Additional information on luminous efficiency of reference street lighting

Summary

In Indonesia, there is an ongoing initiative that promotes the replacement of conventional street lighting with light emitting diode (LED) for increased energy efficiency and GHG emission reductions, but the installation rate of LED street lighting at the national level is estimated to be low. Despite its low installation rate of LED street lighting, to ensure the conservativeness in reference technology and the net emission reductions in Indonesia, the reference technology in this methodology is set to LED street lighting accompanied by lighting control system with the luminous efficiencies of 115 lm/W or 100 lm/W, depending on the rated power consumption (RPC) of project street lighting.

1. Policy circumstances of street lighting

According to the first Nationally Determined Contribution (NDC)[1], the Republic of Indonesia aims for a balanced growth between its current and future development and poverty reduction priorities, pledging to reduce GHG emissions by 26% voluntarily (41% with international support) by 2020 and 29% (41% with international support) by 2030 compared to Business-as-Usual (BaU) scenario. To manage growing demands for electricity resulted from the promotion of economic growth and poverty alleviation, one important measure is to increase the energy efficiency of demand side that will lead to the decrease in energy consumption and accordingly GHG emissions.

For this purpose, the Ministry of Energy and Mineral Resources (MEMR) of the Republic of Indonesia has established a program called "Smart Street Lighting Initiative (SSLI)"[2] as Nationally Appropriate Mitigation Action (NAMA), which intends to increase the energy efficiency of street lighting by replacing conventional ones with more efficient technologies such as LED. Having started with small-scale pilot projects in 2014, SSLI is still ongoing with the expansion of its scale and projects to yield 425,000 tCO_2 emission reductions by 2020 with the installation of 350,000 lamps in 15 middle-sized cities.

[1] UNFCCC website <http://www4.unfccc.int/ndcregistry/PublishedDocuments/Indonesia%20First/First%20NDC%20Indonesia_submitted%20to%20UNFCCC%20Set_November%20%202016.pdf>

[2] UNFCCC website <http://www4.unfccc.int/sites/nama/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=55&viewOnly=1>

2. Use of conventional street lighting and progress of SSLI

The study team conducted surveys through Internet search and interviews to identify the current use of conventional street lighting and the progress of SSLI. First, we conducted an interview on types of existing street lighting and the installation rate for each in Jakarta which is the most urbanized and developed city. As indicated in Table 1, the most widespread type of street lighting as of 2015 is high pressure sodium (HPS) that is generally less efficient than LED. The installation rate of LED street lighting is very low even in Jakarta City. There are also other types of street lighting such as fluorescent and mercury lamps with small installation rates.

Table 1: Existing street lighting and installation rate in Jakarta (as of 2015)

Street lighting Type	RPC [W]	Number of Lighting [Unit]	Installation Rate [%]
High Pressure Sodium (HPS)	70 – 400	161,863	90.5
Fluorescent	18 – 40	4,018	2.2
Light Emitting Diode (LED)	25 – 250	3,140	1.8
Mercury	28 – 400	2,382	1.3
Others	N/A	7,515	4.2
Total		178,918	100.0

Source: Expert interview

The study team also investigated the progress of SSLI by estimating the installation rate of LED street lighting in Indonesia attributed to this initiative. According to MEMR, the total LED street lighting that have been installed through SSLI is about 13,700 unit. The number of installed units for each year is shown in Table 2.

Table 2: Progress of SSLI (2015-16)

Year	2015	2016	Total (2015-16)
LED street lighting [Unit]	670	7,462	8,132
LED street lighting with solar PV [Unit]	516	5,005	5,521
Total [Unit]	1,186	12,467	13,653

Source: MEMR presentation materials provided by the Indonesian technical panel of the Joint Committee for the JCM between Indonesia and Japan

The number of total street lighting currently installed in Indonesia is not officially published by the national government. Due to this data unavailability, the study team estimated the number based on electricity consumption by street lighting in 2016 and simple assumptions about their operation hour and RPC, as shown in Table 3.

Table 3: Estimated number of street lighting in Indonesia

Parameter		Value	Source/Rationality
Electricity Consumption in 2016 [GWh]		3,498	Handbook of Energy & Economic Statistics of Indonesia 2017, published by MEMR[3]
Street Lighting	Type [-]	HPS	The most widespread type of street lighting in Jakarta City
	RPC [W]	400	Conservatively estimated value, maximum value of RPC of HPSs installed in Jakarta City[4]
	Operation hour [Hour * Day]	13 * 365	Conservatively estimated value, longer than operation hour of LED street lighting installed through SSLI[5]
Estimated Number of Street Lighting [Unit]		1,842,993	Estimated value based on the above data and assumptions.

Based on the numbers of installed LEDs through SSLI and all street lighting in Indonesia, as well as the assumption that the all non-replaced street lighting through SSLI are HPSs, it is estimated that the installation rate of LED street lighting resulted from the initiative is about 0.74%. Since some cities such as Jakarta City would have already begun to promote the replacement of conventional street lighting with LED, the above-mentioned assumption does not necessarily hold; therefore, the true installation rate of LED street lighting should be somewhat higher than 0.74%. However, the true installation rate is projected to be still low.

3. Establishment of the luminous efficiency of reference street lighting

In spite of the current low installation rate of LED street lighting, it is rational to conservatively set LED street lighting with lighting control system, assumedly the most advanced technology at present, as reference technology, considering the future potential in the expansion of SSLI and

[3] https://www.esdm.go.id/assets/media/content/content-handbook-of-energy-economic-statistics-of-indonesia-2017-.pdf

[4] Through the interview with experts, it was found that there are mainly four classes based on RPC of HPSs: 70W for alley road, 150W for local road, 250W for collector road, and 400W for protocol/artery road.

[5] MEMR presentation materials provided by the Indonesian technical panel of the Joint Committee for the JCM between Indonesia and Japan.

emergence of other similar programs/policies. The study team researched the luminous efficiency of LED street lighting available in the country, and found that the most efficient products among possible models were produced by an Indonesian manufacturer and had efficiencies of 115 lm/W (RPC = 40W) and 100 lm/W (RPC = 90W and 120W).

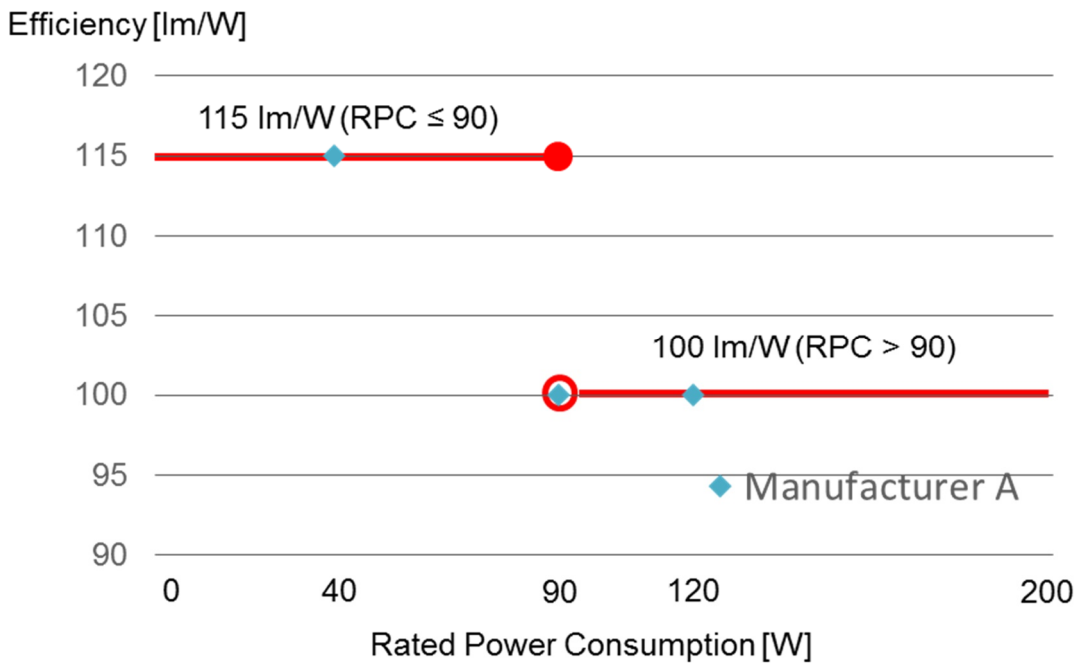

Figure 1: Luminous efficiency and RPC of the most efficient products

Source: Manufacturer's specifications and catalogues

Since the luminous efficiency tends to decrease as input power increases, the luminous efficiencies of reference street lighting are set to these two values depending on the RPC of project street lighting, as summarized in Table 4. The selection of the most efficient products as the luminous efficiency of reference street lighting ensures conservativeness and leads to net emission reductions.

Table 4: Luminous efficiencies of reference street lighting

RPC of project street lighting	RPC ≤ 90W	RPC > 90W
Luminous efficiency of reference street lighting	115 lm/W	100 lm/W