of electricity per day on at least two days per week. As noted earlier, variance in the reported frequency and length of blackouts may reflect different levels of tolerance with interruptions in supply. When asked about their attitudes towards the blackouts, only 18 respondents—all but two of whom lived in the city centre—said that they were not frustrated by them, a statistic that is particularly notable since the Indonesian word *frustrasi* has far stronger connotations than the English word 'frustration'. A further 28% professed to be neutral (including some reporting long and frequent blackouts). However, a staggering 76% of the 240 householders surveyed in urban fringe and peri-urban locations were either somewhat or very frustrated with the blackouts. These findings were supported by enumerators' reports about their interactions with respondents and by respondents' comments to the survey's voluntary, final open question, in which just under 75% of the 79 respondents referred to blackouts. In short, it was clear that interruptions to supply were a serious cause for concern at the time of the survey.

FIGURE 5 Reported duration and frequency of blackouts per week (week before the survey)



Lengthy blackouts were a particular source of stress in households—the overwhelming majority—that rely on an electric pump for their water supply, especially as only 23 of the 360 households surveyed had access to a backup power supply. In all of these households, backup power was produced by a diesel generator; none of the households reported having solar panels. In all but two of these cases, household incomes were greater than Rp 1.8 million ($136) per month. However, not all generator owners were wealthy: 11 of the 23 generator-owning households had incomes below Rp 3.3 million ($249) per month. All but five reported being neutral or satisfied with the performance of their generators, and only seven reported that the price of generator fuel was unreasonable.

Finally, regarding the question of equity in access to supply within urban regions, it is clear that—despite the relatively compact footprint of this relatively prosperous regional centre—there were significant disparities between the three locations. Even allowing for over-reporting, blackouts had been much more frequent in peri-urban areas but had lasted the longest in the urban fringe areas. While the average number of blackouts per week was relatively stable, residents in peri-urban locations were much more likely to experience more blackouts than residents in the city centre or the urban fringe. In terms of length, however, the average duration of blackouts—five hours per blackout in the urban fringe areas— was far higher than the average duration of blackouts in the other two zones.

Conclusion

A vast and sprawling collection of islands, large and small, Indonesia faces particular challenges in the management of infrastructure, including electricity (Cribb and Ford 2009). Over the decades, successive governments have made significant progress in increasing the availability of electricity to residential consumers in the face of rising demand. Yet, despite this apparently high rate of electrification, many households continue to have poor or no access to electricity. The situation is, of course, worst in the most remote parts of Indonesia's least-developed provinces. But as this article has demonstrated, residential consumers' access to an adequate, affordable, and stable electricity supply cannot be guaranteed even in mid-sized cities in the archipelago's more developed regions.

As the survey data revealed, residents of Tanjung Pinang believed that they had adequate access to electricity, but almost all felt that their lives had been disrupted by frequent interruptions in supply. These interruptions, they said, affected their capacity to light and cool their houses, to get adequate sleep, to prepare meals, to use modern technology in the household, and to be economically productive. As one respondent commented in their response to the survey's final open-ended question: 'There just shouldn't be so many blackouts. It's hard on the kids, it ruins our appliances, and it interrupts our work.'

The survey also confirmed that residential consumers' experiences of the electricity supply can differ significantly within a single city in ways that transcend socio-economic backgrounds. The socio-economic profiles of urban, urban fringe, and peri-urban areas of the city are relatively similar, except that the wealthiest residents tend not to live on the urban fringe. Yet, while there was relatively little variation in the proportion of residential consumers on different-sized plans in urban, urban fringe, and peri-urban areas, there were significant differences in the amounts paid by households each month, suggesting differences in behaviour regarding electricity use. Similarly, there were considerable differences in consumers' experiences of interruptions in supply. Blackouts occurred in all three areas in the

week before the survey. They were most frequent in peri-urban areas, and they lasted the longest on the urban fringe.

It must be noted that Tanjung Pinang is in many ways the exception rather than the norm when it comes to cities on Indonesia's smaller islands. Its location in a cluster of islands long targeted for special measures to promote economic development, and its status as provincial capital, means that greater attention has been paid to its electricity infrastructure than would normally be the case for a city of its size. Moreover, the completion of the Batam-Bintan interconnection in late 2016, after the survey was conducted, may have substantially resolved problems with the city's electricity supply, at least temporarily. However, despite the particular characteristics of the field site, the survey findings remain highly salient to populations on other smaller islands, where the supply of electricity continues to be unsatisfactory, not only in terms of the quantity of availability but also in terms of reliability. These problems with supply have serious consequences, both for the economic development of these areas, and for the capacity of residents to adopt the modern lifestyle to which they are encouraged to aspire.

Given the high cost of production on small islands, there are very real challenges in finding financially viable and equitable ways to improve supply. Regulators have attempted to address these challenges through measures to promote decentralisation and privatisation, but to date these measures have fallen short. Given the importance of a reliable electricity supply to community well-being in the twenty-first century, further policy innovation is required if there is to be any chance of levelling the playing field in terms of economic and social opportunity for Indonesians living outside the metropolitan core.

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