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Evaluating Thailand's Free Basic Electricity Program

by

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June 2018

Discussion Paper

No. 87

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7 June 2018

Abstract

This study evaluates the performance of Thailand's Free Basic Electricity (FBE) program along three dimensions: targeting effectiveness, benefit adequacy, and subsidy burden distribution. While the FBE benefits reaches the targeted population (low-income families) quite well, the benefit leakage to the non-targeted population could result in a significant increase in the overall subsidy cost. Furthermore, the current 50-unit free quota given by the FBE program is insufficient for the basic need of many low-income families. Lastly, the FBE subsidy burden falls exclusively on the industrial/commercial customers, but the cost increase has been rather small. Therefore, Thailand's FBE program can be markedly improved by introducing a more effective targeting approach to reduce leakage, which will allow the government to raise the free electricity quota while maintaining the same overall subsidy cost.

This research project was supported by the Thailand Research Fund (TRF)

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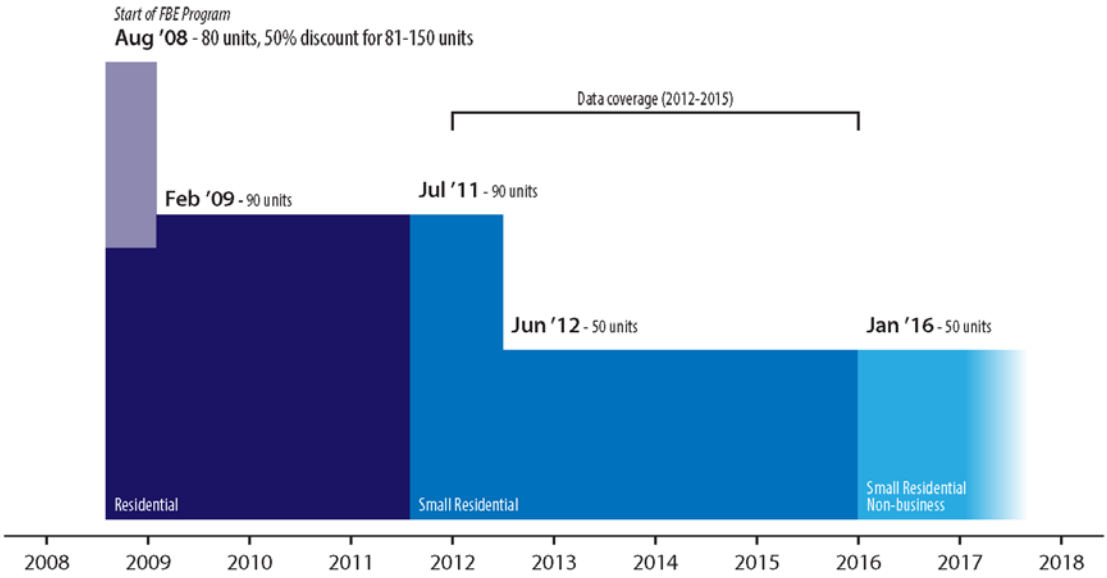
1. Introduction

Thailand's Free Basic Electricity (FBE) program, which began in 2009, is aimed at subsidizing the cost of electricity consumed by low-income households. During the first phase of the program, households that used no more than 90 units of electricity per month were exempted from paying that month's bill. Starting in June 2012, the government modified the exemption so that it applied only to households that owned smaller meters (5(15)A) and used no more than 50 units of electricity per month. From 2016 onward, the government tightened the eligibility rule further so that the exemption applies only to households with small meters that use no more than 50 units per month during the previous three months.

The program is funded by a cross subsidy from all electricity users, excluding residential customers, small general businesses, and those using agricultural hydro pumps. The cross-subsidy contribution decreased over time from 0.12 baht in July 2011 to 0.0265 baht in June 2012 and 0.0258 baht in January 2016. Figure 1 summarizes the evolution of the program.

Figure 1: Timeline of the Free Basic Electricity program in Thailand



Source: Apaitan, Tosborvorn, and Wibulpolprasert (2018).

Thailand's FBE program is one of many forms of utility subsidies used around the world. Apart from a direct cash transfer, other subsidy mechanisms include tax exemptions and rebates, price controls, trade restrictions and limits on market access (European Environment Agency 2005). The country with a utility subsidy most similar to that of Thailand is South Africa. Under its Free Electricity Policy, all qualifying households that applied for tariff relief through their service providers are awarded with 50kWh of electricity per month free of charge (Republic of South Africa Department of Minerals and Energy 2003).[4]

Studies that evaluated South Africa's approach to providing free electricity include that by Mapako and Prasad (2005), which analyzed survey data from regions with the highest poverty level in South Africa and discussed the following issues related to the implementation of that country's program. First, the program was designed for households that are connected to the electricity grid, thus neglecting the poor who have no access to the grid. Second, identifying and targeting poor households is challenging and leads to benefit leakage. Third, the supply of 50 kWh of electricity is not adequate to meet the major energy needs (cooking) and not sufficient for them to carry out income-generation activities. However, the program does enable a reduction in the usage of other fuels, such as candles, as the recipients switch to using more electricity. Although their study brought up important concerns regarding subsidy targeting, subsidy adequacy, and the change in household energy use, the analyses provided were crude and covered only a subset of households in one of the poorest regions of the country.

[4] One major difference in the South African program is that, if a consumer exceeds the 50-unit free quota, payment is due only for the incremental units exceeding the first 50 units. On the other hand, Thailand's FBE program requires that anyone who exceeds the 50-unit free quota must pay for all of the first 50 units of consumption plus the excess (FLASH 2018; Powertime 2015).

Davis, Hughes, and Louw (2008) studied the impacts of South Africa's free basic electricity policy on the energy choices of low-income households in two rural villages in South Africa. They found that electricity consumption in one village increased by approximately 22kWh per month after the policy was implemented. Importantly, the increase in consumption was associated with an increase in the ownership of electric stoves. However, the usefulness of their study was limited by the small sample size (about 80 samples in total), making the regression results not robust.

Another strand of studies focuses on evaluating the effectiveness of the targeting approach and the leakages of other utility subsidies. For example, Foster, Gomez-Lobo, and Halpern (2000) demonstrated through simulations that using combinations of demographic variables as eligibility criteria could help increase targeting accuracy and prevent leakages. Importantly, the authors described good eligibility criteria as the ones that: are highly correlated with underlying poverty; can be readily observed/measured; and are difficult to falsify. Examples of such variables are the quality of floor materials, lack of telephone connection, level of education of the household head and location of toilet facilities.

In Thailand, the only published study on the FBE program is that by Yawan (2013). The author interviewed participants in one Northern province about their electricity consumption before and after the introduction of the FBE program, as well as their satisfaction with the program. The interviewees reported that they had tried to reduce their consumption in order to receive free electricity. In addition, the interviewees reported that the 50-unit free quota was too low a threshold and that they were only moderately satisfied with the program. Although the interview responses shed light on the consumption responses for participants, the study covered only a small area and did not consider other aspects of the policy, such as targeting effectiveness or subsidy burden.

Another related study was commissioned by Thailand's Energy Policy and Planning Office in 2016. The study surveyed 1,000 representative households which used less than 100 units of electricity per month in Thailand. The respondents were asked about their ownership of electrical appliances and their usage of such appliances (in hours per day). The study found that the minimum, subsistent demand for electricity to be about 60 units per month for an average size family of 2.56 persons. The survey results suggested that the current 50-unit free quota may be too low to provide many of the poor households in Thailand with subsistence support (Energy Policy and Planning Office 2016).

To summarize, most existing studies on utility subsidies are narrowly focused on either the change in consumer behavior or the subsidy's performance in terms of targeting accuracy and leakages. Moreover, most of the studies utilized survey data from subgroups of a population that cannot be generalized for an entire country.

The present study is aimed at filling such gaps by providing a comprehensive review of the impacts of Thailand's FBE program using data from the majority of residential electricity consumers in Thailand. Specifically, we evaluate the performance of Thailand's FBE program along three dimensions: (a) the **targeting effectiveness** accessibility of the benefit and leakage); (b) **benefit adequacy**; and (c) the distribution of the **subsidy burden**. To our knowledge, this is the first study that uses large-scale administrative data to answer questions about a comprehensive set of policy issues.

2. Data and methodology

2.1 Data

Data used in this study were provided by the Metropolitan Electricity Authority (MEA), Provincial Electricity Authority (PEA), Energy Policy and Planning Office (EPPO), and National Statistical Office (NSO) of Thailand.

The main data sets were supplied by MEA and PEA, which are the retail electric utilities in the Bangkok metropolitan area and provincial areas, respectively. The PEA service area accounts for the majority (approximately 70 percent) of total electricity consumption in Thailand.

Owing to a data restriction, we were able to obtain the anonymized electricity billing data only from PEA. Thus, in some of the analyses below, only results for the PEA service area are presented. Additionally, since the PEA billing data did not include demographic information or income of individual households, the billing data were supplemented with data from Thailand's Socio-Economic Survey (SES) and the poverty map census of NSO.

Lastly, data on aggregate electricity consumption for customers in each industry were obtained from the EPPO, Ministry of Energy.

2.2 Evaluation methodology

This section contains definitions of a set of indicators that measure the impact of the FBE program according to the three dimensions described above.

2.2.1 Targeting effectiveness

More broadly, targeting effectiveness of a subsidy can be represented using two measures: the error of exclusion and the error of inclusion (Foster, Gomez-Lobo, and Halpern 2000; Komives et al. 2005). The **error of exclusion (benefit accessibility)** refers to a situation when the targeted population (the poor) does not receive the subsidy. On the other hand, the **error of inclusion (benefit leakage)** refers to a situation when a non-targeted population receives the subsidy.

A subsidy program with a high error of exclusion indicates failure of the program itself. A subsidy program with a high error of inclusion, albeit does not fail, would not be cost-effective because the subsidy leakage would increase the overall cost of the subsidy. An effective subsidy program would minimize both types of errors.

Error of exclusion (benefit accessibility)

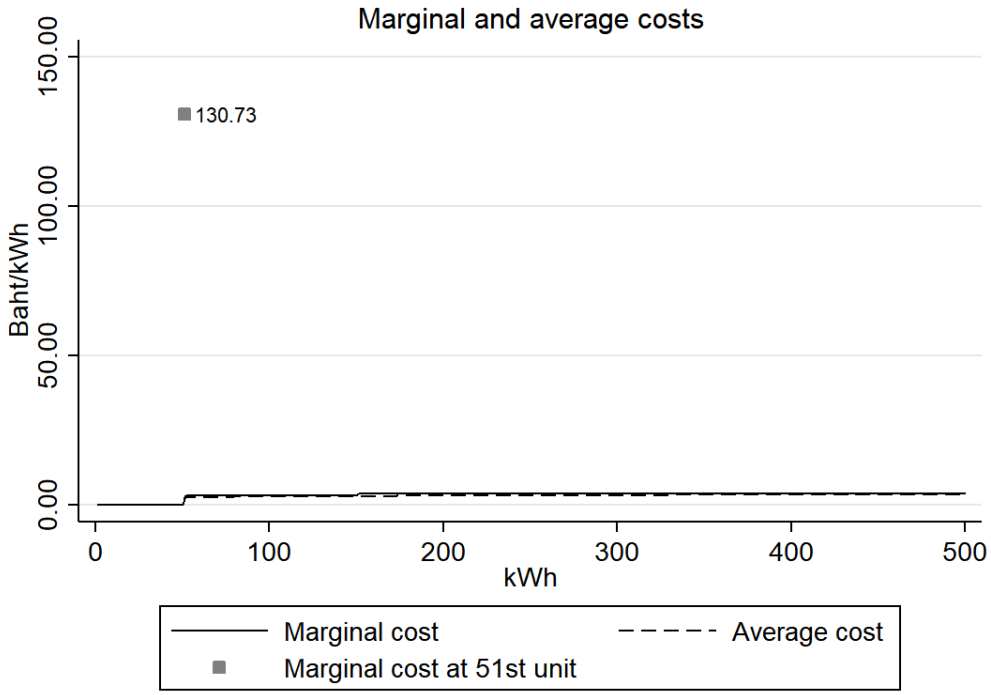
The indicator for the error of exclusion (i.e. accessibility) in the present study is the number of low-income households that do not have access to the FBE program. These households can be further categorized into two groups: (a) low-income households that have no access to electricity; and (b) low-income households that have access to electricity, but do not pay for use of the electricity directly to an electricity utility. An example of the second group would be low-income families that live in rental or temporary housing. Some of these families pay electricity bill to the landlord at a rate that the landlord determined, thus would therefore never be eligible for the FBE subsidy.

Error of inclusion (benefit leakage)

The indicator of the error of inclusion (leakage) comprises two measures. The **first measure of leakage** is the number of meters/homes that are "second homes" of some wealthier consumers. We identify these "suspected second homes" as the meters that do not consume under 50 units per month consistently for three consecutive months.

The **second measure of leakage** is the number of consumers who manipulate their consumption in order to receive the FBE subsidy. The design of the FBE program is such that, if a household exceeds its 50-unit (or 90-unit) free quota, it has to pay for all the electricity used starting from the first unit of electricity consumed. In other words, prior to June 2012, consumers who used 91 units of electricity would have to pay about 253 baht per month, whereas for those who consumed 90 units or less, there was no charge. Similarly, from June 2012, consumers who used 51 units of electricity would have to pay about 128 baht per month, whereas for those who consumed 50 units or less, there was no charge. Figure 2 depicts the discontinuity in the marginal price of electricity that incentivizes consumers to "bunch" their consumption at the threshold point of 90 units or 50 units.

Figure 2: Extreme marginal price increase at 51st unit of electricity use



Lastly, to give a broad picture of targeting effectiveness, we compare the fraction of low-income households to the fraction of households that received the free electricity benefit in each province. It should be noted that, due to data limitations, it is not possible to identify the income level of the households in the electricity billing data. In other words, it is not known if a household that received free electricity also had a low income. However, at the very least, this last province-level comparison could shed light on whether there might be a leakage or accessibility problem at the aggregate level.

2.2.2 Subsidy adequacy

We evaluate the adequacy of the 50-unit free quota using two approaches. First, we compare the cost savings from receiving 50 units of free electricity (equivalent to 128 baht/month) and the average low-income household's monthly expenditure. Second, we analyze the distribution of household sizes among the low-income families and compare it to the sample of electricity consumers surveyed by the Energy Policy and Planning Office (2016). The

comparison allows us to bound the percentage of low-income households whose minimum electricity need would exceed the 50-unit free quota.

2.2.3 Distribution of subsidy burden

We calculate the distribution of the FBE subsidy burden by multiplying the cross-subsidy contribution rate with the amount of electricity consumed by each group of subsidizing customers. Specifically, the subsidizing customers include all electricity users, except for residential customers, small general businesses, and those using agricultural hydro pumps.

Table 1 summarizes the definitions and the indicators for the evaluation.

Table 1: Definitions and indicators for the evaluation

Policy dimension	Definition	Indicators	Service Area
1. Targeting effectiveness			
Accessibility	Whether the targeted population received the free electricity benefit	- Fraction of low-income households in Thailand that do not have access to electricity (SES data) - Fraction of low-income households in Thailand that have access to electricity, and live in a rental or temporary residence (SES data) - Regional correlation between the fraction of low-income households (SES data) and the fraction of households that receive the free electricity benefit[a] (Electricity billing data)	-Whole country -Whole country -PEA areas
Leakage 1 ("Second home")	Whether the non-target population also received the free electricity benefit	- Number of meters that do not consume under 50 units consistently for three consecutive months, i.e. the "suspected second home" (Electricity billing data)	-PEA areas
Leakage 2 ("Consumption distortion")	Whether the targeting approach leads to distorted consumption behavior	- Number of meters that reduce consumption to below 50 units in order to become eligible of the FBE program (electricity billing data)	-PEA areas
2. Adequacy			
Benefit adequacy and fairness	Whether the 50 units of electricity is adequate for the basic needs of low-income households	- The fraction of average monthly expenditure that is accounted for under the FBE benefit - A benchmark survey on the level of the basic electricity need - The distribution of the household size among low-income families (SES data)	-Whole country -Whole country -Whole country
3. Subsidy burden distribution			
	How the subsidy is distributed across consumers	- The proportion of the FBE subsidy paid by different types of consumer across various industries	-Whole country

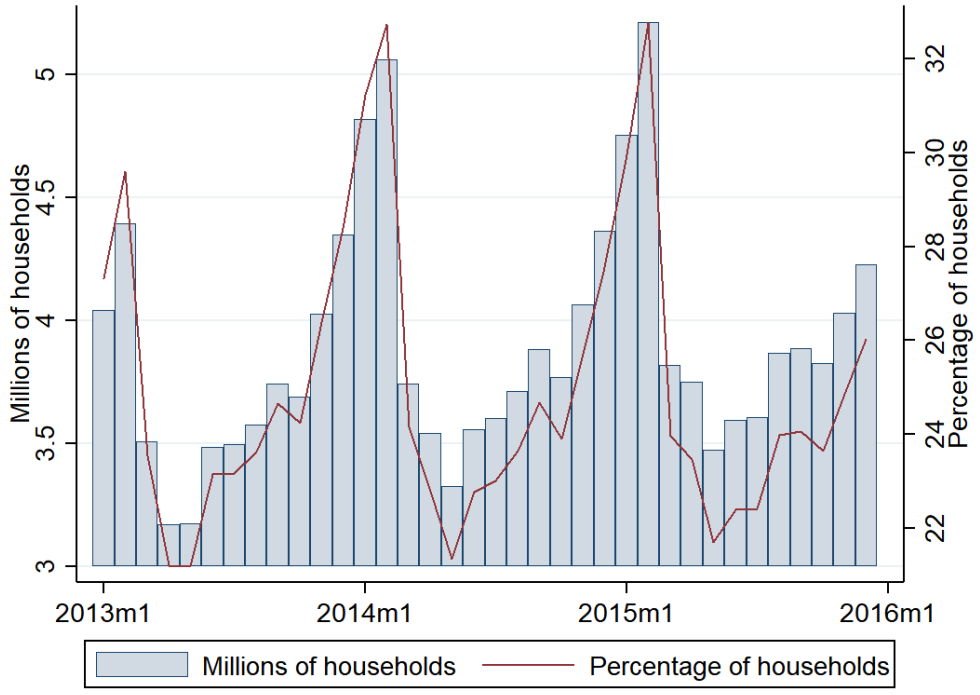
[a] Due to data limitations, the authors were unable to identify the income status of the households in the electricity billing data. Therefore, it is not known if a household that received free electricity was also a low-income household. Thus, the comparison could be done only at the provincial level.

3. Evaluation Results

3.1 Targeting effectiveness

Data from PEA show that approximately 3 million to 4.5 million households received FBE benefits each month between January 2013 and December 2015 (Figure 3). These households accounted for 20–32 percent of all households in the PEA service area. The number of FBE recipients also shows strong seasonality, with the highest number of recipients in the winter months (December through January).

Figure 3: Number of households that received Free Basic Electricity, 2013–2015



Source: PEA billing data; calculations by TDRI.

3.1.1 Error of exclusion (accessibility)

Table 2 suggests that the percentage of low-income households without electricity access ranges from 0.05 percent to 0.2 percent during 2013 and 2015. This was equivalent to 37,366 households (in 2013) and 10,966 households (in 2015). The provinces with the highest percentage were Mae Hong Son, Tak, Nakornnayok, Nan, and Lamphun.

Table 2: Percentage of low-income households without access to electricity

Year	Number of household without access to electricity	Percentage of households without access to electricity	Top five provinces with highest ratio of households lacking access
2013	37,366	0.19	Mae Hong Son, Kanchanaburi, Mukdahan, Lamphun, Tak
2014	22,210	0.11	Tak, Kanchanaburi, Amnat Charoen, Udon Thani, Phichit
2015	10,996	0.05	Mae Hong Son, Tak, Nakhon Nayok, Nan, Lamphun

Source: Socio-Economic Survey for period 2013–2015 undertaken by the National Statistical Office of Thailand.

Furthermore, Table 3 shows the percentage of low-income households that might not have access to the FBE program because they do not pay their electricity bills directly to the electricity utility. These are households that live in rental or temporary residences. The percentage of this group has increased over time with an estimation of 15,497 low-income households or about 0.07 percent of total low-income households in Thailand in 2015. It should be noted that this number presents an **upper bound** of the households that lack access for this reason. It is very likely that some families that live in rental residences pay their own electricity bills (and thus receive the FBE benefit). However, data on how many of these households pay their own bills are not available.

Table 3: Low-income households with access to electricity but might not have access to free electricity because they do not pay their bills directly to the electricity utility

Year	Number of households living in rental residences* (1)	Number of households living in temporary residences (2)	Total number of low-income households that might not qualify (1)+(2)	Percentage of low-income households that might not qualify
2013	4,817	2,517	7,388	0.04
2014	6,093	5,169	11,261	0.05
2015	12,031	3,466	15,497	0.07

Note: Rental residences consist of "apartments, condominiums or flats" with "rental" ownership status.

Source: Socio-Economic Survey for the period 2013–2015 undertaken by the National Statistical Office of Thailand.

The results from Table 2 would suggest that the error of exclusion that arises from households lacking access to electricity might not be a major issue in Thailand, because most households already have access to electricity. On the other hand, the error of exclusion based on the number of low-income

families living in rental or temporary residences might be a more serious concern because the fraction has risen over time (Table 3).

3.1.2 Leakage 1: Higher-income households may also receive the Free Basic Electricity benefit

Table 4 indicates that there could have been substantial leakage of FBE benefits among the non-targeted population, namely those with a "potential second home," during the period of 2013–2015. Specifically, there were more than 800,000 meters in the PEA service area that did not consistently consume under 50 units, yet the received the FBE benefit. The subsidy that went to these meters was worth more than a total of 830 billion baht per year.

A caveat in interpreting the results in Table 4 is that the numbers only present the **upper bound** of benefit leakage among PEA customers. Our algorithm to identify potential second homes likely overcounted the occurrence of the actual leakage. Owing to data limitations, only the consumption level (50 units consistently) was considered; no other demographic information was assessed. Thus, the potential second homes identified in the study could certainly include low-income households that use slightly more than 50 units in certain months, or large low-income families whose basic need is always in excess of 50 units per month.

Table 4: Upper bound of benefit leakage

Year	Possible number of leakages to a second home (Meter-year)	Possible funding that was leaked to second homes (Baht)	Possible units of electricity that were leaked to second homes
2013	9,619,524	840,265,976	345,906,234
2014	9,600,597	830,716,014	342,277,046
2015	9,374,278	837,354,560	332,670,727

Source: PEA billing data; calculations by TDRI.

The above calculation might suggest that the largest possible leakage of FBE benefits could be as high as 830–840 billion baht per year (or about 30 percent of the annual subsidy burden) during the period 2013–2015. This potential leakage highlights a weakness in the targeting approach where eligibility is based on the level of consumption alone.

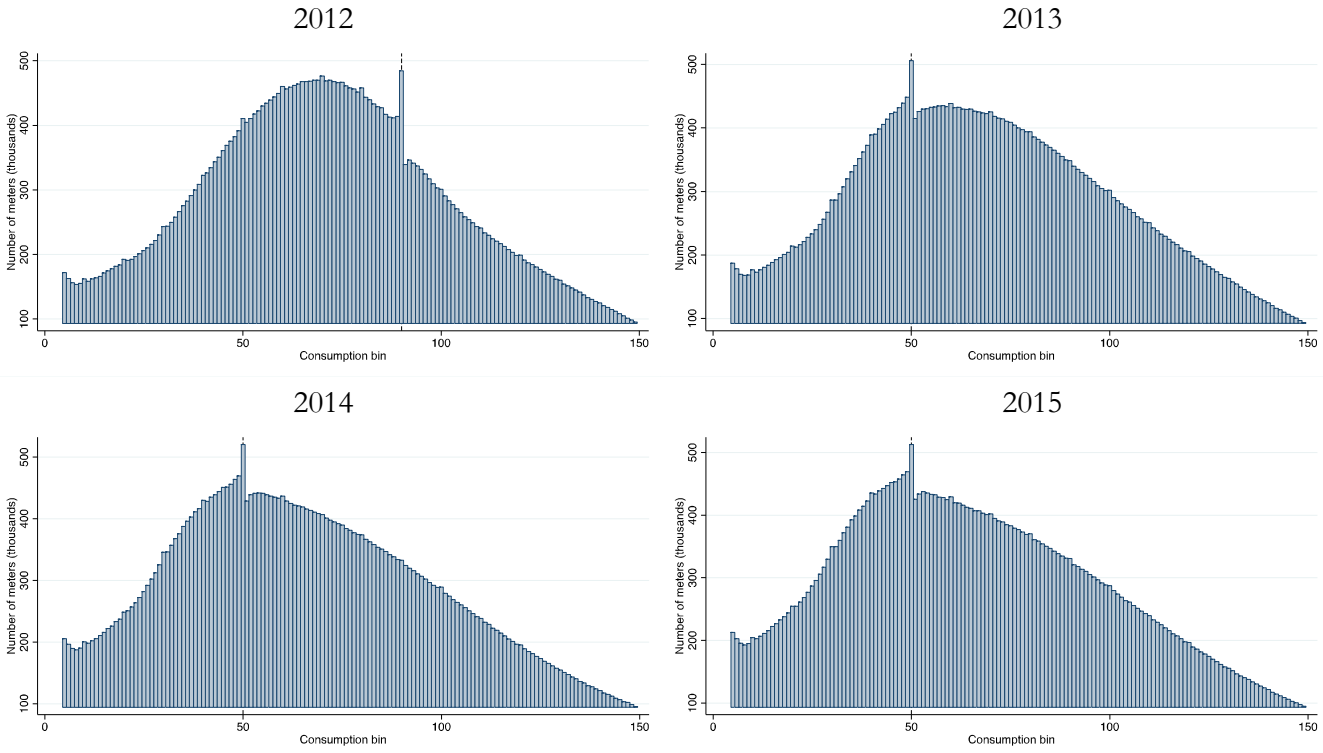
3.1.3 Leakage 2: Consumption distortions that result from program incentives

Figure 4 shows evidence that a disproportionate number of customers tried to target their electricity use at 50 units (or 90 units in 2012) in order to become eligible for the FBE program. The figures indicate that this "bunching" behavior was practiced by consumers whose usual consumption (in the absence of the FBE program) was anywhere from 1 to 10 units above the FBE threshold. Such bunching behavior results in leakage of the FBE subsidy because these households are presumably not the targeted population intended by the FBE program.

We used an empirical method outlined in Chetty et al. (2011), and Kleven and Waseem (2013) to estimate the number of customers who bunch at the threshold, and the associated increase in the subsidy burden.[5] Table 5 presents the estimation results.

[5] For details on the estimation method, see Apaitan, Tosborvorn, and Wibulpolprasert (2018).

Figure 4: Consumption distribution for the period January–May over four years



Source: PEA billing data; calculations by TDRI.

Table 5 indicates that the non-targeted customers intentionally reduced their consumption in order to receive the benefit on approximately 336,000–355,000 occasions (meter-month) per year during the period 2012–2015. The associated subsidy leakage was approximately 62 million baht in 2012, and 43–47 million baht per year among the PEA customers between 2013 and 2015.

Table 5: Estimation of the number of times that end users reduced their consumption in order to receive free electricity

Free electricity policy period	Number of times that end users reduced their consumption to receive free electricity	Additional subsidy from consumption distortions (Millions of baht)
2012 (90 units for 5 months, 50 units for 7 months)	345,568	62.57
2013 (50 units for 12 months)	336,624	42.95
2014 (50 units for 12 months)	355,690	45.38
2015 (50 units for 12 months)	341,082	43.52

Source: PEA billing data; calculations by TDRI.

The free electricity policy might have also incentivized users who normally used less than 90 or 50 units to increase their consumption up to the 90-unit or 50-unit free quota ("overconsumption"). This is

because all consumption below the free quota level was provided essentially free of charge. Overconsumptions would also increase the overall subsidy burden. Owing to data limitations, we are unable to quantify the magnitude of such overconsumption. However, we believe that the event of over-consumption might be rare due to the risk of overshooting the threshold and having to pay for all the units consumed.

With this limitation in mind, the second measure of leakage from the consumption distortion ("bunching") analysis may be thought of as a **lower bound** of the actual subsidy burden caused by the overall consumption distortions.

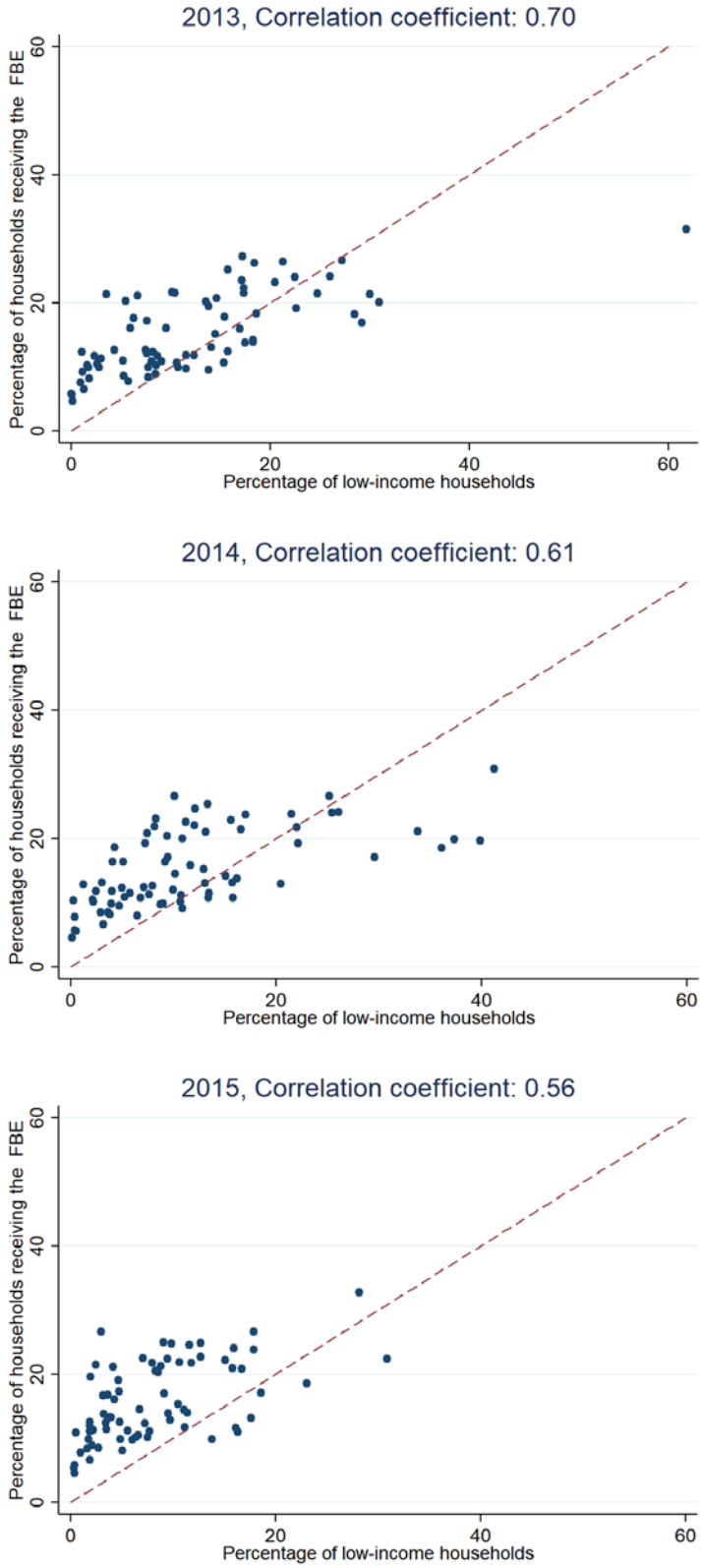
3.1.4 A broader picture of targeting effectiveness

Figure 5 presents the correlation between the fraction of low-income households and that of households which received free electricity at the provincial level. Clearly, provinces with a higher fraction of low-income households also have a larger fraction of households that received FBE benefits, with the correlation coefficients ranging from 56 to 70 percent between year 2013 and 2015. The positive correlation tends to decrease over time due to the fact that the number of low-income households has been declining.

In addition to the highly positive correlation, Figure 5 also reveals that the fraction of households that receive free electricity exceeds the fraction of the low-income households in most provinces. If it is assumed that the SES data can accurately reflect the poverty situation in Thailand, Figure 5 implies that the FBE benefit might have leaked to the non-target population for the majority of provinces.

In summary, all the evidence on targeting effectiveness thus far suggests that for the FBE program the leakage problem (error of inclusion) poses an issue of greater concern than the accessibility problem (error of exclusion).

Figure 5: Percentage of low-income households and households qualified for free electricity at provincial level



Source: Socio-Economic Survey for the period 2013–2015 undertaken by the National Statistical Office of Thailand, and billing data provided by PEA

3.2 Adequacy of the Free Basic Electricity program benefits

Table 6 compares the average monthly expenses, including for electricity expenditure, of low-income families to the cost saving realized from implementation of the 50-unit free quota. On average, low-income households were found to have spent approximately 6,500–6,800 baht per month during 2013 to 2015. The FBE 50-unit free quota presents a saving of 2 percent of the monthly expenditure of these low-income families and tended to drop over time due to increasing monthly expenditures.

Table 6: Free electricity and monthly expenses

Year	Monthly expenses, including for electricity (Baht)	Cost of electricity at 50 units of consumption (Baht)	Cost of electricity as a percentage of monthly expenses
2013	6,553.41	127.6	1.95
2014	6,749.12	127.6	1.89
2015	6,850.93	127.6	1.86

Source: Socio-Economic Survey for the period 2013–2015 undertaken by the National Statistical Office of Thailand, and calculations by TDRI.

Next, Table 7 shows that the average size of low-income households was 3.3–3.5 persons per household during 2013 through 2015. The family size was highly dispersed, with almost 25 percent of the total having more than five members in a household.

Table 7: Distribution of low-income household sizes

Household members (Persons)	2013		2014		2015	
	No. of household	%	No. of household	%	No. of household	%
1 – 4	1,011,260	77.21	1,458,297	76.49	1,575,782	72.52
5 – 8	285,363	21.79	433,540	22.74	584,641	26.90
9 - 12	12,130	0.93	13,781	0.72	10,184	0.47
> 12	939	0.07	928	0.05	2,390	0.11
Total	1,309,692	100	1,906,546	100	2,172,997	100
Average	3.39		3.43		3.54	

Source: Socio-Economic Survey for the period 2013–2015 undertaken by the National Statistical Office of Thailand

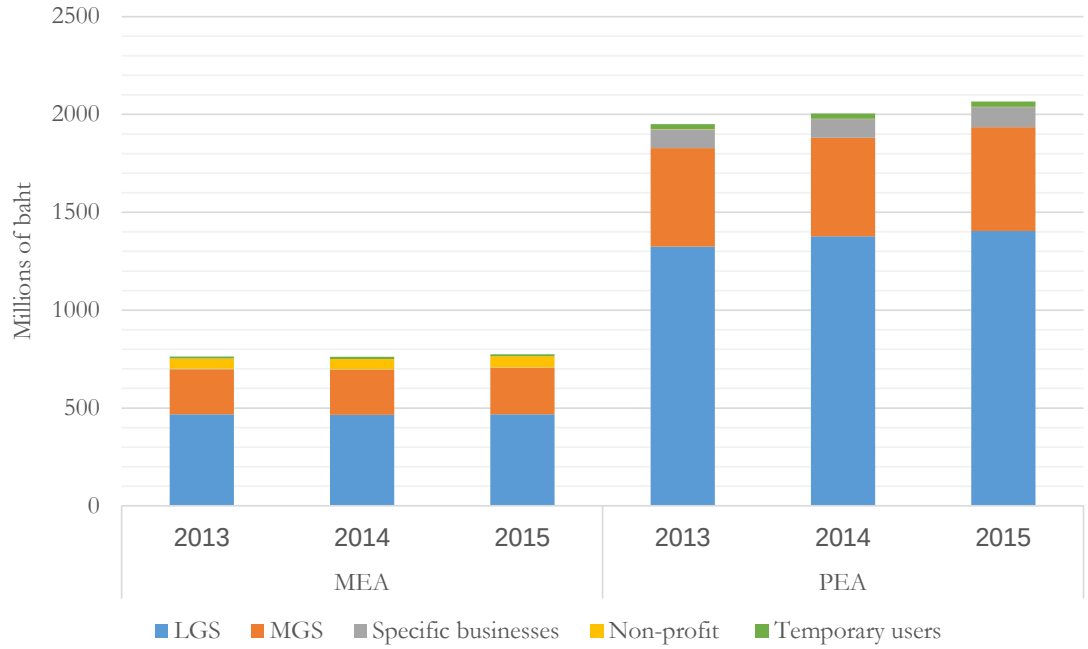
In light of the representative survey results by the Energy Policy and Planning Office (2016), which found that a household with an average of 2.56 family members required about 60 units of

electricity per month, it is suggested by the data in Table 7 that the 50-unit free quota might not be adequate for at least 20 percent of the low-income families that have many family members.

3.3 Distribution of the Free Basic Electricity subsidy burden

Figure 6 show the average subsidy burden between 2013 and 2015. During these years, the burden was about 800 million baht for MEA users and 2,000 million baht for PEA users. Large general service (LGS) and medium general service (MGS) customers bore most of the subsidy burden, amounting to 72 percent and 25 percent of the total burden respectively.

Figure 6: Subsidy burden of each group of electricity users



Source: Energy Policy and Planning Office; calculations by TDRI.

Table 8 calculates the subsidy burden as a percentage increase in the cost of electricity. It should be noted that the LGS and MGS customers are subject to a time-of-use tariff, and that the average cost of electricity between peak and off-peak periods has been used in the calculations. For most of the customers that bear the subsidy burden, the subsidy contribution of 0.0265 baht per unit represents a mere 0.87 percent increase in the electricity cost. The top five industries that bear the largest subsidy burden are food production industries, hotels, machinery production industries, textile industries and metal works.

Table 8: Impact of subsidy burden on production costs

Type of user	Average cost of electricity per unit (Baht) [A]	Subsidy burden per unit of electricity (Baht) [B]	Increased production cost (Percentage) [B]/[A] * 100
Medium/large-sized businesses	3.03	0.0265	0.87
Specific business	3.03	0.0265	0.87
Temporary users	6.44	0.0265	0.41
Non-profit organizations	3.03	0.0265	0.87

Source: Calculations by TDRI.

4. Conclusion and Policy Implications

This study evaluated FBE program performance according to three dimensions: targeting effectiveness, benefit adequacy, and subsidy burden distribution.

In terms of targeting effectiveness, it was found that the FBE benefit could reach the targeted population quite well because almost all households in Thailand have access to electricity. Subsidy leakage, however, is a much greater concern than accessibility. Leakage results from the fact that the FBE program uses only meter size and consumption level to determine eligibility. The greatest leakage occurs when the program criteria fail to screen out non-poor households that have low consumption, especially potential second homes. The second form of leakage results from the program incentive that induces bunching at the threshold. This latter form of leakage, however, is quite small because it is difficult for consumers to reduce their consumption below their usual baseline.

In terms of benefit adequacy, it was found that the 50-unit monthly allowance may not be adequate to meet the basic needs of average households. Furthermore, the adequacy problem is exacerbated among low-income families that have many members and thus consume more electricity in meeting their basic needs.

Lastly, the FBE program has been cross-subsidized, mostly by large general service and medium general service customers. The subsidy contributions, however, lead to a less than 1 percent increase in the cost of electricity that these larger consumers pay.

Overall, the results of the present study suggest that Thailand's FBE program could markedly benefit from an improved targeting approach to reduce leakage. One possible improvement is to collect a richer set of demographic characteristics that are readily observable but difficult to fabricate, such as housing characteristics; these could be used as additional screening criteria. With less leakage, the government could even increase the free electricity threshold to better match households' basic needs at the same or even a lower subsidy cost.

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