



ROADMAP

DEVELOPMENT OF HIGH-EFFICIENCY LIGHTINGS FOR INDONESIA



BADAN LAYANAN UMUM

P3tek **KEBTKE**

Project Team

Director	:	Dadan Kusdiana (General Director of EBTKE & Acting Head of Research and Development Agency of Energy and Mineral Resources, Ministry of Energy and Mineral Resources)
Supervisor	:	Hariyanto (Head of P3tek KEBTKE, Ministry of Energy and Mineral Resources)
Team Leader	:	Muhammad Indra Al Irsyad (P3tek KEBTKE)
Members	:	Tri Anggono (P3tek KEBTKE) Gea Prita Srikandi (P3tek KEBTKE) Paber Parluhutan Sinaga (P3tek KEBTKE) Dedi Suntoro (P3tek KEBTKE) Vetri Nurliyanti (P3tek KEBTKE) Rizki Triana Putri (Directorate of Electronics & Telematics Industry, Ministry of Industry) Marlina Pandin (P3tek KEBTKE) Herlin Herlianika (CLASP Advisory Indonesia) Katherine Hasan (CLASP Advisory Indonesia) Renyta Citra (ADLIGHT) Mirza Rahim (ADLIGHT Consultant for Street Lights) Ihsan Andika Lubis (Directorate of Electronics & Telematics Industry, Ministry of Industry) Ardian Marta Kusuma (Directorate of Energy Conservations, Ministry of Energy and Mineral Resources) Arief Heru Kuncoro (P3tek KEBTKE) Harun Al Rasyid (P3tek KEBTKE) Errie Kusriadie (P3tek KEBTKE)

Center for Research and Development of Electricity Technology, New Renewable Energy, and Energy Conservation

Research and Development Agency of Energy and Mineral Resources

MINISTRY OF ENERGY AND MINERAL RESOURCES

Bogor, 2021

Steering Committee of ADLIGHT

Chief Director	: General Director of New-Renewable Energy and Energy Conservation. Ministry of Energy and Mineral Resources.
Vice Director	: Resident Representative. UNDP Indonesia.
Members	: GEF Task Manager, Climate Change Mitigation. UNEP Asia Pacific. Secretary of General Directorate of New-Renewable Energy and Energy Conservation. Ministry of Energy and Mineral Resources. Director of Energy Conservation. Ministry of Energy and Mineral Resources. Director of Electronics & Telematics Industry. Ministry of Industry. Director of Supervision of Circulating Goods and Services. Ministry of Trade. Director of Evaluation, Accounting, and Settlement. Ministry of Finance. Director of Greenhouse Gas Inventory and Monitoring, Reporting and Verification. Ministry of Environment and Forestry. Director of Road Traffic. Ministry of Transportation. Director of Business Climate Development and International Cooperation. Government Goods/Services Procurement Agency.

Executive Summary

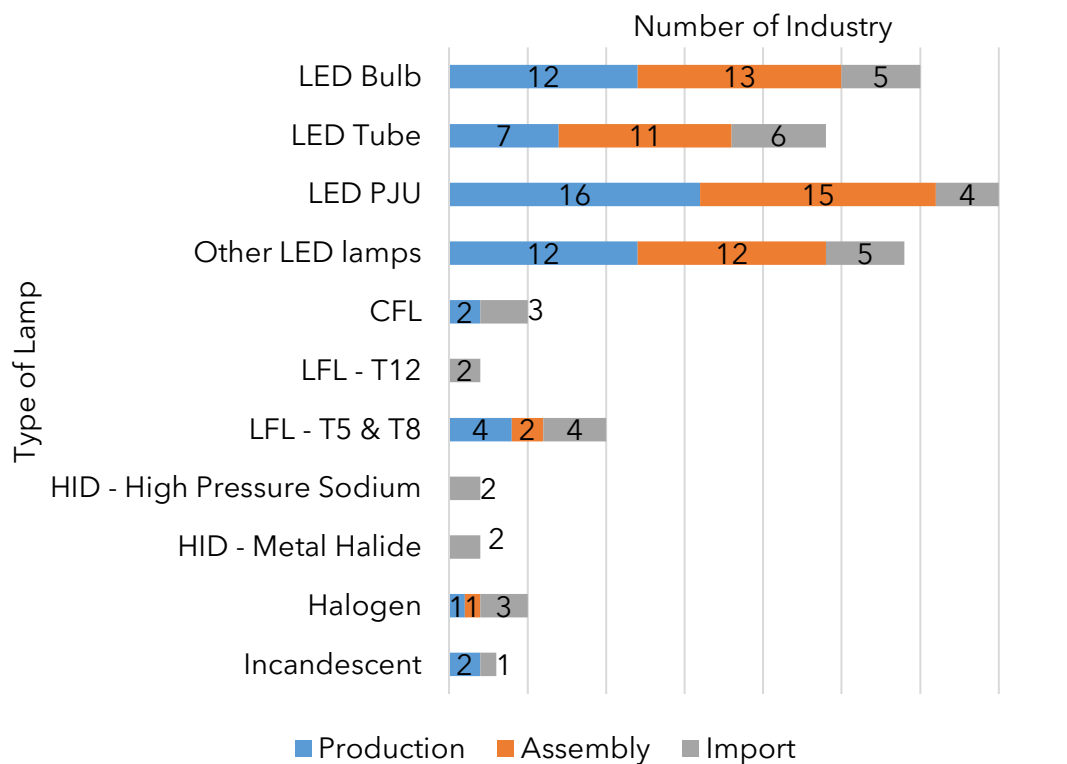
The ADLIGHT project aims to reduce electricity consumption and greenhouse gas emissions in Indonesia by transforming the national lighting market by encouraging high-efficiency lighting technology, such as LED lamps. The focus of component 1 in the ADLIGHT project is to assist the domestic lamp industry to grow and produce high-quality energy-efficient lighting. These efforts need to be carried out in structured and integrated actions between sectors in determining the transformation strategy-, short-, medium-, and long-term targets as set out in this roadmap.

This roadmap consists of 6 sections that discuss the demand for lamps in Indonesia, the capacity of the local lighting industry, the quality and price of local lamps, policy action plans, capacity building, gender equality, and environmental protection. In part 1, lamp demand in Indonesia has been projected by CLASP and PwC [1]. The average growth of lamp sales for the household sector is around 0.4% from 2019 - 2030. The average growth of lamp sales for the professional sector is negative, i.e., -0.3% per year, with an average sale of 67.7 million units per year during 2019 - 2030. In contrast, the average growth of outdoor lighting sales during 2019 - 2030 is relatively high at 4.5% per year or increased from 4.6 million units in 2019 to 7.7 million units in 2030.

The ratio of local LED lamps and imported LED lamps in 2018 was around 13% so that the market share of local LED lamps other than street lights was around 12% [1]. The low market share of local LED lamps for non-street lights has made several domestic lighting industries no longer produce. APERLINDO admitted that four of its members are no longer producing lamps. In line with that, GAMATRINDO reported that one of its members is no longer producing lamps. The LED Street lights market is estimated to have been dominated by local lamps. The primary users of street lights are government agencies required to use domestic products if there are products with TKDN and a BMP value of 40% [2].

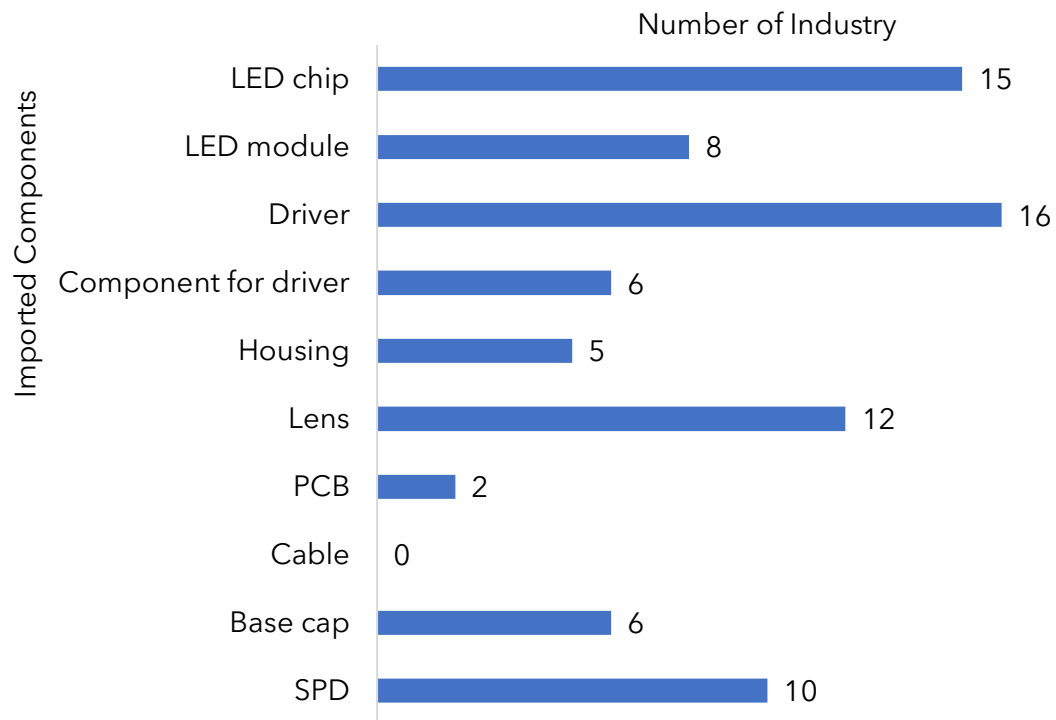
Part 2 discusses the results of a survey of 27 domestic lamp industries. Indonesia can produce high-quality LED lamps exported to Asia, Africa, Europe, the Pacific, and America. This capability can reduce LED lamp import, around 70% of total LED lamps circulated in Indonesia. The domestic lighting industries manufacture various lamps such as LED lamps, fluorescent, incandescent lamps, and high-intensity discharge (HID). The LED lamp types

also vary, i.e., street lights, bulbs, tube lights, and other LED lamp types. LED *bulbs* are generally manufactured and assembled domestically, but five industries are still importing LED *bulbs*. A similar supply pattern also occurs for LED tube lights, street lights, and other LED lamp types. Most lamp industries have a production capacity of less than 1 million lamp units per year. Lamp sales volume is correlated with the production volume. In 2019, 67 % of respondents had a total sales volume of less than 1 million LED bulbs per year.

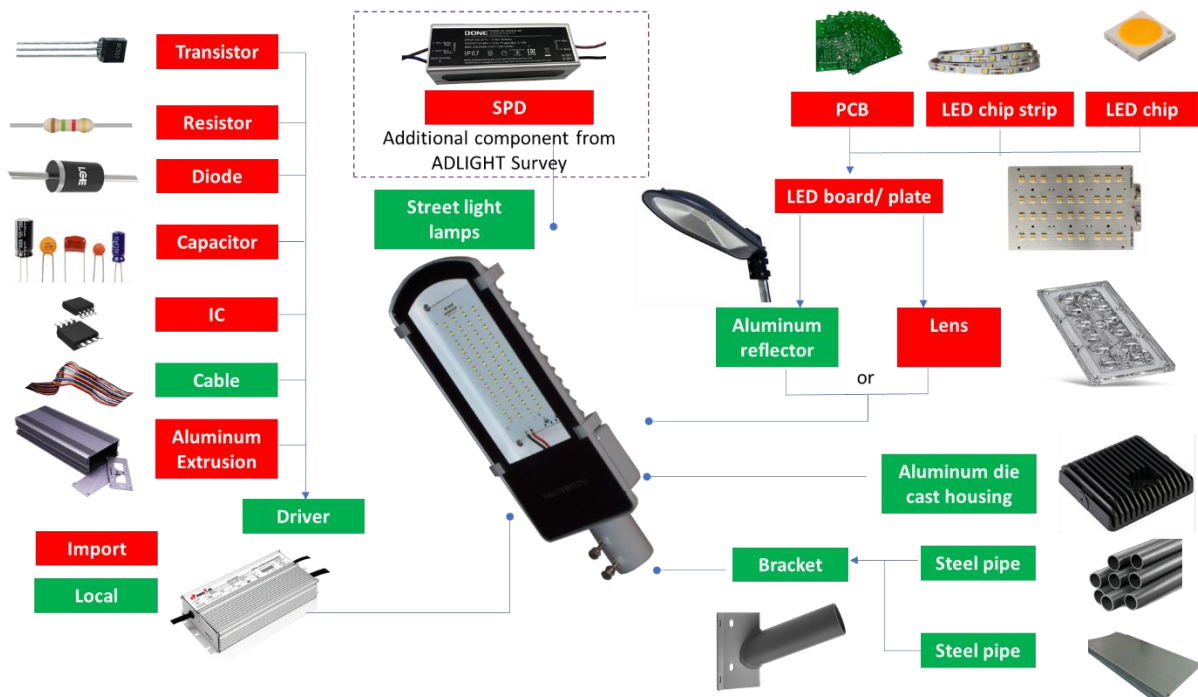


Type of Lamp by Domestic Industry and Its Supply Pattern

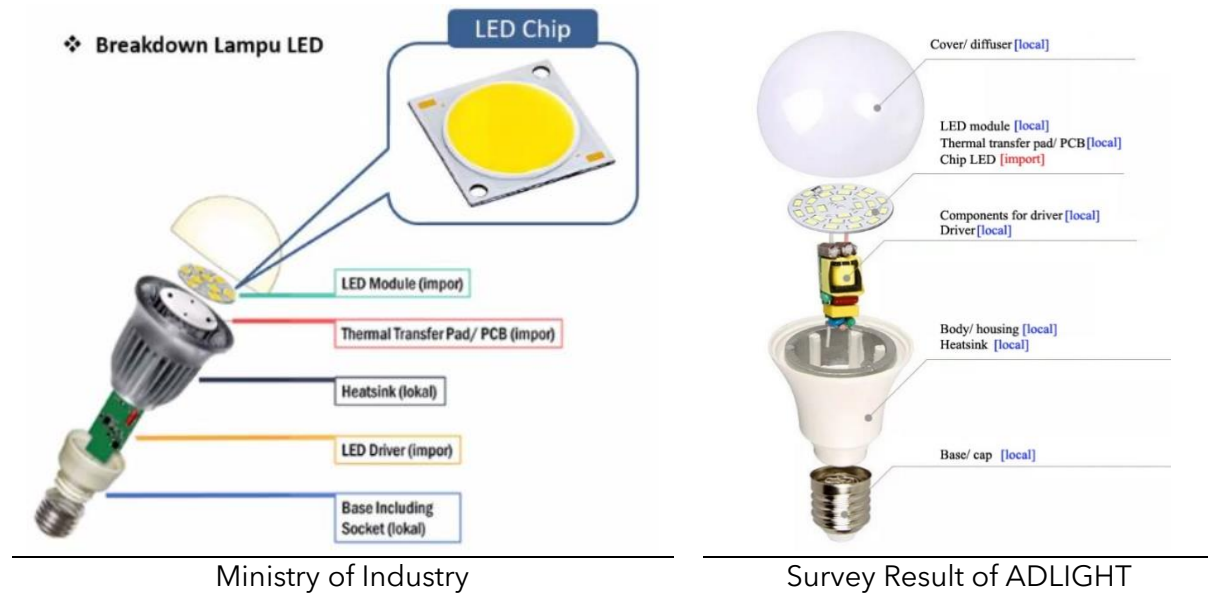
Regarding the supply chain, the majority of the LED lamp industry still imports most components. However, the LED Lamp industry can produce parts such as PCBs, housings, and lenses domestically. The survey results propose adding the SPD component to the industry tree of the street lights. The survey results suggest classifying the LED modules and PCBs as components that the LED lamp industry can produce domestically for the industrial tree of LED bulbs. Similar suggestions are for drivers and driver components because the LED lamp industry can make those domestically.



Number of Industries with Imported Components

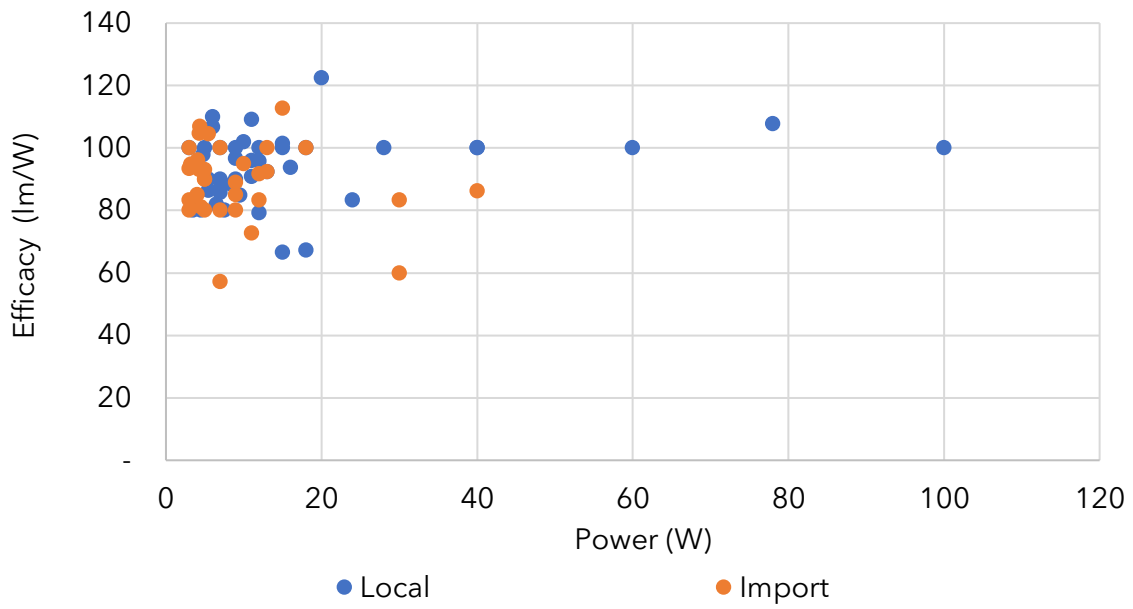


Industrial Tree of LED Street Lighting as per the Ministry of Industry

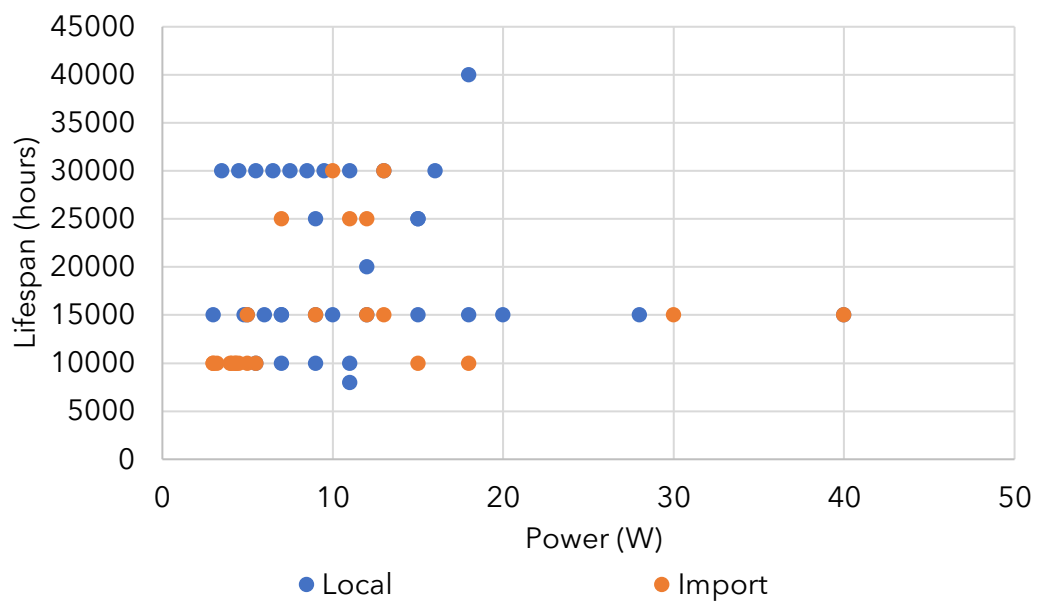


Industry Tree of LED Bulb

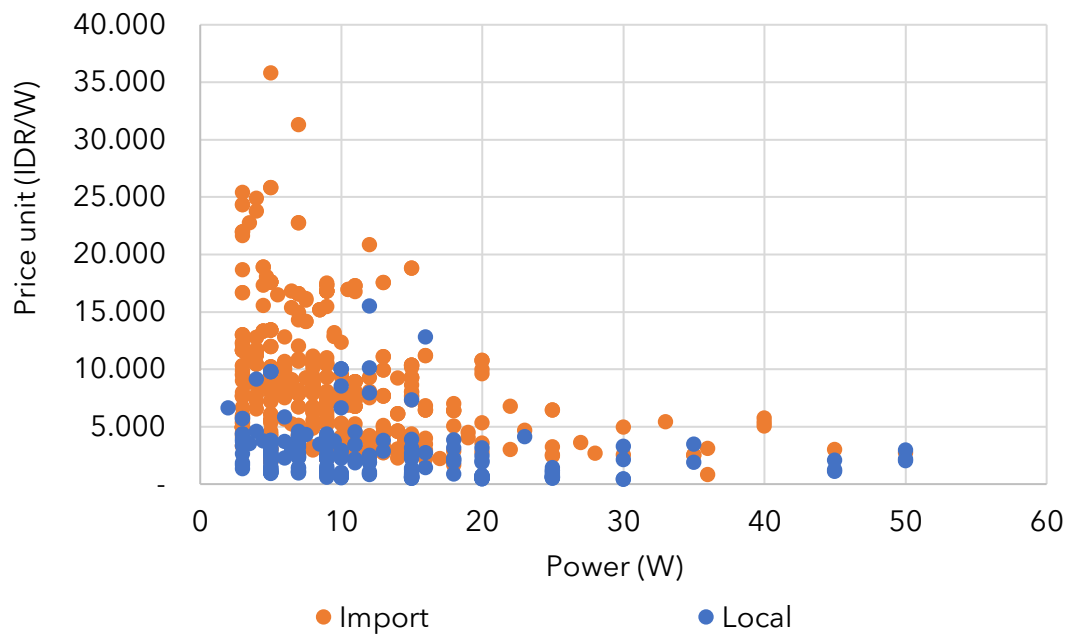
Section 3 discusses the quality of local LED lamps, including efficacy, lifespan, power factor, and price. The average efficacy of local LED bulbs is 93 lm/W, higher than the moderate efficacy of imported LED bulbs (i.e., 89 lm/W). The lifespan of local LED bulbs reaches 40 thousand hours with an average value of 20 thousand hours. For comparison, imported LED bulbs' average and maximum lifespan are 15 thousand hours and 30 thousand hours, respectively. The average power factor of local lamps is acceptable, namely 0.52 for bulb lamps, 0.6 for tube lights, and 0.9 for street lights. Local LED lamp prices are also quite competitive. Local LED bulbs range from IDR 556 /W to IDR 15,500 /W, with an average price of IDR 3,972 /W. On the other hand, the price range for imported LED bulbs is IDR 831 - 35,800 /W with an average price of IDR 8,264/W



Rated efficacy on local and imported LED bulbs



Rated lifespan on local and imported LED bulbs



Price unit of local and imported LED bulbs

Section 4 discusses the Action Plans to increase local lamps' quality and market share in the short, medium, and long term. Section 5 discusses the impacts of the Action Plans on the market share of local lamps. The market share of local and high-efficiency lamps for the professional sector is expected to increase from 12% in 2019 to 19% in 2025, 50% in 2030, and 75% in 2035. The increase in the market share impacts various action plans, particularly the action plan for replacing lamps that do not meet the MEPS or contain mercury with lamps that meet national safety standards and MEPS and minimum 40% local content. Together with import governance, this action plan will also increase the market share of local lighting for the household sector. The demand for local lamps in the household sector will increase from 12% in 2019 to 19% in 2030 and 75% in 2035. On average, the market share of local lamps in these two sectors is 15% in 2025, 32% in 2030, and 75% in 2035.

Action Plans in Short Term (2022 - 2025)

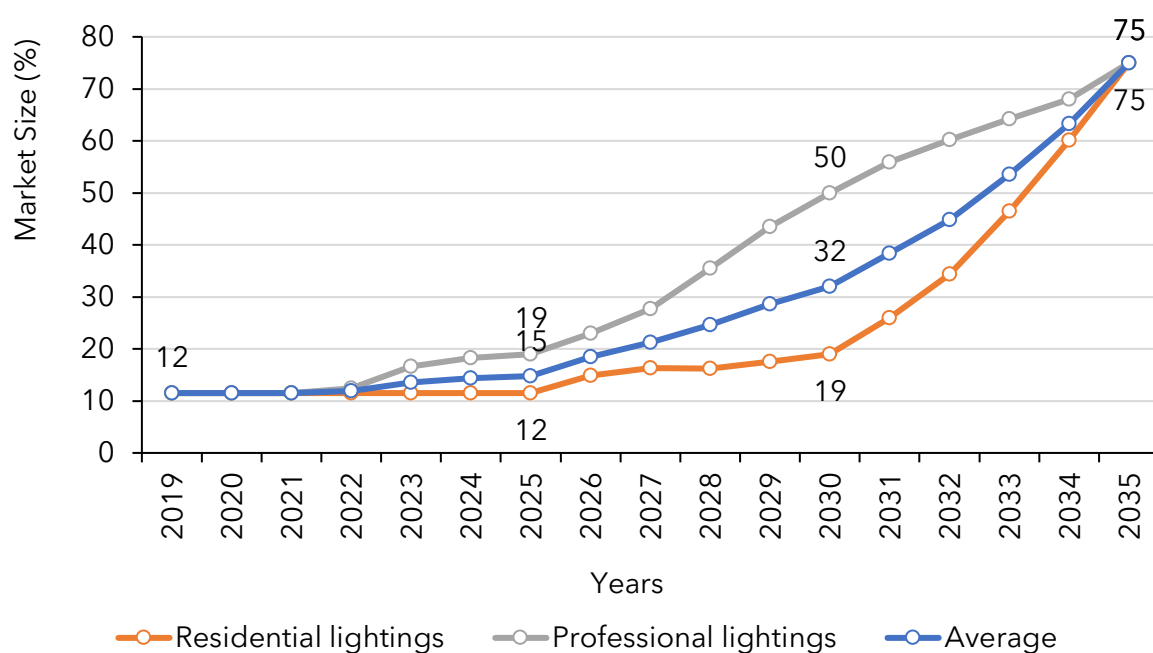
Action Plans	Ministry of EMR	Ministry of EF	Ministry of Industry	LKPP	ADLIGHT	Ministry of Finance	BRIN	Ministry of WECP
ENVIRONMENTAL PROTECTION								
MEPS 80 lm/W for bulbs, 90 lm/W for tube lights, and 120 lm/W for street lights.	2022							
Phasing out lamps that contain mercury in government agencies and SOEs buildings.	←	2022						
Lamp waste disposal regulation.		2023						
INCREASING MARKET SHARE OF LOCAL LAMPS								
Import Management (HS Code: 8539.50.00; 9405.10.91; 9405.10.92; 9405.20.90; 94053000; 9405.40.40; 9405.40.50; 9405.40.60).			2022					
Prototyping non-street lights meet the national safety standard and MEPS with minimum local content and BMP of 40%.	←		2022					
An obligation of government agencies and SOEs to use local lights (local contents and BMP at least 40%) that meet the national safety standard and MEPS.			2023					
The LKPP Electronic Catalogue contains local non-street lights that meet the national safety standard and MEPS.				2023				
Disseminations of local lamp brands (local contents and BMP at least 40%) that the national safety standard and MEPS.					2023			
LOCAL CONTENT ENHANCEMENT								
Research and development of national molding and drivers for street lights.							2023 2024	
Providing super deduction tax for lamp industries that conducts research						2025		
GENDER EQUALITY								
A guideline for gender mainstreaming in the lamp industry.								2023

Action Plans in Medium Term (2026 - 2030)

Action Plans	Ministry of EMR	Ministry of EF	Ministry of Industry	Ministry of PWH	Association/ Industry	Ministry of Finance	BRIN
ENVIRONMENTAL PROTECTION							
MEPS 130 lm/W for non-streetlights bulb, and 180 lm/W for street lights.	2026						
Mandatory national safety standards of lamps for public procurement.			2026				
Phasing out lamps that contain mercury in all professional buildings.		2027					
INCREASING MARKET SHARE OF LOCAL LAMPS							
Commitments of construction planners and contractors to use local lamps (local contents and BMP at least 40%) that the national safety standard and MEPS.				2026			
LOCAL CONTENT ENHANCEMENT							
Lamp industries use lamp housing molding and national drivers for street lights.					2026		
Investments in LED chip or semiconductor industry.			2028				
Investment incentives						2030	
Research and development of national SPD for street lights.							2026

Action Plans in Long Term (2031 - 2035)

Action Plans	Ministry of EMR	Ministry of Trade	Association/ Industry	Ministry of Industry
ENVIRONMENTAL PROTECTION				
MEPS 150 lm/W for non-streetlights bulb, and 210 lm/W for street lights.	2032			
INCREASING MARKET SHARE OF LOCAL LAMPS				
Provision of a Function-worthy Certificate (SLF) accompanied by conditions for the use of lamps that meet the national safety standard and MEPS with local contents and BMP at least 40%				2033
<i>Domestic purchasing obligation</i> (some lamps sold by importers are required to have local contents and BMP at least 40%)		2035		
LOCAL CONTENT ENHANCEMENT				
Industries of street lights use the national SPD.			2031	
Minimum local contents and BMP is increased to 60% for the procurement of street lights by government agencies.				2034



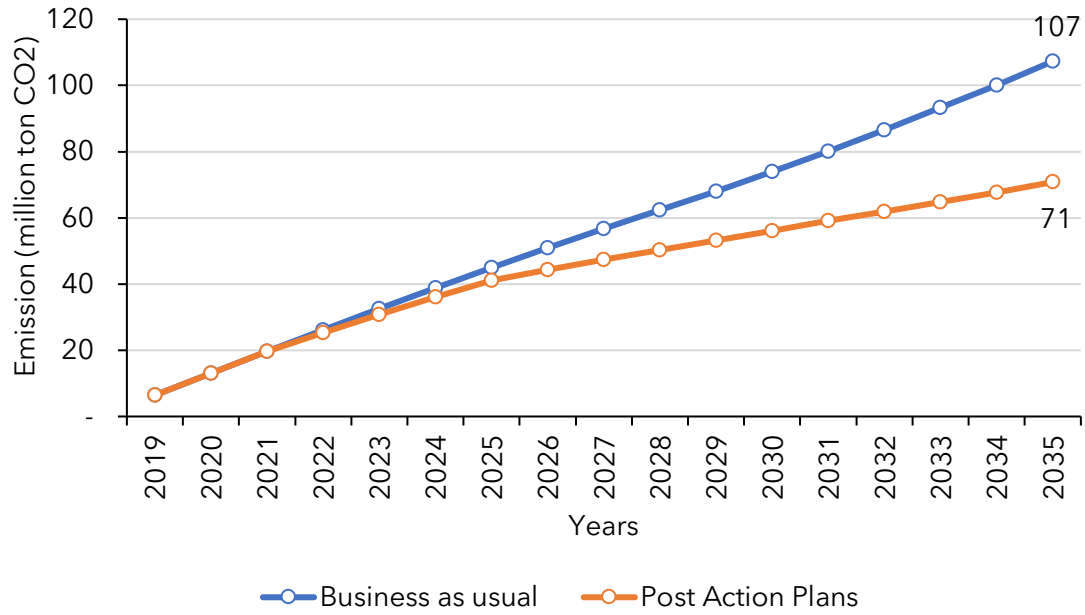
Projection of local LED lamp market share

Section 6 addresses issues of gender equality and environmental protection. The survey results show that the total employees in 23 industries have a relatively wide range from 12 to 730 people, with an average of 153 people. The number of female workers is quite significant, with an average of around 36.6% of total employees. Most industries are concerned about worker welfare by giving incentives and facilities, such as paid maternity leave, menstrual leave, and lactation room.

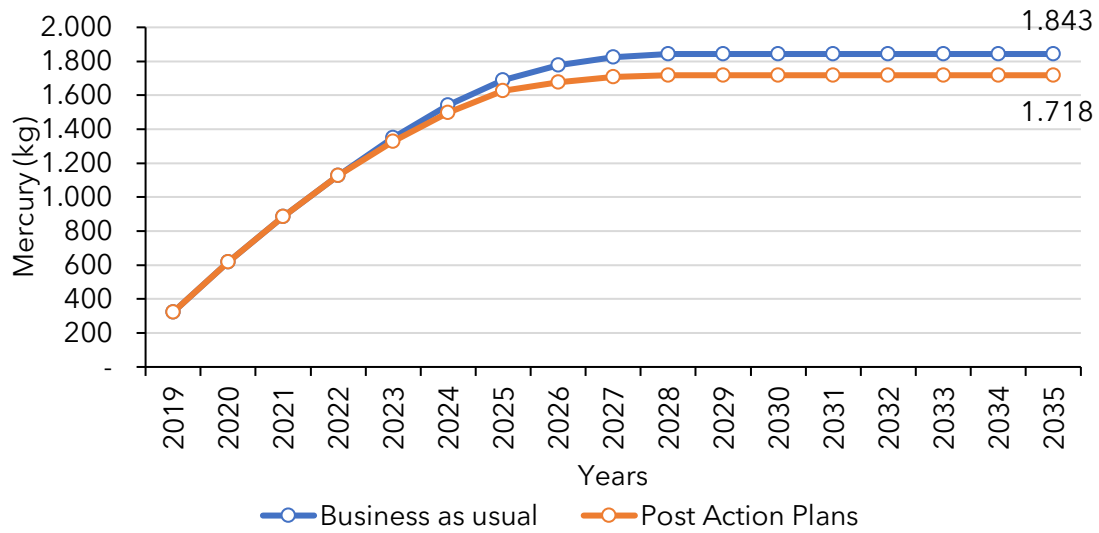


Percentage of Number of Female Workers in the Lighting Industry

The proposed action plan will reduce emissions and mercury due to the sale of lamps during 2019 - 2035. The total potential for emission reductions for all sectors is 36 million tons of CO₂e. The total cumulative mercury reduction from the action plan on lamp sales 2019 - 2035 is 125 kg.



Accumulative emissions from the use of lamps sold in 2019 - 2035



Accumulative mercury from the use of lamps sold in 2019 - 2035

Table of Contents

Project Team	2
Steering Committee of ADLIGHT	3
Executive Summary.....	4
Table of Contents	15
List of Figure.....	17
List of Table	20
Definition and Abbreviation	21
1. LAMP DEMAND.....	24
1.1. Baseline of Lamp Demands	25
1.2. The Market Share of Local Lamps.....	29
2. CAPABILITIES OF THE INDONESIAN LAMP INDUSTRY	33
2.1. Lamp Industry in Indonesia	34
2.2. Production Capacity	37
2.3. Technology.....	39
3. QUALITY AND PRICE OF LAMPS IN INDONESIA	47
3.1. Efficacy.....	48
3.2. Lifespan	54
3.3. Power Factor.....	58
3.4. Standardization	60
3.5. Price	62
4. POLICY ACTION PLANS.....	66
4.1. Challenges Hindering Local Lamp Industries	67
4.2. Legal Basis	70
4.3. Short Term Action Plan	73
4.4. Medium Term Action Plan.....	81
4.5. Long Term Action Plan.....	83
5. CAPACITY INCREASE	85
6. GENDER EQUALITY AND ENVIRONMENTAL PROTECTION	93
6.1. Gender Equality	94
6.2. Environmental Protection.....	96
7. REFERENCES.....	102

8. RESPONDENT PROFILE	107
8.1. CV. Sentosa Electric.....	108
8.2. PT. Artolite Indah Mediatama	109
8.3. PT. Catur Mukti Pratama	110
8.4. PT. Cipta Sinergi Asia	111
8.5. PT. Daya Mandiri Terbarukan	112
8.6. PT. Fokus Indo Lighting	113
8.7. PT. Honoris Industry	114
8.8. PT. Jaya Eco Energi	115
8.9. PT. Kingled Indonesia	116
8.10. PT. LED Pro IDN	117
8.11. PT. Makarim Berjaya.....	118
8.12. PT. Moradon Berlian Sakti	119
8.13. PT. Niko Elektronik Indonesia.....	120
8.14 PT. Panasonic Gobel Life Solustions.....	121
8.15. PT. Pandawa LED Indonesia	122
8.16. PT. Prisled Innovative Lighting Indonesia.....	123
8.17. PT. Saka Agung Karya Abadi	124
8.18. PT. Santinilestari Energi Indonesia	125
8.19. PT. Sarana Karya Solusindo.....	126
8.20. PT. Sinar Angkasa Rungkut	127
8.21. PT. Signify Commercial Indonesia	128
8.22. PT. Solarens Ledindo	129
8.23. PT. Sumber Klik Sejahtera	130
8.24. PT. Surya Citra Teknik Cemerlang	131
8.25. PT. Surya Utama Putra.....	132
8.26. PT. Tjipto Langgeng Abadi	133

List of Figure

Figure 1.1 Projected number of lamps in the household sector	25
Figure 1.2 Projected number of lamps in the professional sector	26
Figure 1.3 Projected number of outdoor lamps	27
Figure 1.4 Projection of lamp sales in the residential sector	28
Figure 1.5 Projection of lamp sales in the professional sector	28
Figure 1.6 Sales projection of outdoor lamp	29
Figure 1.7 Lamp market share in 2018	30
Figure 1.8 The export destinations of Indonesia's lamps	32
Figure 2.1 Production capacity of Indonesia's LED lamp industries.....	37
Figure 2.2 Sales volume of Indonesia's LED lamp industries in 2019	38
Figure 2.3 Sales volume of Indonesia's LED lamp industries in 2020	38
Figure 2.4 Production Tools	39
Figure 2.5 Imported components/parts	40
Figure 2.6 The industrial tree of LED bulbs	41
Figure 2.7 The industrial tree of LED street lights.....	42
Figure 2.8 TKDN of LED street lights in the LKPP Electronic Catalog	42
Figure 2.9 LED chip brands used by street lights in the LKPP Electronic Catalog	43
Figure 2.10 LED driver brands used by street lights in the LKPP Electronic Catalog	44
Figure 2.11 The types of housing used by street lights in the LKPP Electronic Catalog	44
Figure 2.12 The production cost structure of LED bulbs.....	45
Figure 2.13 The production cost structure of LED street lights.....	46
Figure 3.1 Efficacy listed from local and imported LED bulbs.....	48
Figure 3.2 Local LED bulb efficacy measurement results	49
Figure 3.3 Stated efficacy of local and imported LED tube lights	50
Figure 3.4 Measured efficacy of local LED tube lights	50
Figure 3.5 Stated efficacy of local and imported LED downlights	51
Figure 3.6 Stated efficacy of local and imported LED floodlights.....	51
Figure 3.7 Stated efficacy of local and imported LED high bay	52
Figure 3.8 Stated efficacy of local and imported LED street lights	53

Figure 3.9 Measured efficacies of local street lights and high bay	53
Figure 3.10 The stated lifespan of local and imported LED bulbs.....	54
Figure 3.11 The stated lifespan of local and imported LED tube lights.....	55
Figure 3.12 The stated lifespan of local and imported LED downlights.....	55
Figure 3.13 The stated lifespan of local and imported LED floodlights.....	56
Figure 3.14 The stated lifespan of local and imported high bays.....	56
Figure 3.15 The stated lifespan of the local and imported street lights	57
Figure 3.16 The warranty of LED street lights at the LKPP Electronic Catalog.....	57
Figure 3.17 The measurement results of power factor of local LED bulbs.....	58
Figure 3.18 The measurement results of power factor of local LED tube lights.....	59
Figure 3.19 The power factor measurement results of local street lights and high bay	59
Figure 3.20 The capacity factor of LED street lights in the LKPP Electronic Catalog	60
Figure 3.21 Management system applied by local industries	61
Figure 3.22 Test standards used by local industries	61
Figure 3.23 Number of LED bulbs complying with SNI IEC 62560:2015	62
Figure 3.24 Unit prices for local and imported LED bulbs.....	63
Figure 3.25 Unit prices of local LED tube lights	63
Figure 3.26 The unit price of local LED floodlights	64
Figure 3.27 Unit prices for LED lamps type panel, downlights, and post-top	65
Figure 3.28 The price unit of local street lights.....	65
Figure 4.1 Policy proposals from local industries	68
Figure 4.2 Opinions on the mandatory safety SNI	69
Figure 4.3 Industry opinion on SKEM harmonization in ASEAN	79
Figure 5.1 The establishment year of local industries.....	86
Figure 5.2 Type of capital ownership.....	86
Figure 5.3 Investment and development plans	87
Figure 5.4 Local LED lamp market share projection	88
Figure 5.5 Sales projections of high-efficiency lamps in the residential sector	89
Figure 5.6 Projection of lamp sales in the residential after the action plans	89
Figure 5.7 The sales projection of LED lamps for the professional sector	90
Figure 5.8 The sales projection of all lamp types for professionals (post-action plans).....	90
Figure 5.9 The sales projection of LED outdoor lamps	91
Figure 5.10 The sales projection of all outdoor lamp types (post-action plans).....	91
Figure 6.1 Number of employees	94
Figure 6.2 Percentage of the number of female employees	95

Figure 6.3 Facilities for employees.....	95
Figure 6.4 Accumulative electricity consumption from lamp use for household	96
Figure 6.5 Accumulative electricity consumption from lamp use for professionals	96
Figure 6.6 Accumulative electricity consumption from using outdoor lamps	97
Figure 6.7 Accumulative electricity consumption from lamp sales 2019 - 2035.....	97
Figure 6.8 Accumulative emissions from the use of lamps sold to the residential sector ..	98
Figure 6.9 Accumulative emissions from the use of lamps sold to the professional sector	98
Figure 6.10 Accumulative emissions from the use of sold outdoor lamps.....	99
Figure 6.11 Accumulative emissions from the use of lamps sold in 2019 - 2035	99
Figure 6.12 Accumulative mercury amount from the usages of lamps sold to the professional sector	100
Figure 6.13 Accumulative mercury amount from the usages of sold outdoor lamps	100
Figure 6.14 Accumulative mercury amount from the usages of lamps sold in 2019 - 2035	101
Figure 8.3 The Production Process at PT. Catur Mukti Pratama	110
Gambar 8.4 Lampu PJU LED produksi PT. Cipta Sinergi Asia	111
Gambar 8.13 Proses produksi di PT. Niko Elektronik Indonesia	120
Gambar 8.20 Proses produksi lampu LED filamen di PT. Sinar Angkasa Rungkut.....	127

List of Table

Table1.1 Number of local industries based on the LED lamp procurement process.....	31
Table2.1 Industries participating in drafting the Roadmap	36
Table 4.1 Short Term Action Plan (2022 - 2025).....	74
Table 4.2 Medium Term Action Plan (2026 - 2030).....	82
Table 4.3 Long Term Action Plan (2031 - 2035)	84

Definition and Abbreviation

ACFTA	: ASEAN-China Free Trade Area
ALINDO	: Indonesian Luminaire Association
APDAL-IRAS	: Electrical Power Distribution Equipment and Direct Current House Installation
APERLINDO	: Indonesian Lighting Industry Association
ASEAN	: Association of Southeast Asian Nations
BAPPENAS	: National Development Planning Agency
BMP	: Company Benefit Weight
BPJT	: Toll Road Regulatory Agency, Ministry of Public Works and Housing
BRIN	: National Research and Innovation Agency
BSN	: National Standardization Agency
CFL	: Compact fluorescent lamp
CLASP	: Collaborative Labeling and Appliance Standards Program
Directorate General of EBTKE	: Directorate General of New Renewable Energy and Energy Conservation
EMC	: Electromagnetic compatibility
FDG	: Focus Group Discussion
GAMATRINDO	: Indonesian Integrated Lighting Manufacturing Industry Association
Import	: Lamps are imported in a state already assembled for packaging or already packaged from suppliers.
IoT	: Internet of Things
Ministry of WECP	: the Ministry of Women's Empowerment and Child Protection
PPP	: Government and Business Entity Cooperation
Imported lamp	: The imported lamps are fully assembled so they can be used right away
Local lamps	: Lamps assembled domestically use components that are partly from within or wholly from abroad.
LED	: Light-emitting diode
LFL	: Linear fluorescent lamp
LKPP	: Government Goods/Services Procurement Policy Institute
LPDP	: Education Fund Management Institute
LTSHE	: Energy Saving Solar Lamps
M&E	: Mechanical and Electrical
OEM	: Original Equipment Manufacturer
OSS	: Online Single Submission
PBG	: Building Approval

PCB	: Printed circuit board
Production	: There is a process of making lamp components within the factory area or in the territory of Indonesia.
PwC	: PricewaterhouseCoopers
Assembly	: All materials are imported from outside the factory outside the territory of Indonesia (import), but the lamps are assembled in Indonesia.
MEPS	: Minimum Energy Performance Standard
SLA	: Service Level Agreement
SLF	: Functional Eligibility Certificate
SMT	: Surface mount technology
SPD	: Surge protection device
TKDN	: Domestic Component Level

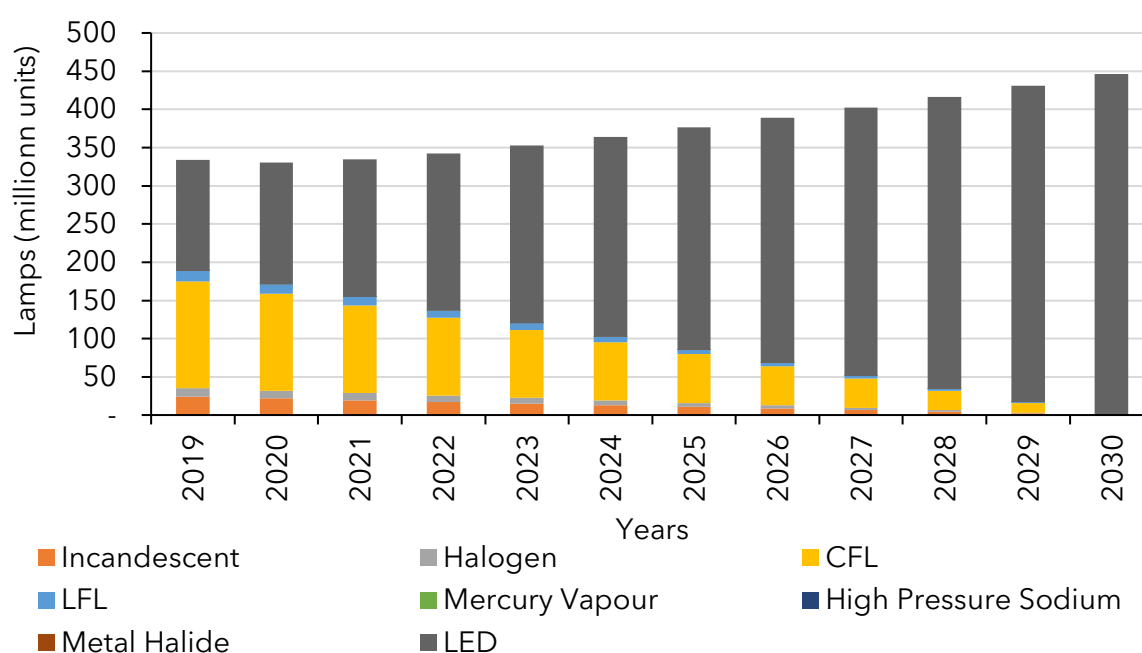
Industry survey results, analytical methods, data, and assumptions are reported separately.



LAMP DEMAND

1.1. Baseline of Lamp Demands

CLASP and PwC [1] had projected the demands for lamps for three lamp users, namely household (Figure 1.1.), professional (Figure 1.2), and outdoor (i.e., street lights, and another outdoor lamp) (Figure 1.3). The projections are made using the Policy Analysis Modeling System (PAMS), survey data of 51 retail stores, survey data on 5000 households, data from industry associations, government data, lamp industry websites, and reviews of previous studies. The PAMS is a spreadsheet in an excel file developed by the Lawrence Berkeley National Laboratory (LBNL) and the Collaborative Labeling and Appliance Standards Program (CLASP) [3]. The projections were made for three lamp users,



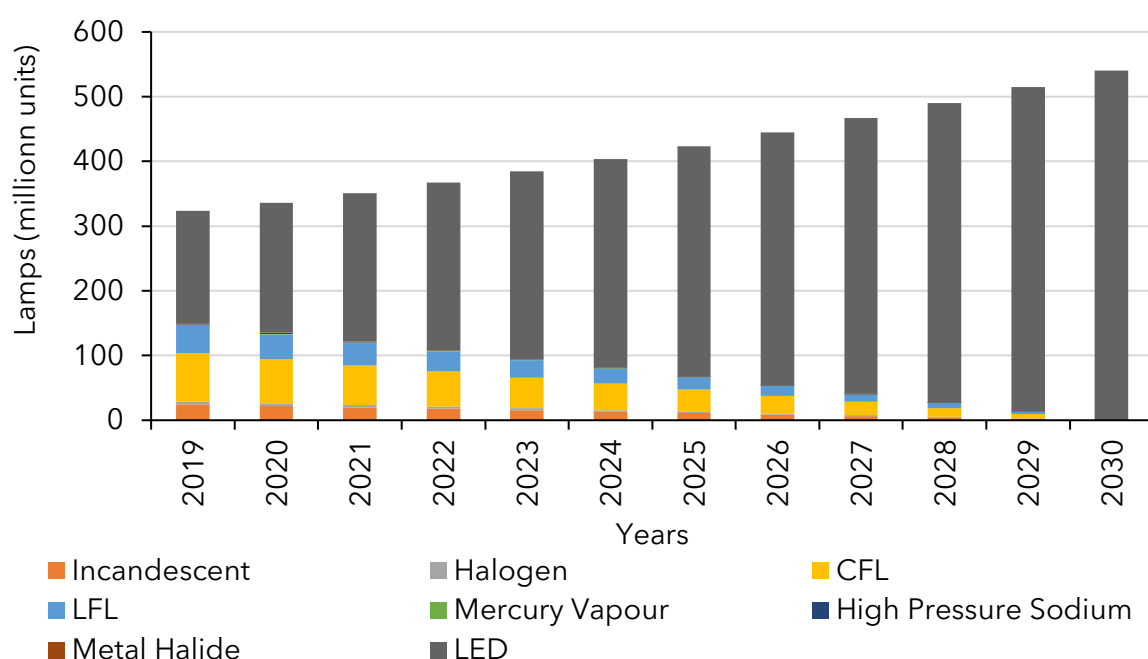
Source: CLASP and PwC [1]

Figure 1.1 Projected number of lamps in the household sector

The number of lamps in the residential sector will increase by 2.7% per year from 334.2 million units in 2019 to 446.2 million units in 2030 [1]. The proportion of incandescent and compact fluorescent lamps (CFL) users in 2019 was still relatively high, at 7.1% and 41.8%, as shown in Figure 1.1. The portion of lamp-emitting diode (LED) lamp users in 2019 was already high at 43.5%, and the share of LED lamp users will continue to increase to 100% in 2030. The high penetration of LED lamps results from various advantages of LED lamps, declining prices of LED lamps, and the prohibition on mercury imports [1, 4]. Several advantages of LED lamps are high efficiency, long lifespan, better color rendering, and zero

harmful mercury [5]. Therefore, retailers now sell more LED lamps (76%) of the 765 models found on the market than CFL lamps (24%) and incandescent lamps (0.4%) [1].

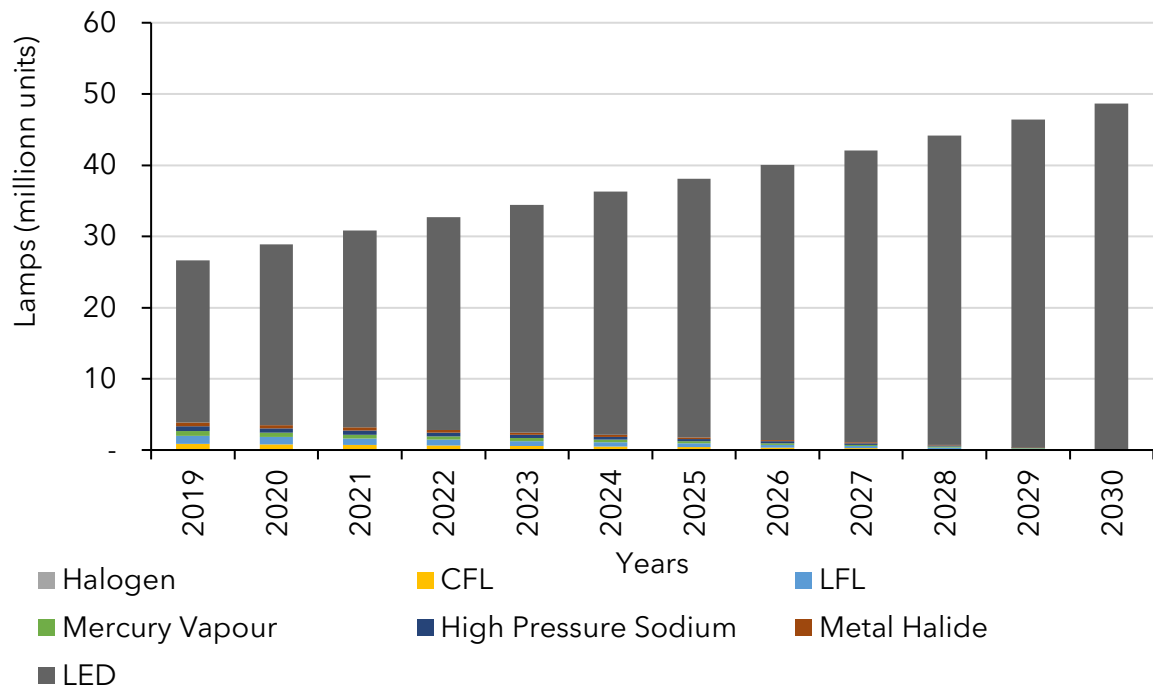
The shift from non-LED lamps to 100% LED lamps also occurs in the professional sector (i.e., commercial, government, and industrial buildings), as shown in Figure 1.2. The use of lamps in the professional sector will increase from 323.7 million units in 2019 to 540 million units in 2030 (average growth of 4.8% per year) [1]. The portion of lamps that will be significantly reduced are fluorescent lamps, CFL, and linear fluorescent lamps (LFL) from 36.2% in 2019 to be entirely replaced by LED lamps in 2030.



Source: CLASP and PwC [1]

Figure 1.2 Projected number of lamps in the professional sector

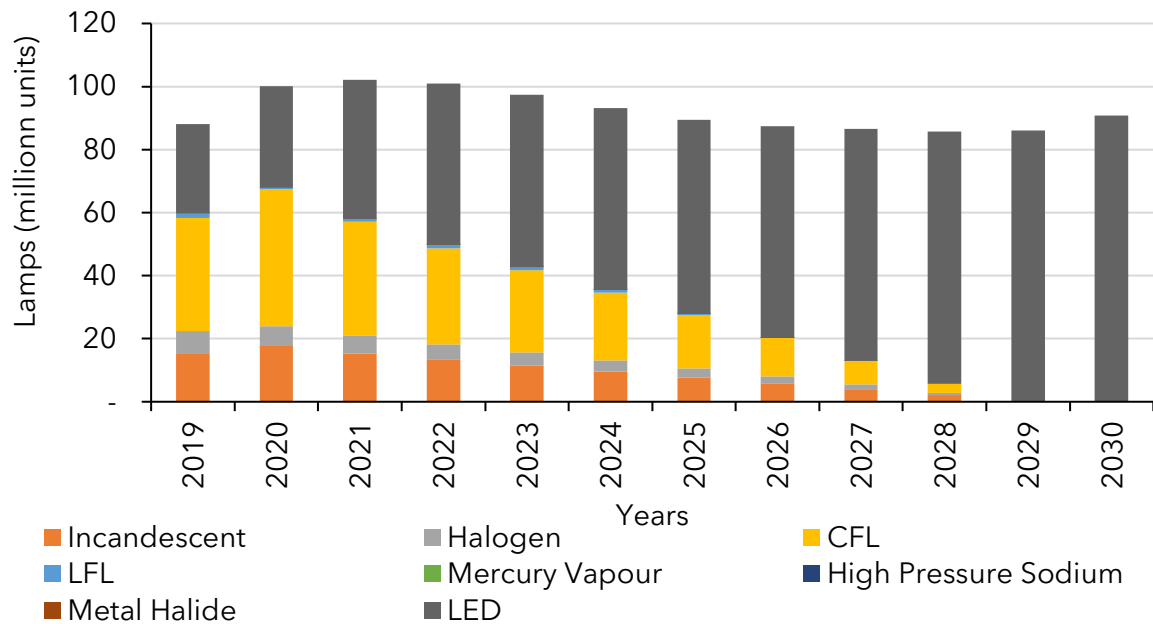
The use of LED lamps for outdoor in 2019 has reached 85.5%, as shown in Figure 1.3 [1]. The projections are based on data from BPS, the Ministry of Transportation, toll road operators, eight-city governments as the foremost users of street lights, four industry associations, and five industries that control 75% of the lamp market share in Indonesia. Outdoor lamps will increase from 26.6 million units in 2019 to 48.7 million units in 2030. CLASP and PwC [1] predicted that all outdoor lamps by 2030 will be LED lamps.



Source: CLASP and PwC [1]

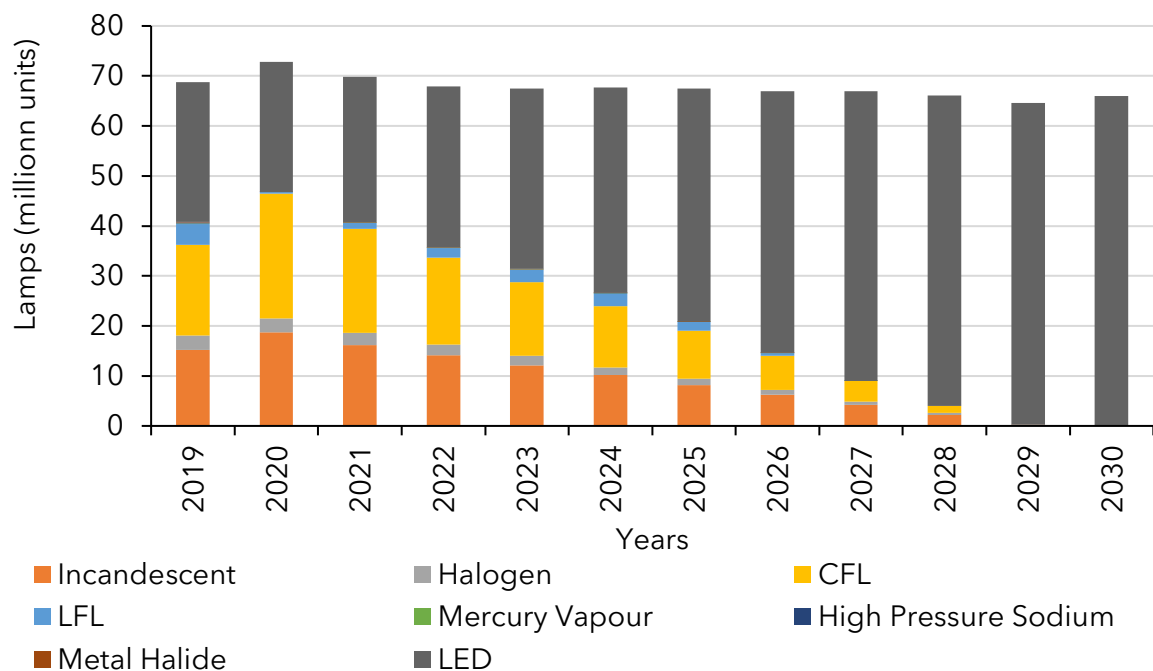
Figure 1.3 Projected number of *outdoor* lamps

Although the number of lamps used by residential and professional sectors will increase, lamp sales in these two sectors in 2022 - 2030 are relatively stable [1]. The average growth of lamp sales for the household sector is around 0.4% per year during 2019 - 2030, as shown in Figure 1.4. The average growth of lamp sales for the professional sector is negative, i.e., - 0.3% per year, with an average sales of 67.7 million units per year during 2019 - 2030, as shown in Figure 1.5. This relatively stable sales growth is due to the long lifespan of LED lamps, up to 50,000 hours, compared to the maximum lifespan of CFL lamps (i.e., 15,000 hours) [1].



Source: CLASP and PwC [1]

Figure 1.4 Projection of lamp sales in the residential sector

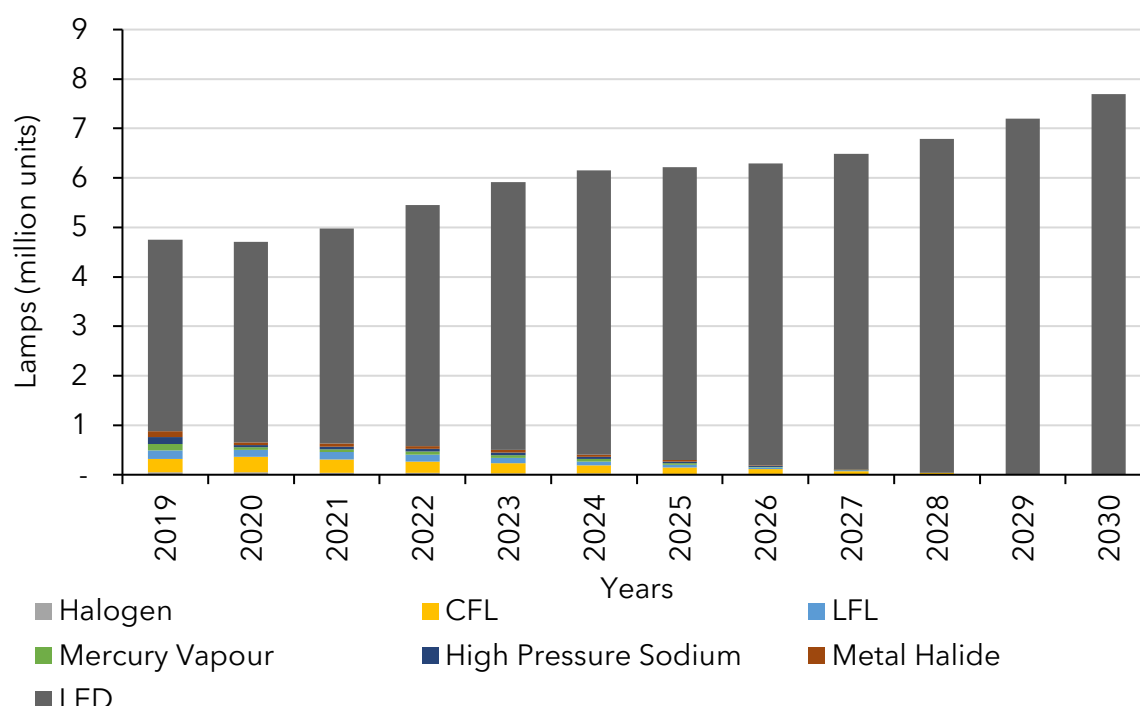


Source: CLASP and PwC [1]

Figure 1.5 Projection of lamp sales in the professional sector

On the other hand, the average growth of outdoor lamp sales during 2019-2030 is relatively high at 4.5% per year. Figure 1.6 shows that outdoor lamp sales will increase from 4.6 million units in 2019 to 7.7 million units in 2030 [1]. LED lamps with a long life span have

dominated outdoor lamps, so the analysis of the lamp replacement period in the PAMS model is relatively the same. Meanwhile, demands for new outdoor lamps are growing so that sales of outdoor lamps will continuously increase, as shown in Figure 1.6.



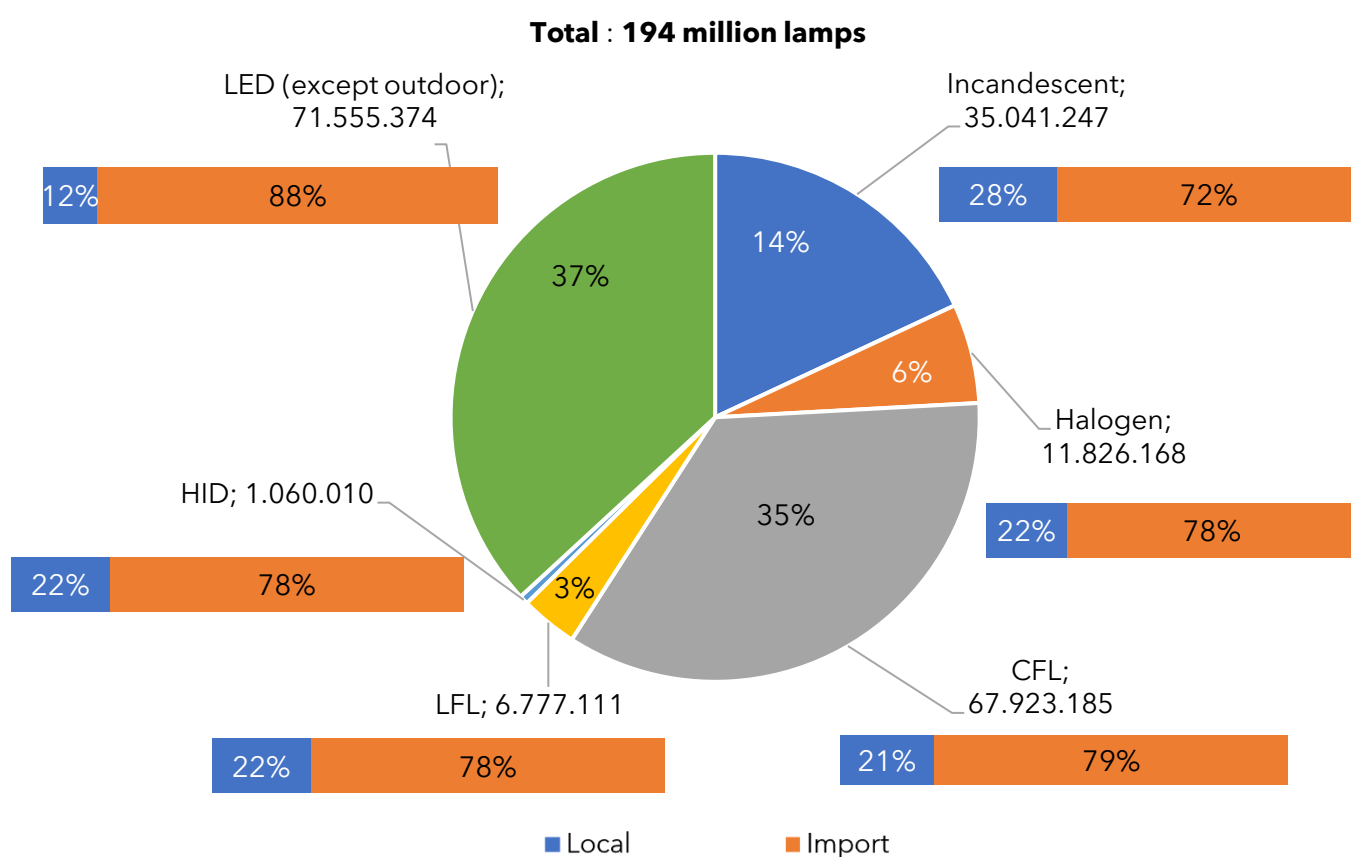
Source: CLASP and PwC [1]

Figure 1.6 Sales projection of outdoor lamp

1.2. The Market Share of Local Lamps

Based on discussions with associations and several lamp industries, the market size of local lamps is around 20% of the total lamp supply in Indonesia. CLASP and PwC [1] estimated the market share of local lamps in 2018 through three stages. The first stage was the estimation of the number of imported lamps based on data on the weight of imported lamps from the Central Statistics Agency (BPS) [6] and the average weight of each type of lamp from UN Comtrade [7]. The second stage was to calculate the ratio of the number of local lamps to the number of imported lamps in 2018. CLASP and PwC [1] estimated that the number of local lamps in 2018 was 62 million units based on data provided by several domestic industries. The estimated imported lamps in 2018 were around 158 million units, resulting in a 28% ratio. The ratio is similar to that estimated by associations and lamp industries, i.e., 20% / 80% or 25%. The third stage was to estimate the production of each

type of local lamp using the 28% ratio. CLASP and PwC [1] adjusted the ratios for incandescent, CFL, and LED bulbs based on data from associations and industries. Figure 1.7 shows that the ratio of local LED lamps and imported LED lamps in 2018 was around 13% so that the market share of local LED lamps other than street lights was around 12%. The low market share of local LED lamps for non- street lights had shut several domestic lamp industries. APERLINDO admitted that four of its members are no longer producing lamps. In line with that, GAMATRINDO reported that one of its members is no longer producing lamps.



Source: CLASP and PwC [1]

Figure 1.7 Lamp market share in 2018

LED street lights are mostly local street lights. The key users of street lights are government institutions requiring domestic products if a product with a total value of TKDN and BMP of 40% exists in the market [2]. Government institutes procuring street lights every year are 514 district/city governments, the Ministry of Energy and Mineral Resources, the Ministry of Transportation, and the Ministry of Public Works and Housing. Other users of street lights are toll road operators, residential and industrial estate developers, private companies, and

the general public. Those users may use imported street lights because they have no obligation to use local street lights. Imported street lights can still enter government procurement due to the following possibilities:

- a. The implementing team or the goods/services procurement committee do not know the obligations of TKDN and BMP because they do not regularly purchase street lights;
- b. Lack of supervision by government institutions on the production and assembly processes of purchased street lights. During the survey, the industry discussed the possibility of street lights' import strategy amid contract deadlines and large procurement volumes. The survey results in Table 1.2 show that four local industries import street lights even though these industries are producing or assembling street lights.

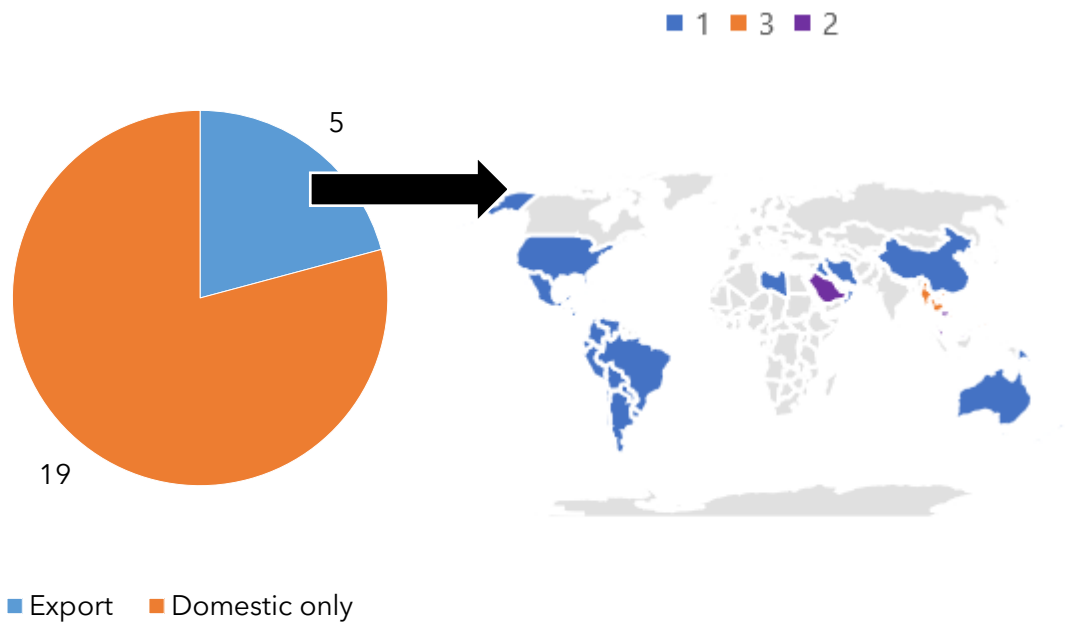
Table 1.1 also shows that 27.8% of the 25 industries surveyed import LED bulbs even though these industries also carry out assembly (1 industry) or production and assembly (2 industries). Two industries that import LED bulbs without any production/assembly are generally industries of street lights or other LED lamps.

Table 1.1 Number of local industries based on the LED lamp procurement process

Procurement process	Bulbs	Tube lights	Street lights	Other types of LED lamps
Production	1	1	6	4
Assembly	5	3	5	4
Import	2	3	0	0
Production and assembly	7	7	7	4
Assembly and import	1	1	1	1
Production, assembly, and import	2	2	3	4
Total	18	17	22	17

n = 25 domestic industries

Of the 24 respondents, five industries export lamps to various countries. In Figure 4.6, Indonesia's lamp export destinations are the Association of Southeast Asian Nations (ASEAN), Asia, Middle East, Pacific, the United States, Latin American, and Africa. Those exporting industries generally have more than 1 million units per year of sales and production capacity. The age of an industry and the type of investment also affect the ability to export.



Base (n) = 24 respondent

Figure 1.8 The export destinations of Indonesia's lamps



CAPABILITIES OF THE INDONESIAN LAMP INDUSTRY

2.1. Lamp Industry in Indonesia

Indonesia has 40 lamp industries and three industry associations, i.e., the Association of Indonesian Luminaires (ALINDO), the Indonesian Electrical Lighting Industry Association (APERLINDO), and the Indonesian Integrated-Lamp Manufacturing Industry Association (GAMATRINDO). ALINDO members are generally industries of street lights. APERLINDO has 44 members, but around 58% are importers. PT. Jaya Eco Energi, PT Solarens Ledindo, PT. Karya Energi Semesta, and PT. Saka Agung Karya Abadi are members of two associations (i.e., ALINDO and APERLINDO). Meanwhile, GAMATRINDO has ten local industry members, but the active members are only eight industries. Following lamp industries are not a member of any association:

- a. PT. Catur Mukti Pratama.
- b. PT. Cipta Sinergi Asia.
- c. PT. Daya Mandiri Terbarukan.
- d. PT. Global Persada Internusa.
- e. PT. LED Pro Idn.
- f. PT. Makarim Berjaya.

The ALINDO is the association of business entities or manufacturers engaged in luminary production. Since its establishment on February 9, 2015, ALINDO has 12 members:

- a. CV. Solarindo Jaya.
- b. PT. Adyawinsa Electrical and Power.
- c. PT. Faidhi Systema Solusindo.
- d. PT. Fokus Indo Lighting.
- e. PT. Jaya Eco Energi.
- f. PT. Karya Energi Semesta.
- g. PT. Prisled Innovative Lighting Indonesia.
- h. PT. Saka Agung Karya Abadi.
- i. PT. Santinilestari Energi Indonesia.
- j. PT. Solarens Ledindo.
- k. PT. Subur Semesta.
- l. PT. Surya Utama Putra.

APERLINDO was founded and initiated by lamp industries in 1980 with a goal to build a lamp industry community towards a better future. APERLINDO assists its members with

instructions, information, and recommendations. APERLINDO also introduces its members and their products to the public at home and abroad through exhibitions, symposiums, and magazine publications. APERLINDO has 41 members, of which 17 are local industries that are:

- a. PT. Artolite Indah Mediatama.
- b. PT. Honoris Industry.
- c. PT. Jaya Eco Energi.
- d. PT. Karya Energi Semesta.
- e. PT. Kingled Indonesia.
- f. PT. Niko Elektronik Indonesia.
- g. PT. Ningbo Global Lamp.
- h. PT. Panasonic Gobel Eco Solutions Manufacturing Indonesia.
- i. PT. Pancaran Indonesia.
- j. PT. Pandawa LED Indonesia.
- k. PT. Saka Agung Karya Abadi.
- l. PT. Sarana Karya Solusindo.
- m. PT. Signify Commercial Indonesia.
- n. PT. Solarens Ledindo.
- o. PT. Sumber Klik Sejahtera.
- p. PT. Surya Citra Teknik Cemerlang.
- q. PT. Tjipto Langgeng Abadi.

GAMATRINDO was established in 2013 to support the nation's independence, especially in the lamp industry. The GAMATRINDO aspiration is to strengthen the development of a highly competitive domestic industry in the face of increasingly open global competition in regional and international markets. GAMATRINDO has ten members, but only nine are still in production, namely:

- a. CV. Sentosa Electric
- b. PT. Global Jaya Elektronik.
- c. PT. Hikari.
- d. PT. Infinity Light Indonesia.
- e. PT. Lighting Solution.
- f. PT. Moradon Berlian Sakti.
- g. PT. Sentra Solusi Elektrindo.

- h. PT. Sinar Angkasa Rungkut.
- i. PT. Suke Teknologi Indonesia.

The data in this Roadmap is based on the results of surveys and discussions in 27 industries, as shown in Table 2.1.

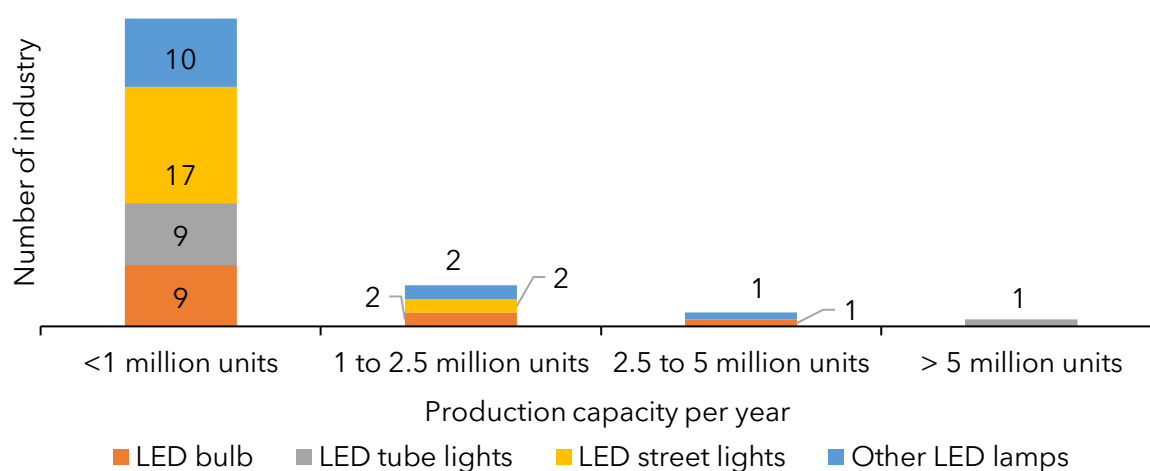
Table 2.1 Industries participating in drafting the Roadmap

Respondent	Province	Association
PT. Fokus Indo Lighting	West Java	ALINDO
PT. Jaya Eco Energi	DKI Jakarta	ALINDO/ APERLINDO
PT. Prisled Innovative Lighting Indonesia	Riau Islands	ALINDO
PT. Santinilestari Energi Indonesia	East Java	ALINDO
PT. Saka Agung Karya Abadi	East Java	ALINDO/ APERLINDO
PT. Solarens Ledindo	West Java	ALINDO/ APERLINDO
PT. Surya Utama Putra	West Java	ALINDO
PT. Artolite Indah Mediatama	West Java	APERLINDO
PT. Honoris Industry	West Java	APERLINDO
PT. Kingled Indonesia	North Sumatra	APERLINDO
PT. Niko Elektronik Indonesia	Central Java	APERLINDO
PT. Panasonic Gobel Life Solustions	East Java	APERLINDO
PT. Pandawa LED Indonesia	Central Java	APERLINDO
PT. Sarana Karya Solusindo	East Java	APERLINDO
PT. Signify Commercial Indonesai	DKI Jakarta	APERLINDO
PT. Sumber Klik Sejahtera	DKI Jakarta	APERLINDO
PT. Surya Citra Teknik Cemerlang	West Java	APERLINDO
PT. Tjipto Langgeng Abadi	East Java	APERLINDO
CV. Sentosa Electric	West Java	GAMATRINDO
PT. Moradon Berlian Sakti	Banten	GAMATRINDO
PT. Sinar Angkasa Rungkut	East Java	GAMATRINDO
PT. Catur Mukti Pratama	Banten	No association
PT. Cipta Sinergi Asia	West Java	No association
PT. Daya Mandiri Terbarukan	Banten	No association
PT. Global Persada Internusa	Banten	No association
PT. LED Pro Idn	West Java	No association
PT. Makarim Berjaya	DKI Jakarta	No association

2.2. Production Capacity

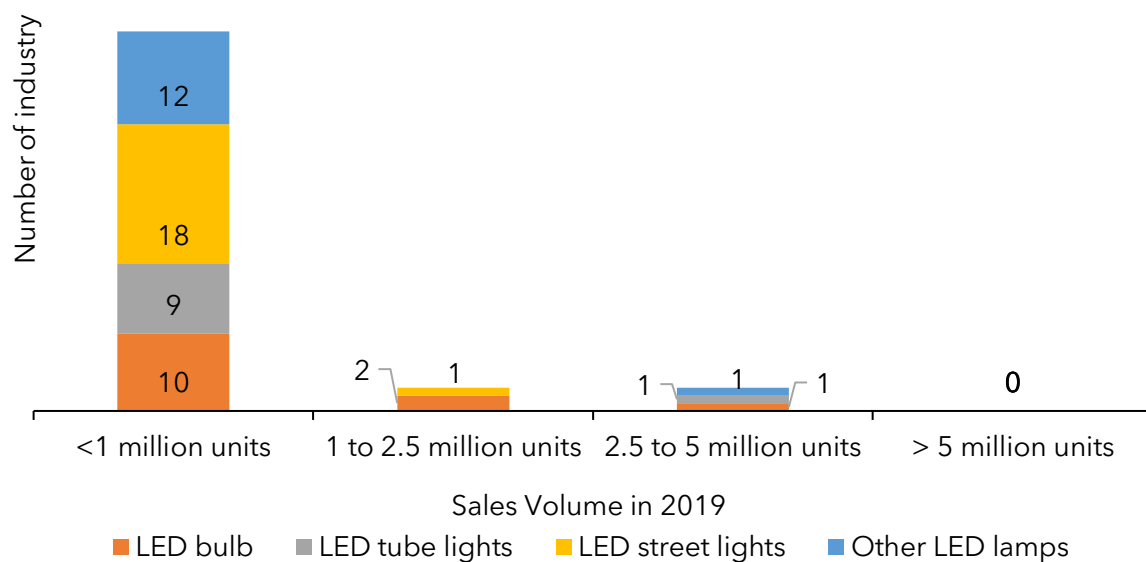
The LED lamp production process is simpler than the non-LED lamp production process. The production process of LED lamps does not need glass components, gas, and mercury. Generally, local industries procure LED components in modules (either from imports or other domestic industries), and then the local industries assemble these components. As an illustration for the LED bulb, an industry with basic equipment and seven workers working 8 hours can produce 1,500 lamps per day or 540 thousand lamps per year. For the production process of street lights, an industry with 28 workers can produce 300 lamps per day or 108 thousand lamps per year. The production capacity can be increased easily by increasing the working hours or adding laborers.

Most local industries have a production capacity of fewer than 1 million units per year, as shown in Figure 2.1. Production capacity relies on the number of workers, where industries with more than 1 million units have more than 70 employees. The Ministry of Industry estimates that the production capacity utilization of local lamp industries is only 15 to 16%. The low utility is due to the low demand for local lamps. Figure 2.2 and Figure 2.3 show that the sales volume of the Indonesian lamp industry is generally below 1 million lamps, which the range is relatively high, from hundreds of units to thousands of units per year.



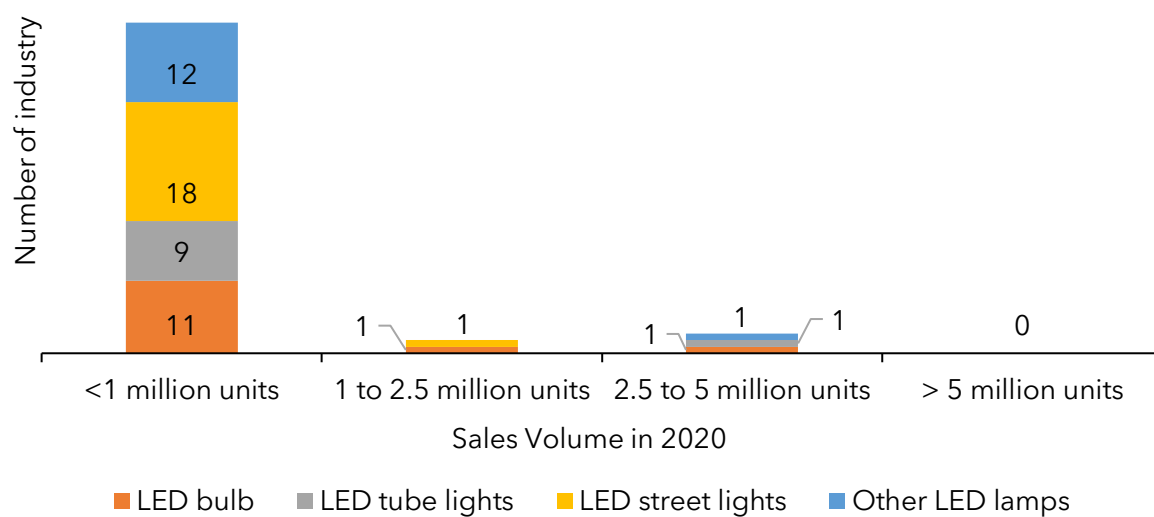
n = 26 respondents

Figure 2.1 Production capacity of Indonesia's LED lamp industries



n = 26 respondents

Figure 2.2 Sales volume of Indonesia's LED lamp industries in 2019

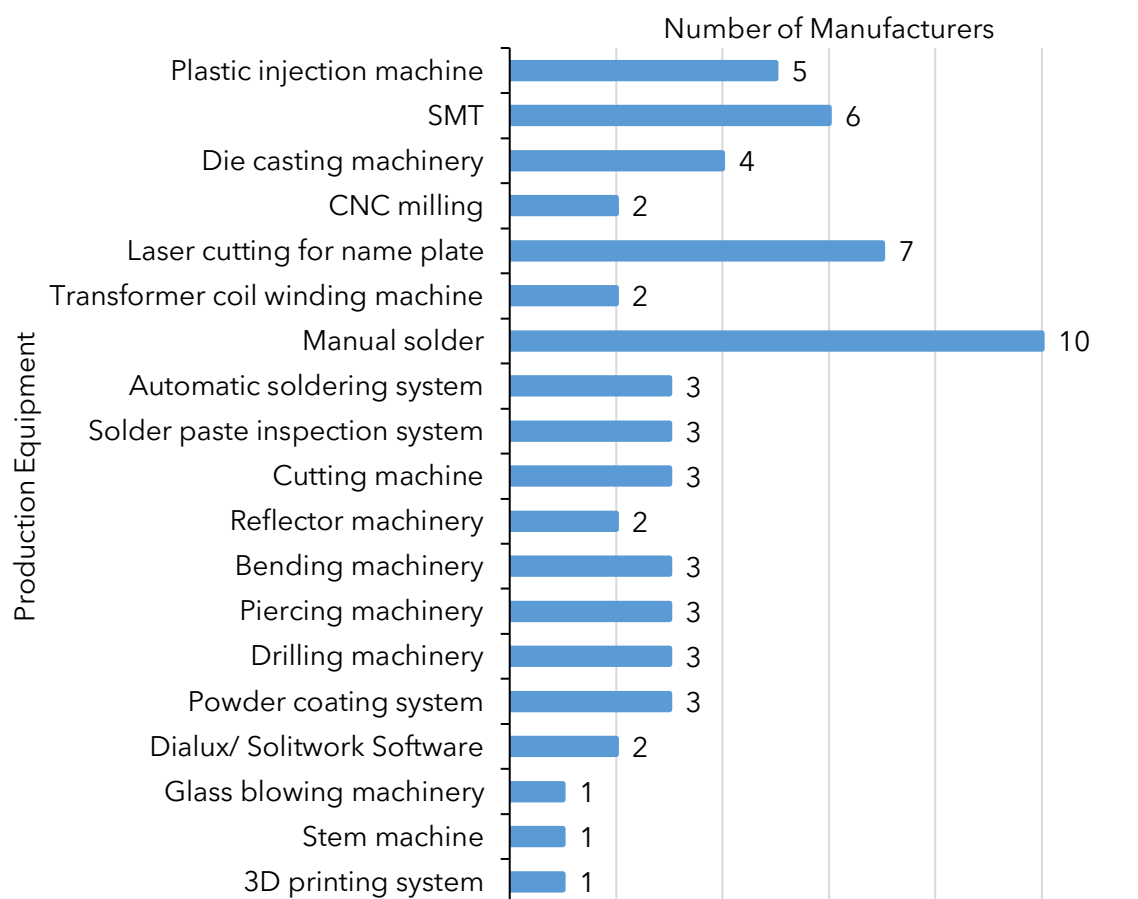


n = 26 respondents

Figure 2.3 Sales volume of Indonesia's LED lamp industries in 2020

2.3. Technology

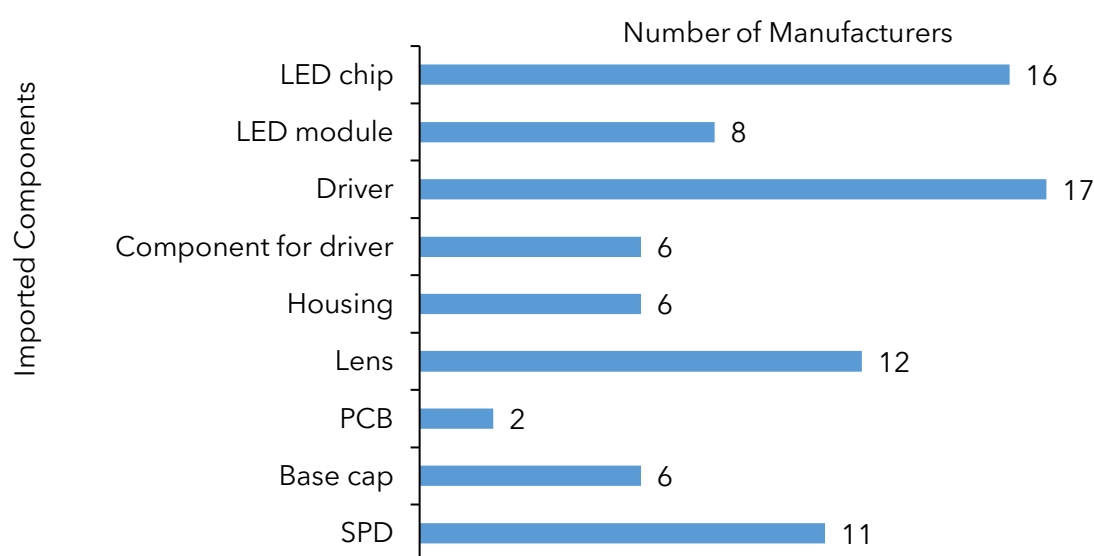
Local industries have different ownership levels of production equipment, as shown in Figure 2.4. The commonly used basic production tools are manual soldering and laser cutting machines to stamp information at housings or lamp covers. Local industries also have surface mount technology (SMT) machines (6 industries), plastic injection machines for producing casing/cover (5 industries), die-cast machines (4 industries), and automatic soldering systems (3 industries). One industry has a glass-blowing machine and a stem machine to produce filament-type LED lamps. One industry has a 3D printing machine to produce consumer-designed lamp housings quickly. All industries have electrical characteristic test equipment, e.g., multimeters and current-measuring instruments, and aging test equipment. Other standard test equipment are integrated sphere photometry (ISP) (8 industries), humidity and temperature chamber (2 industries), goniophotometer, and water spray chamber (1 industry).



Base (n) = 20 respondents

Figure 2.4 Production Tools

The local industry still relies on imported components, as shown in Figure 2.5. 66.7% of respondents import LED chips and assemble them onto a printed circuit board (PCB). Other respondents import LED plates (i.e., PCBs that have LED chips installed). Most industries already use local PCBs, but two industries still import PCBs, especially double-layer PCBs. In addition, most industries still import lamp drivers, and only six industries import driver components and later assemble them in Indonesia. Although local industries can produce housing (housing) and lamp lenses (diffuser), some still import these two products. Import decisions take into account economies of scale for own production. For example, manufacturing the bulb housings in plastic injection machines has material losses, so producing the housings in small volumes will have higher costs. Likewise, six industries argue that import prices of the base cap component are lower than producing or buying them domestically.



Base (n) = 24 respondents

Figure 2.5 Imported components/parts

Most components can be made or assembled domestically, such as base cap (i.e., fitting), lamp housing, heatsink inside the housing, driver, driver components, diffuser, PCB, thermal transfer pad, and LED plates. However, many industries still import these components due to price considerations. The results of the ADLIGHT survey suggest several revisions to industrial trees made by the Ministry of Industry, as shown in Figure 2.6 for LED bulbs and Figure 2.7 for street lights. The revision in Figure 2.6 breaks the LED

module into three parts, namely the LED chip, PCB, and LED plate, and breaks down the LED driver into drivers and driver components. Industri can assemble LED plates and drivers domestically because 6 LED lamp industries have SMT machines to attach LED chips on PCB. Industries without SMT machines have bought LED plates and drivers from other local industries that have SMT machines.

At least the street light technology consists of components in Figure 2.7, i.e., a driver, SPD, reflector/lens, LED plate, housing, and bracket. Materials for driver components, SPD, and LED plates are from import. Components made domestically are reflectors, housings, and brackets. LKPP [8] noted that the TKDN of street lights reached 69%, with an average of 17.8%, as shown in Figure 2.8. About 332 street lights have 0% TKDN, but LKPP assured that those street lights are local products. Those street light industries neither registered the TKDN certificate nor entered TKDN values into the Electronic Catalog application.

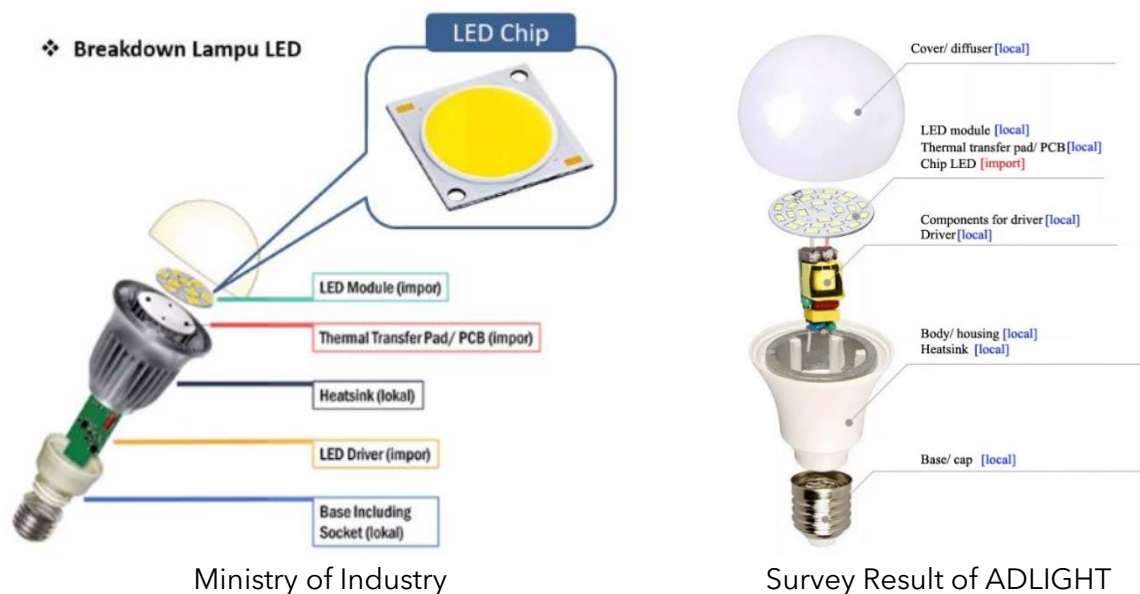


Figure 2.6 The industrial tree of LED bulbs

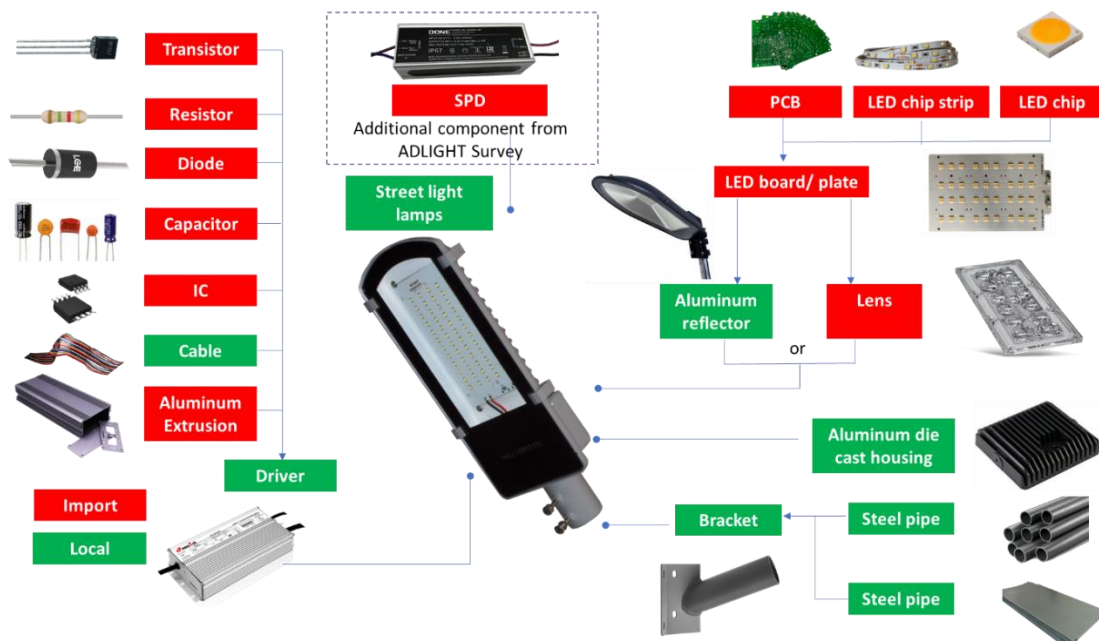
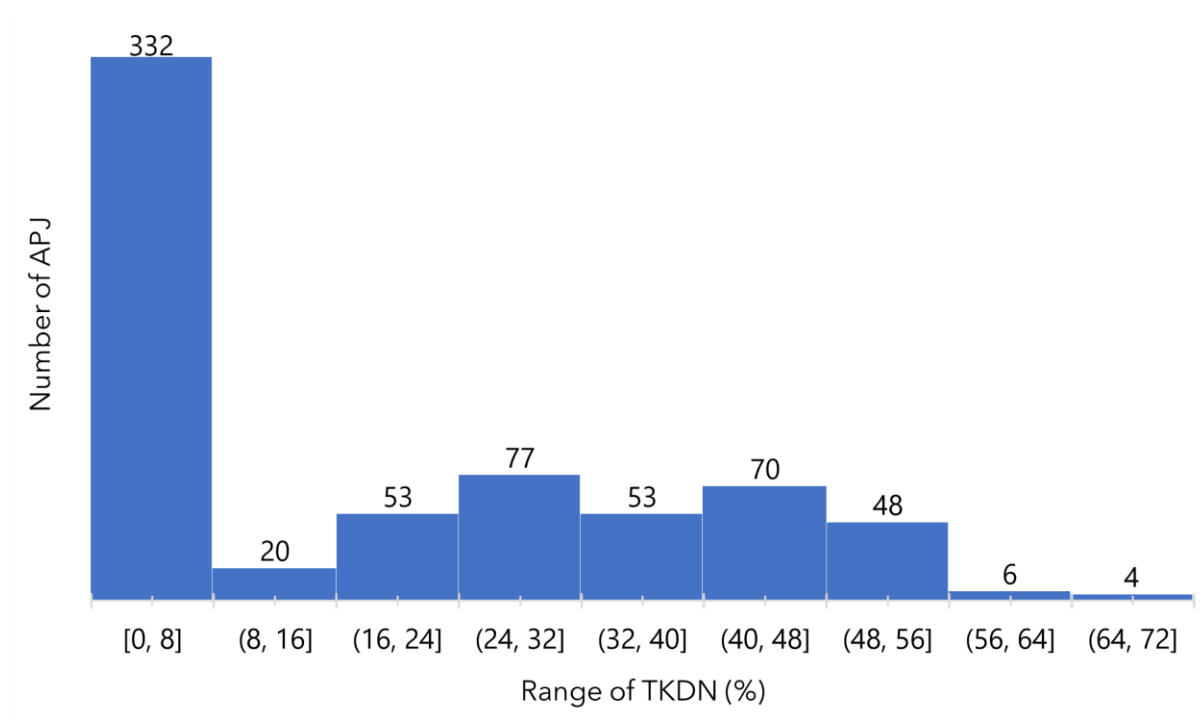


Figure 2.7 The industrial tree of LED street lights

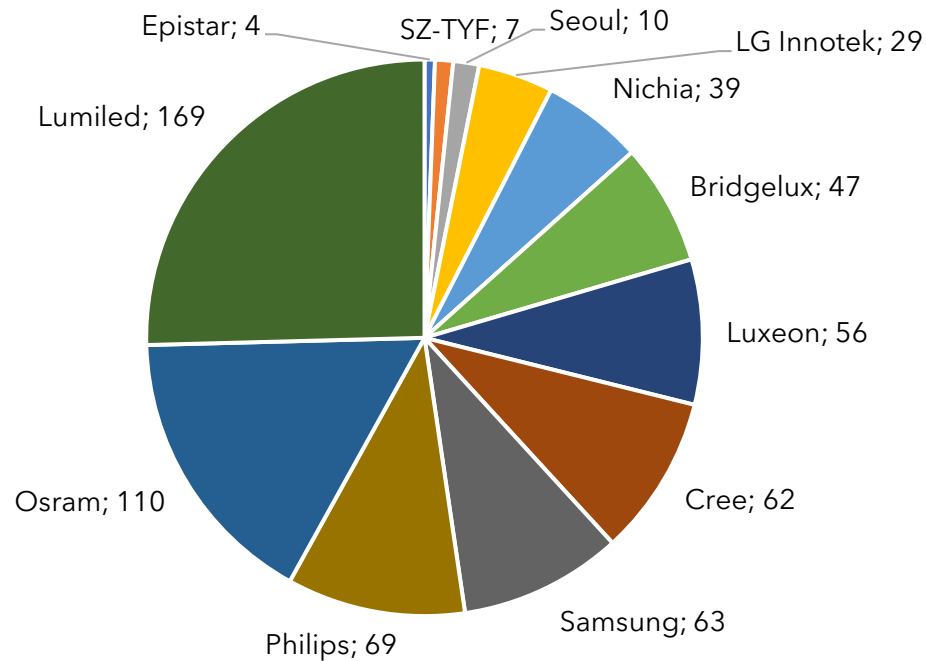


Source: LKPP [8]

Figure 2.8 TKDN of LED street lights in the LKPP Electronic Catalog

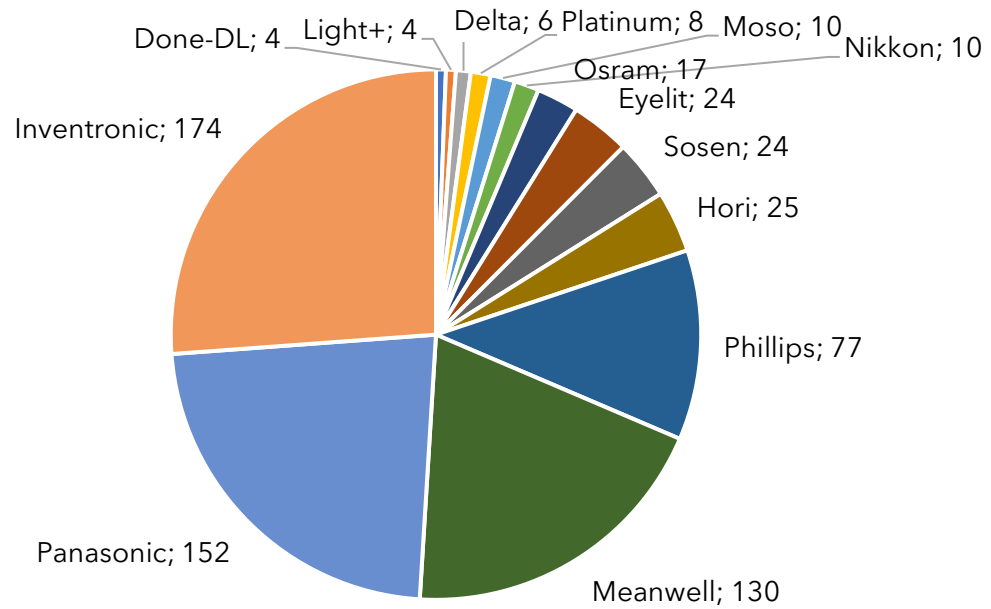
Technologies of LED chips, drivers, and housings for street lights listed in the LKPP Electronic Catalog are diverse, as shown in Figures 2.9, 2.10, and 2.11 [8]. The most widely used LED chip technologies are Lumiled (169 lamps), Osram (110 lamps), Phillips (69

lamps), Samsung (63 lamps), and Cree (62 lamps), as shown in Figure 2.9. The common brands for drivers are Inventronic (174 lamps), Panasonic (152 lamps), and Meanwell (130 lamps), as shown in Figure 2.10. Figure 2.11 shows that 68.7% of street lights in LKPP [8] have die-casting type housings. The number of street lights with aluminum housings consists of 71 types of pure aluminum, 50 types of aluminum alloy, 8 types of high purity aluminum, and 32 types of aluminum combined with die-cast as accessories.



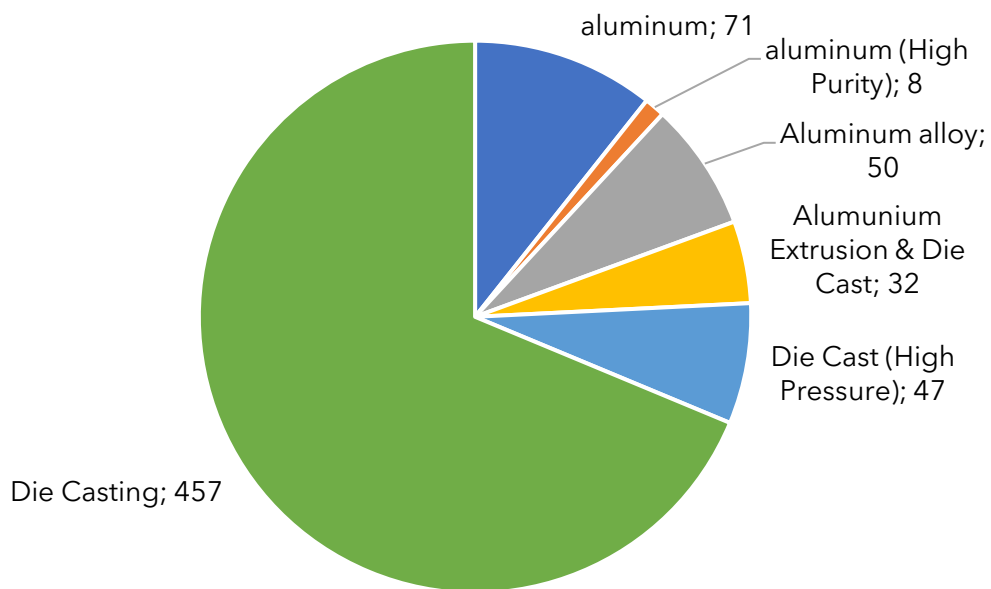
Base (n) : 665 lamps; Source: LKPP [8]

Figure 2.9 LED chip brands used by street lights in the LKPP Electronic Catalog



Base (n) : 665 lamps; Source: LKPP [8]

Figure 2.10 LED driver brands used by street lights in the LKPP Electronic Catalog

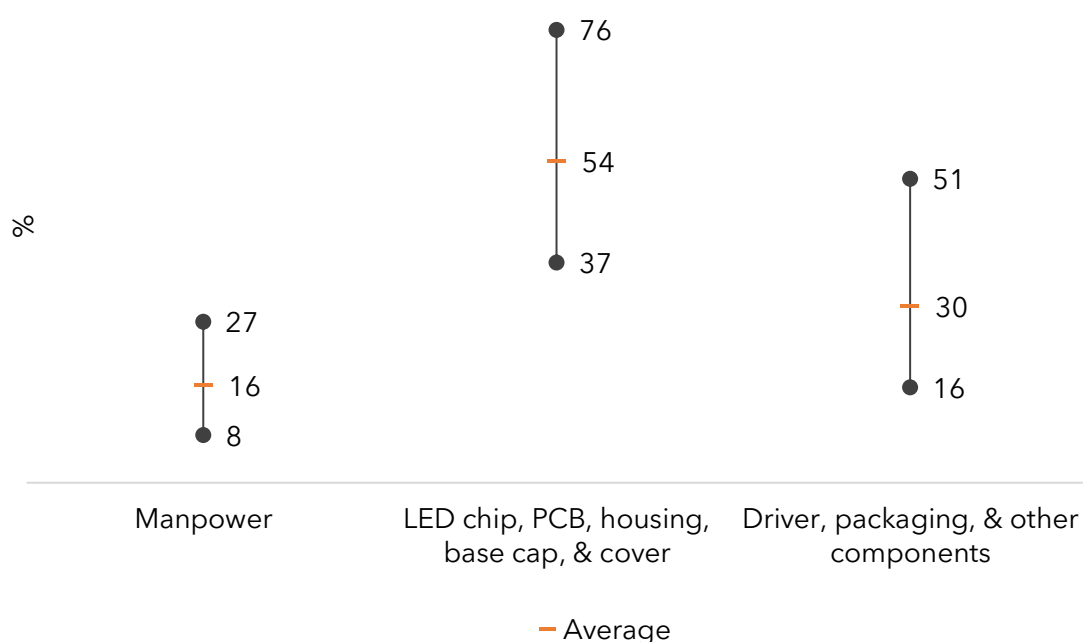


Base (n) : 665 lamps; Source: LKPP [8]

Figure 2.11 The types of housing used by street lights in the LKPP Electronic Catalog

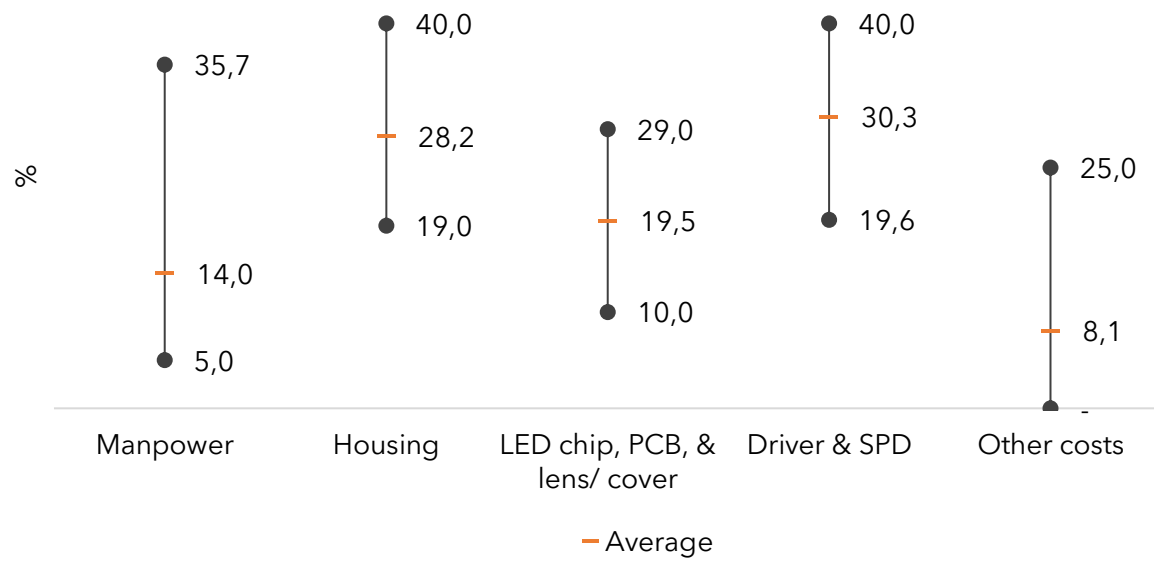
The main production costs of LED bulbs are for the LED chip, PCB, housing, cover, and base cap, which are between 37% to 76% with an average value of 54% of the total cost, as shown in Figure 2.12. The cost breakdown is 9% - 27% for the housing, 16% - 49% for the LED chip and PCB, 2% - 3% for the base cap, and 9% for the cover. The second highest cost is for the driver, packaging, and other components, around 30% on average. The cost of the driver itself is around 23% - 36% of the total production costs. The labor cost range from 8% - 27%, with an average of 16% of total production costs.

The driver and SPD components are the main component costs in LED street lights, as shown in Figure 2.13. The driver price is around 16% - 40% of the production costs, while the SPD price is around 4.5% - 21%. The combined price of these two components is equivalent to 19.6% - 40%, with an average of 30.3% of the total production costs. The following highest average costs were for housing (28.2%), LED chip, PCB and lens (19.5%), and labor (14%). The price of the LED chip is about 11% of the total production cost, and the lens price is between 2% - 7% of the total production cost. In addition to these costs, the production process of street lights also requires other costs such as cables, connectors, and other supporting equipment. These other costs are equivalent to 6% of the total production costs on average.



Base (n) = 5 respondents.

Figure 2.12 The production cost structure of LED bulbs



Base (n) = 8 respondents.

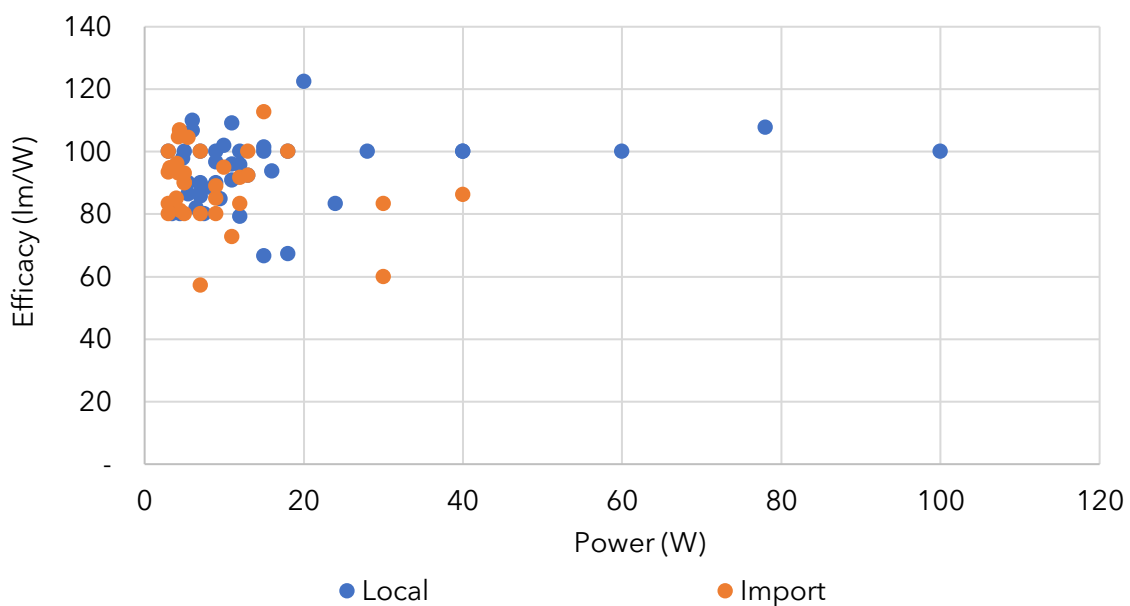
Figure 2.13 The production cost structure of LED street lights



QUALITY AND PRICE OF LAMPS IN INDONESIA

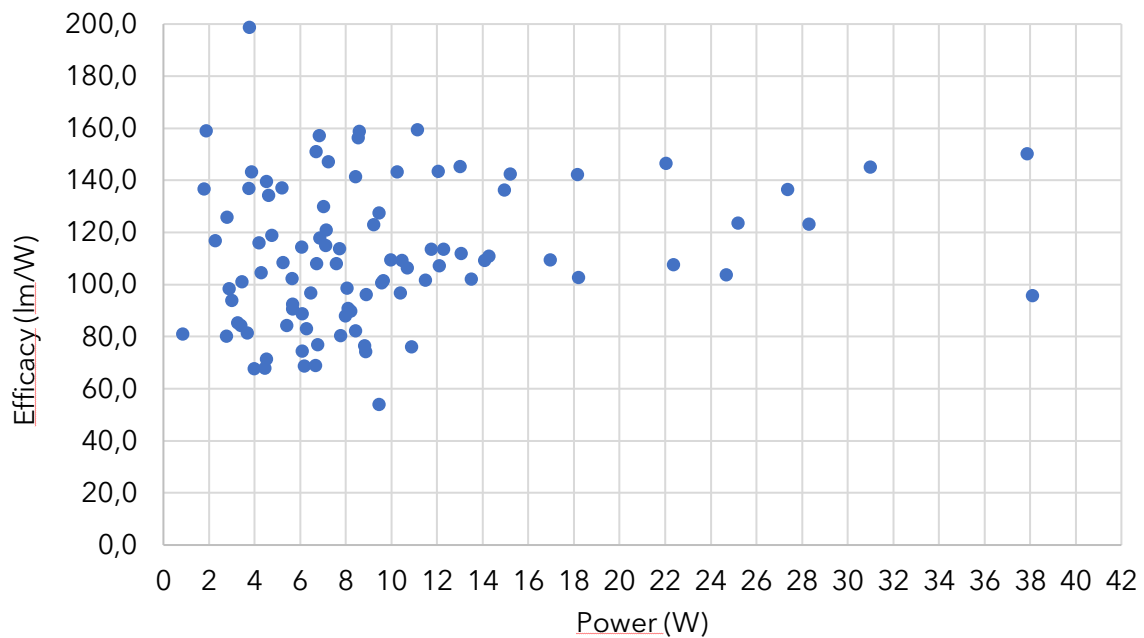
3.1. Efficacy

Local LED lamps have better efficacy than imported LED lamps circulating in Indonesia. Data of CLASP and PwC [1] show that the average efficacy of local LED bulbs is 93 lm/W, which is higher than the average efficacy of imported LED bulbs (89 lm/W) as shown in Figure 3.1. As a note, CLASP and PwC [1] data were data stated on the markings of the packaging. The stated value is reliable because, based on the suitability test of 102 LED lamp models by ADLIGHT [9], the deviation of stated and measured light intensity in 71% of measured lamps was less than 20%. Figure 3.2 shows the efficacy of the measurement results by ADLIGHT [9] in 2021. The efficacy of local lamps ranges between 53.8 lm/W to 198.6 lm/W with an average value of 110 lm/W.



Source: CLASP and PwC [1]; n = 42 local lamps and 33 imported lamps

Figure 3.1 Efficacy listed from local and imported LED bulbs

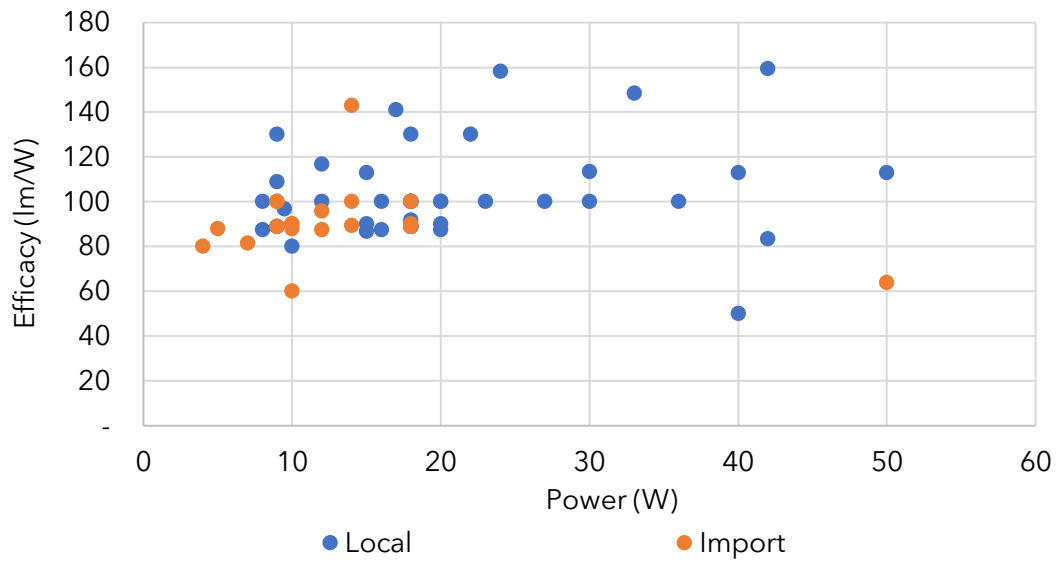


Source: ADLIGHT [9]; n = 95 local lamps

Figure 3.2 Local LED bulb efficacy measurement results

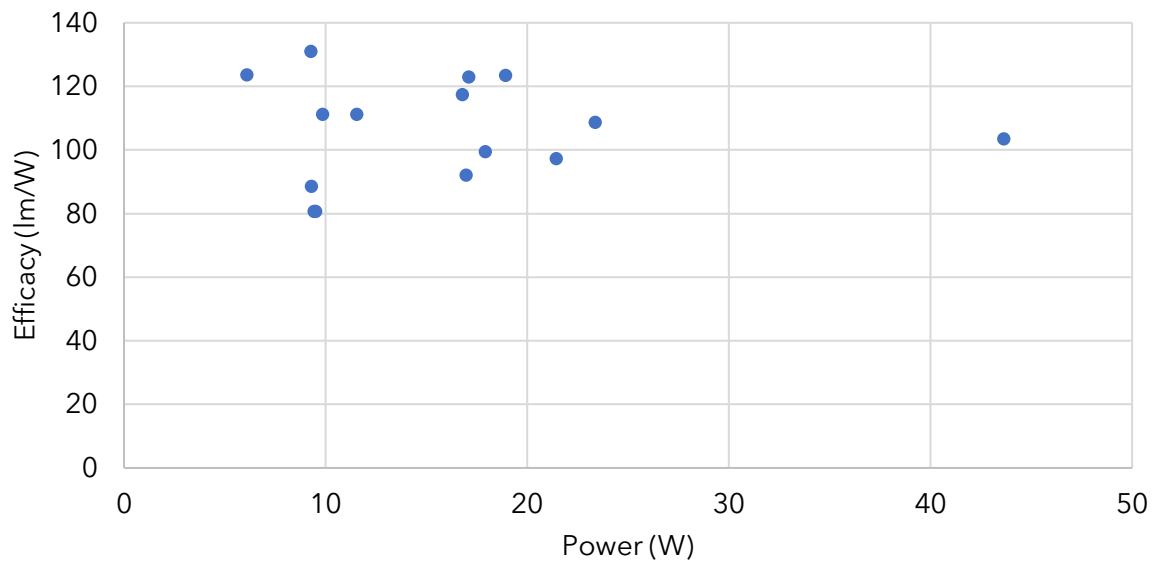
Furthermore, CLASP and PwC [1] data show that local LED tube lights have better efficacy than imported LED tube lights with an average efficacy of 103 lm/W and 91 lm/W, respectively, as shown in Figure 3.3. Data in Figure 3.3 are quite accurate because the measurements by ADLIGHT [9] obtained that the average ratio of the actual data and stated information is about 0.98. Figure 3.4 shows that the results of the efficacy measurement are within the range of stated efficacy, i.e., 80.6 lm/W to 123.3 lm/W, with an average efficacy of 104.3 lm/W.

Related to LED bulbs and LED tube lamps, the measurement data of ADLIGHT [9] is relatively the same as the stated data. Therefore, efficacy survey data from CLASP and PwC [1] is trustworthy. CLASP and PwC [1] data show that the average efficacy values of other local LED lamps are also high, i.e., 98 lm/W for downlights (Figure 3.5), 97 lm/W for floodlights (Figure 3.6), and high bay (Figure 3.7). In contrast, the average efficacy values of other imported LED lamps are 86 lm/W for downlights (Figure 3.5), 88 lm/W for floodlights (Figure 3.6), and 104 lm/W for high bay (Figure 3.7).



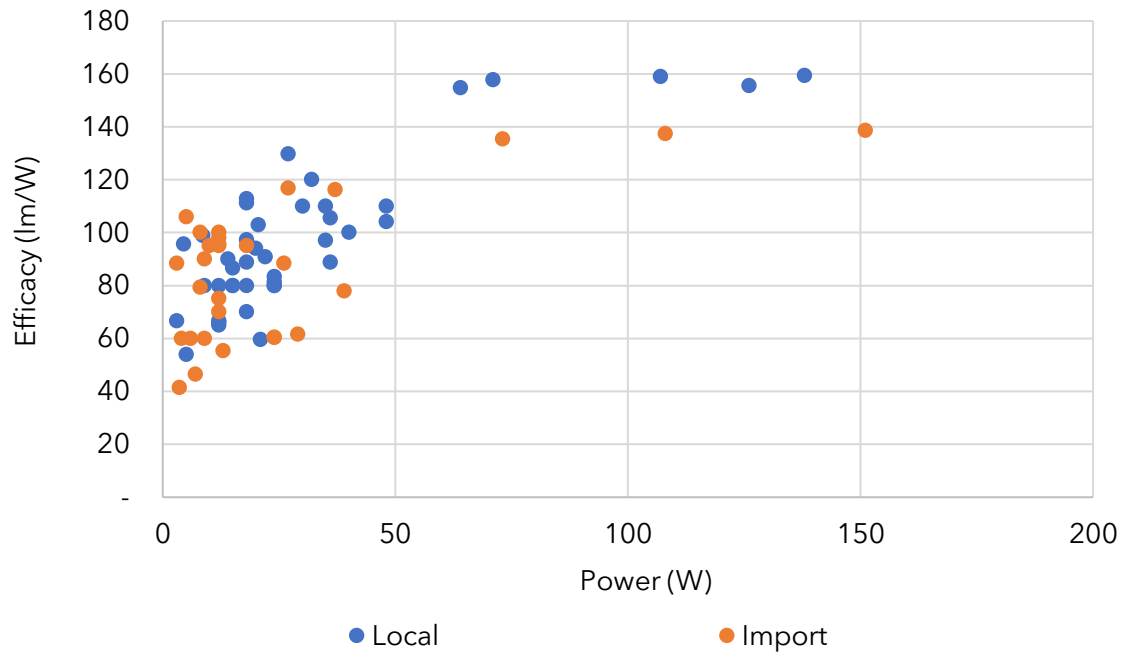
Source: CLASP and PwC [1]; n = 43 local lamps and 19 imported lamps

Figure 3.3 Stated efficacy of local and imported LED tube lights



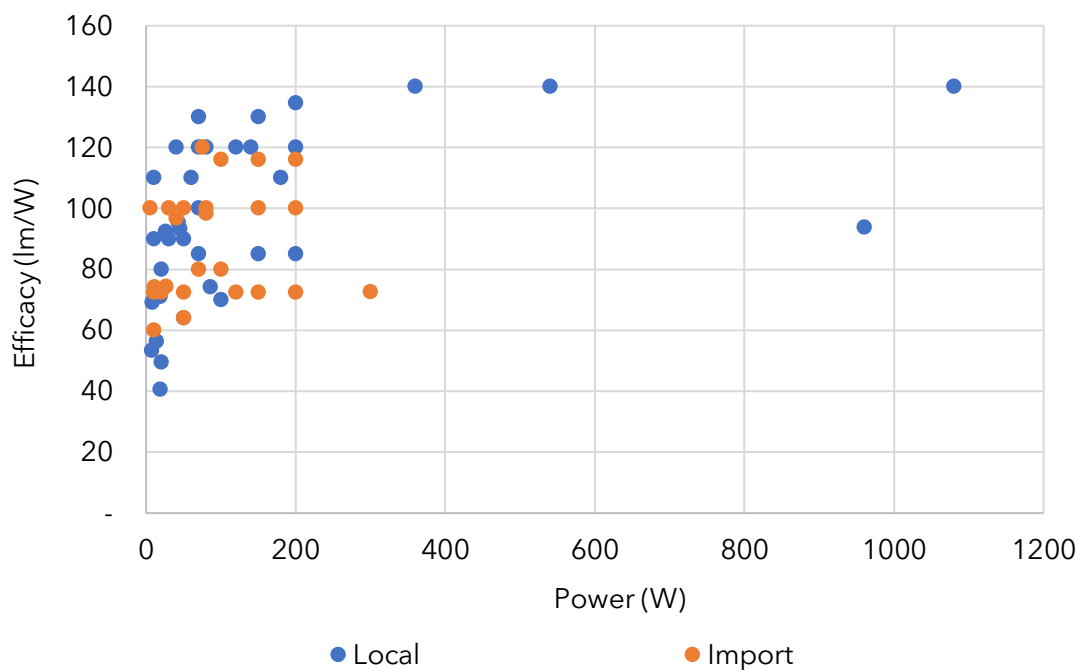
Source: ADLIGHT [9]; n = 14 local lamps

Figure 3.4 Measured efficacy of local LED tube lights



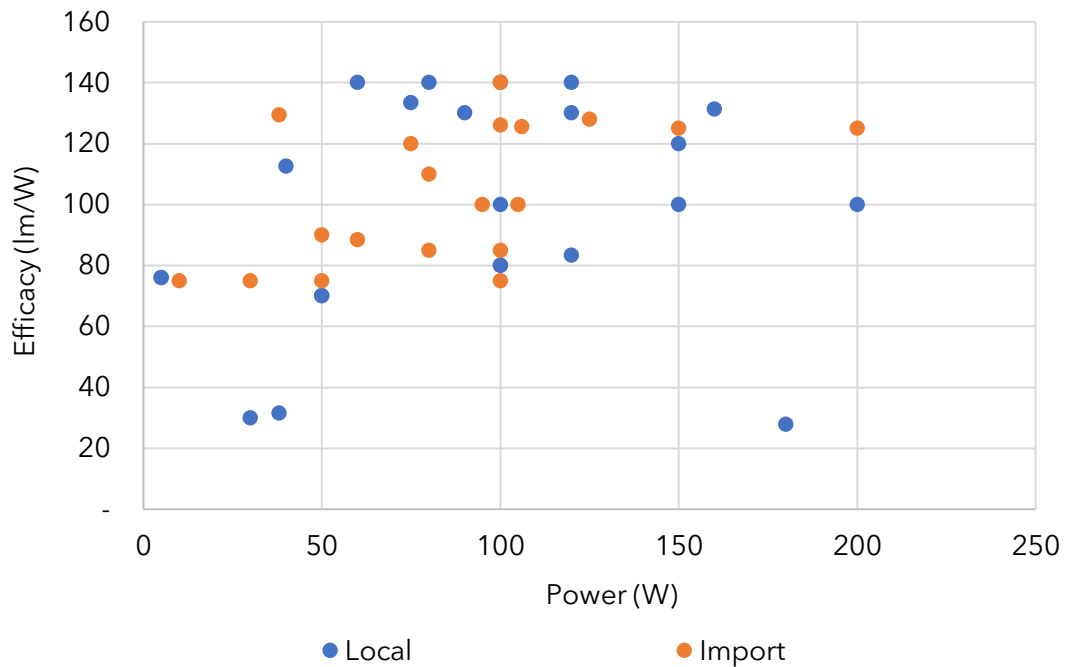
Source: CLASP and PwC [1]; n = 42 local lamps and 29 imported lamps

Figure 3.5 Stated efficacy of local and imported LED downlights



Source: CLASP and PwC [1]; n = 36 local lamps and 25 imported lamps

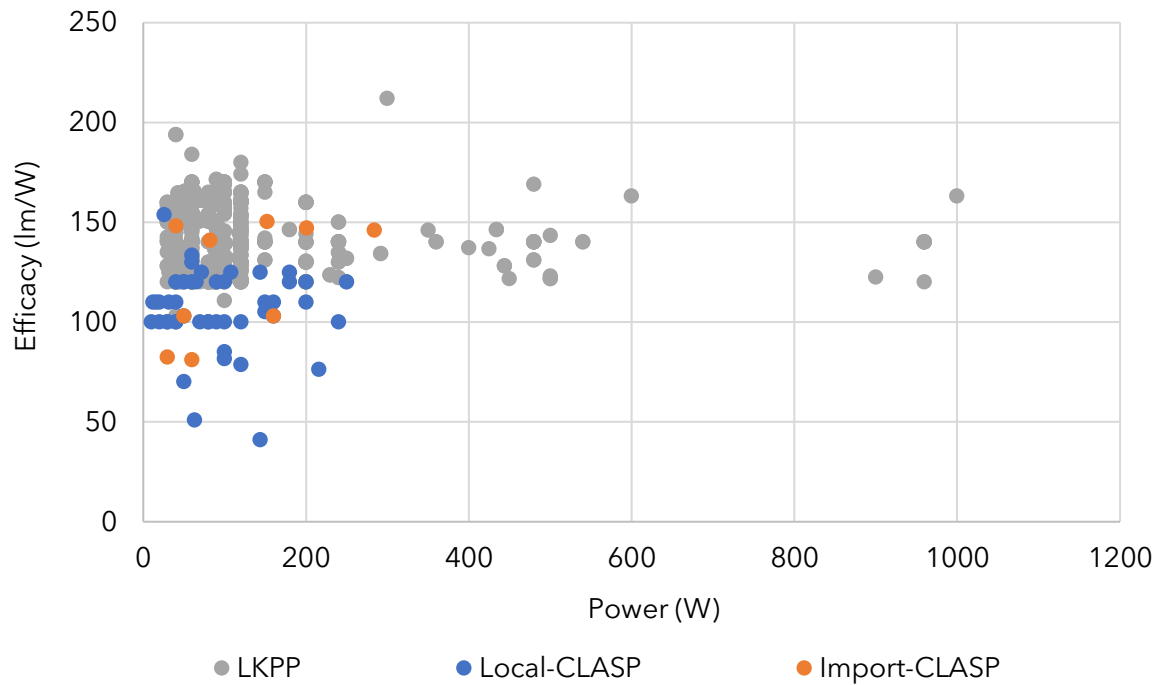
Figure 3.6 Stated efficacy of local and imported LED floodlights



Source: CLASP and PwC [1]; n = 23 local lamps and 19 imported lamps

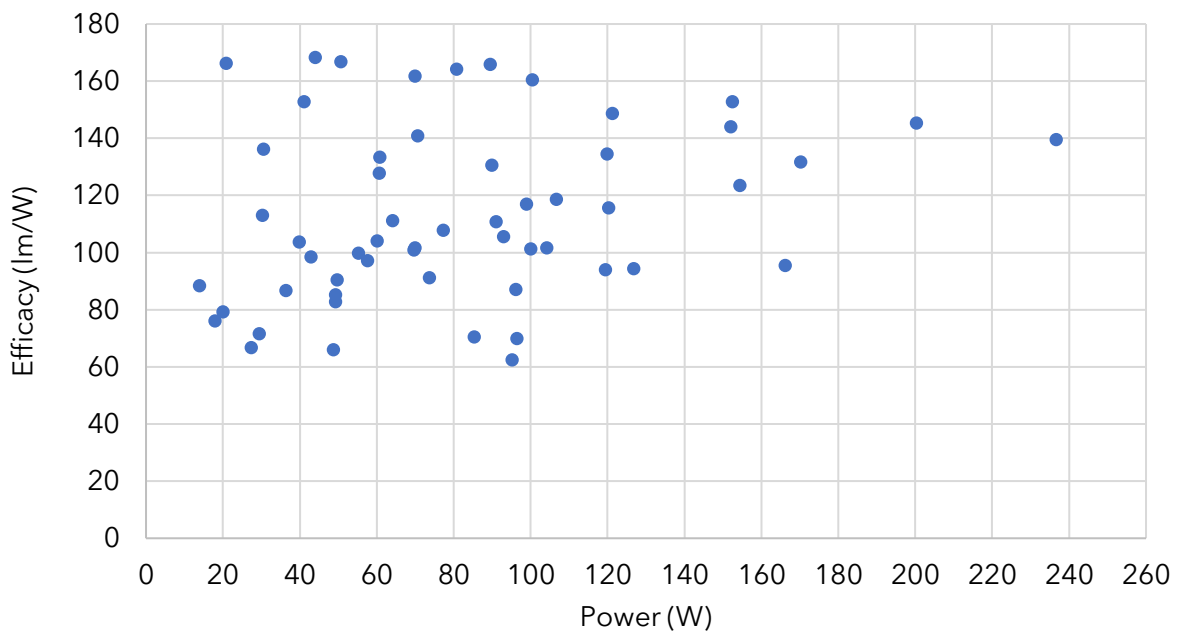
Figure 3.7 Stated efficacy of local and imported LED high bay

In general, the efficacy of local street lights can compete with imported street lights, as shown in Figure 3.8. Survey data of CLASP and PwC [1] show that, on average, local street lights have an efficacy of 106 lm/W while imported street lights have an efficacy of 122 lm/W. The efficacy of LED street lights in the Electronic Catalog [8] ranges from 81 lm/W to 212 lm/W with an average of 140 lm/W. Survey data of CLASP and PwC [1] are relatively similar to the measurement data of ADLIGHT [9]. The average measured efficacies of 58 local street lights and high bay lamps are 113 lm/W, as shown in Figure 3.9.



Source: LKPP [8]: n = 664 lamps; CLASP and PwC [1]: n = 48 local lamps, and 9 imported lamps.

Figure 3.8 Stated efficacy of local and imported LED street lights



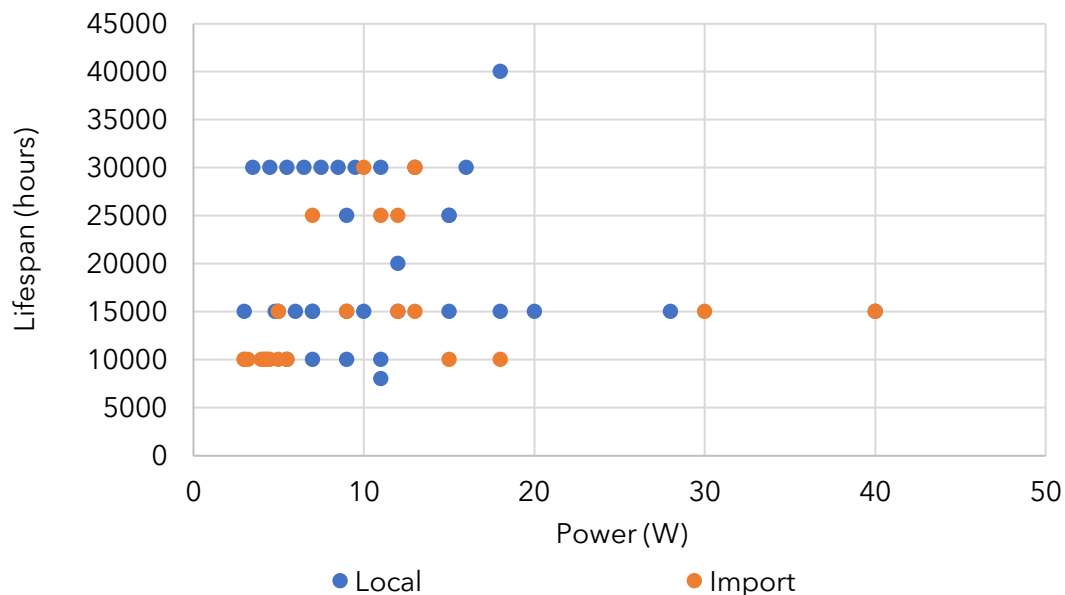
Source: ADLIGHT [9]; n = 58 local lamps

Figure 3.9 Measured efficacies of local street lights and high bay

3.2. Lifespan

Survey results of CLASP and PwC [1] show that, on average, local LED lamp industries state a longer lifespan than that of imported LED lamps. In Figure 3.10, the lifespan of local LED bulbs reaches 40,000 hours with an average value of 20,000 hours. For comparison, the lifespan of imported LED bulbs is 15,000 hours on average and 30,000 hours at most. Local LED tube lights also have a higher average lifespan of 37,000 hours than the average lifespan of imported LED tube lights, i.e., 27,000 hours (Figure 3.11).

Other LED lamps also have a better average life[1]. The average lifespans for local and imported LED downlights are 36,000 hours and 29,000 hours, respectively, as shown in Figure 3.12. Local LED floodlights have a lifespan between 20,000 to 50,000 hours with an average of 40,000 hours (Figure 3.13). On the other hand, the lifespan range of imported LED floodlights is around 25,000 to 50,000 hours, with an average of 35,000 hours. In Figure 3.14, the average lifespans of local and imported high bays are 38,000 hours and 33,000 hours, respectively.



Source: CLASP and PwC [1]; n = 34 local lamps and 23 imported lamps

Figure 3.10 The stated lifespan of local and imported LED bulbs

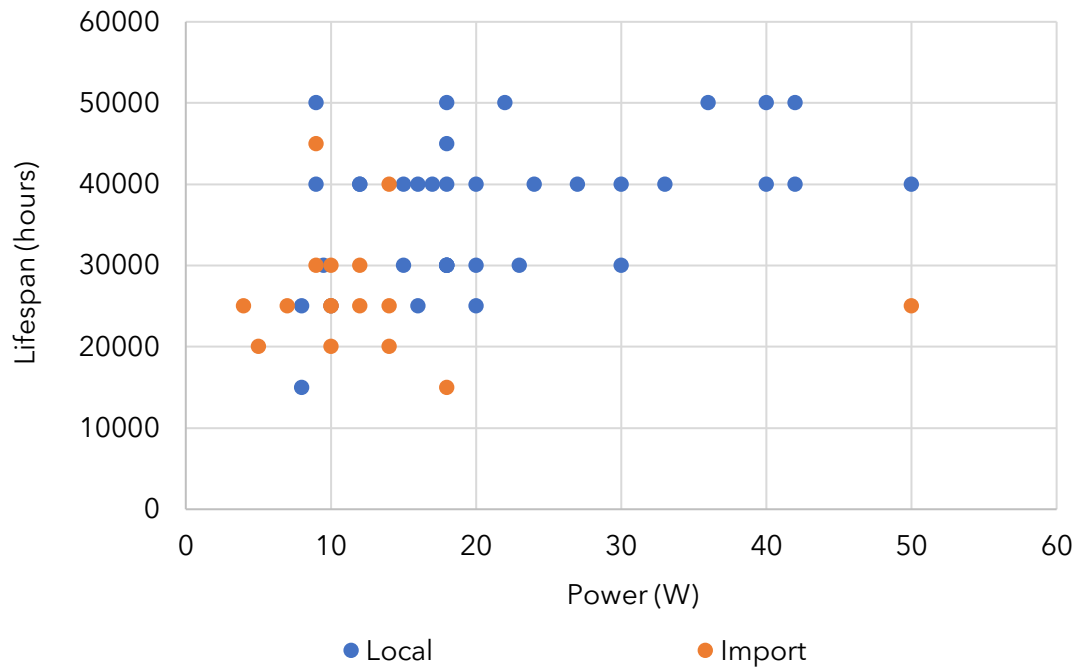


Figure 3.11 The stated lifespan of local and imported LED tube lights

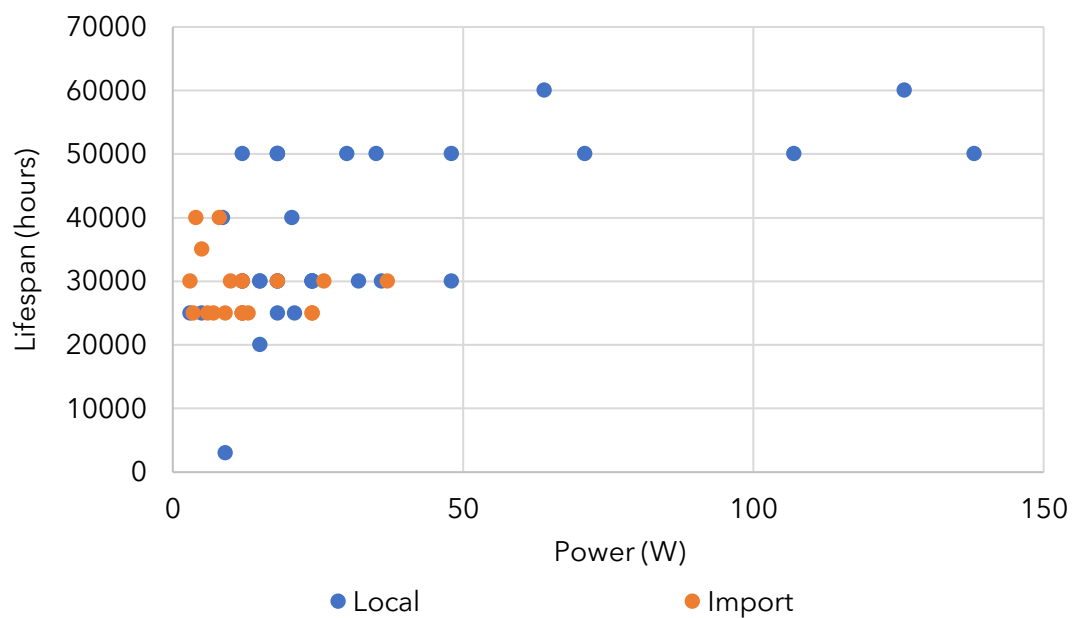
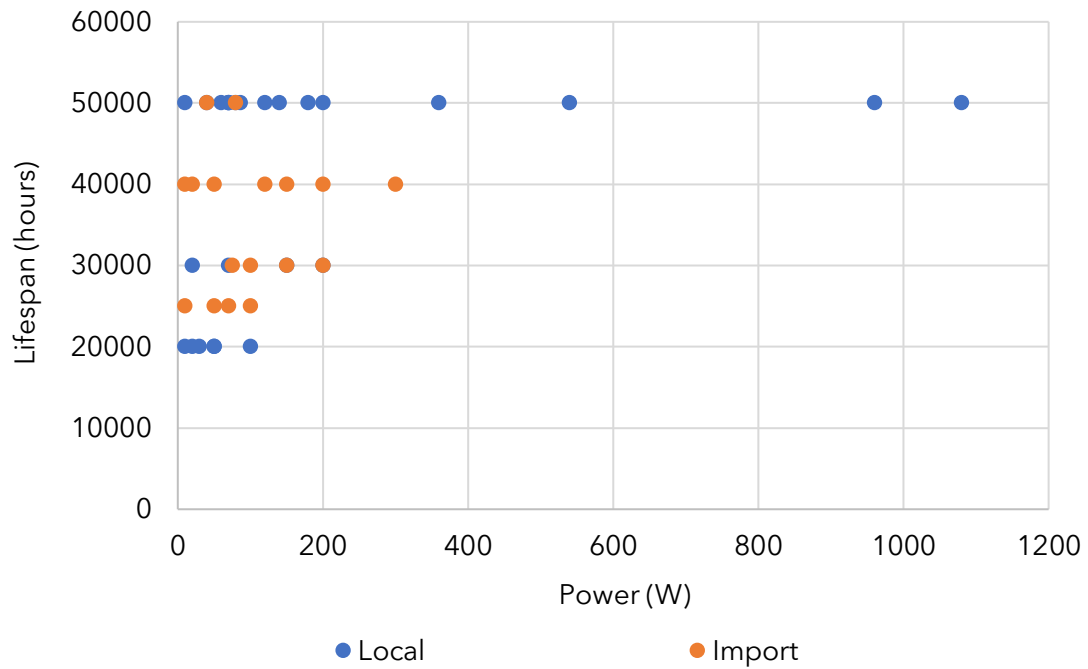
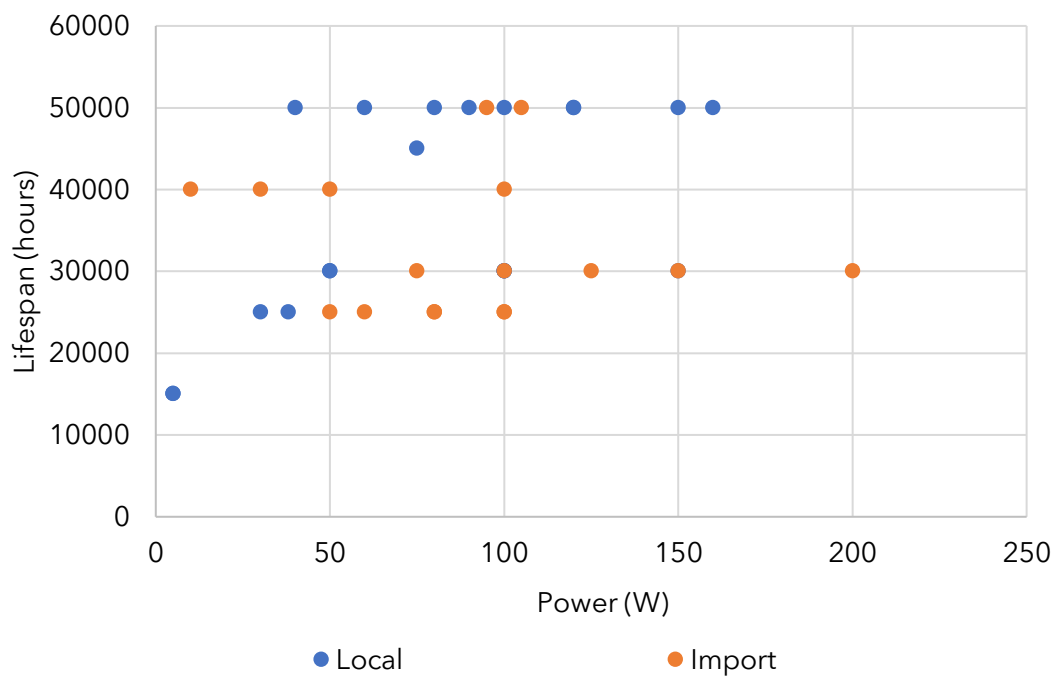


Figure 3.12 The stated lifespan of local and imported LED downlights



Source: CLASP and PwC [1]; n = 26 local lamps and 19 imported lamps

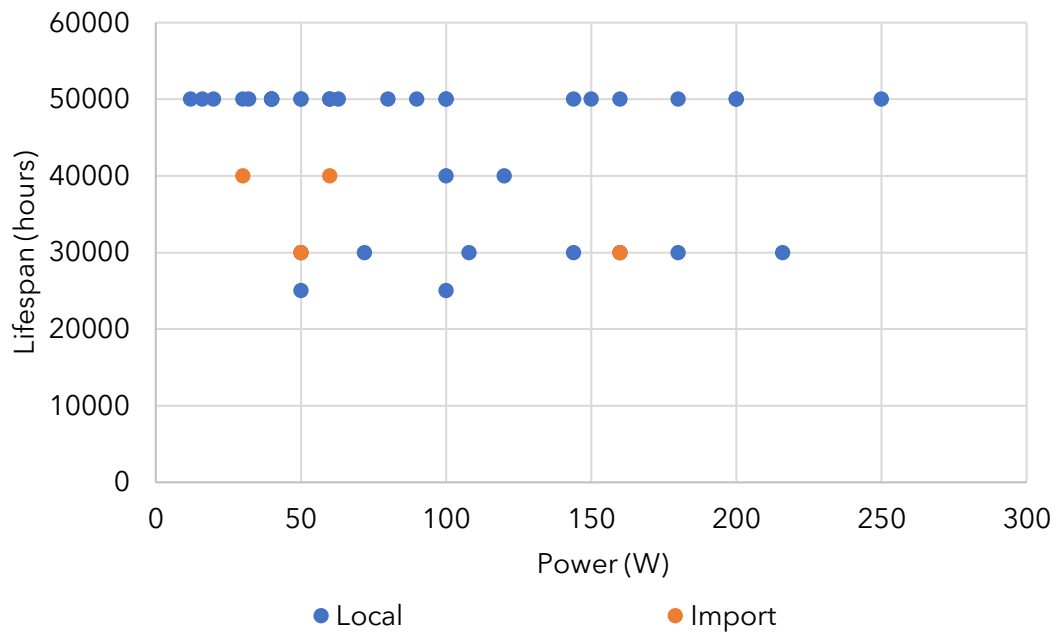
Figure 3.13 The stated lifespan of local and imported LED floodlights



Source: CLASP and PwC [1]; n = 20 local lamps and 17 imported lamps

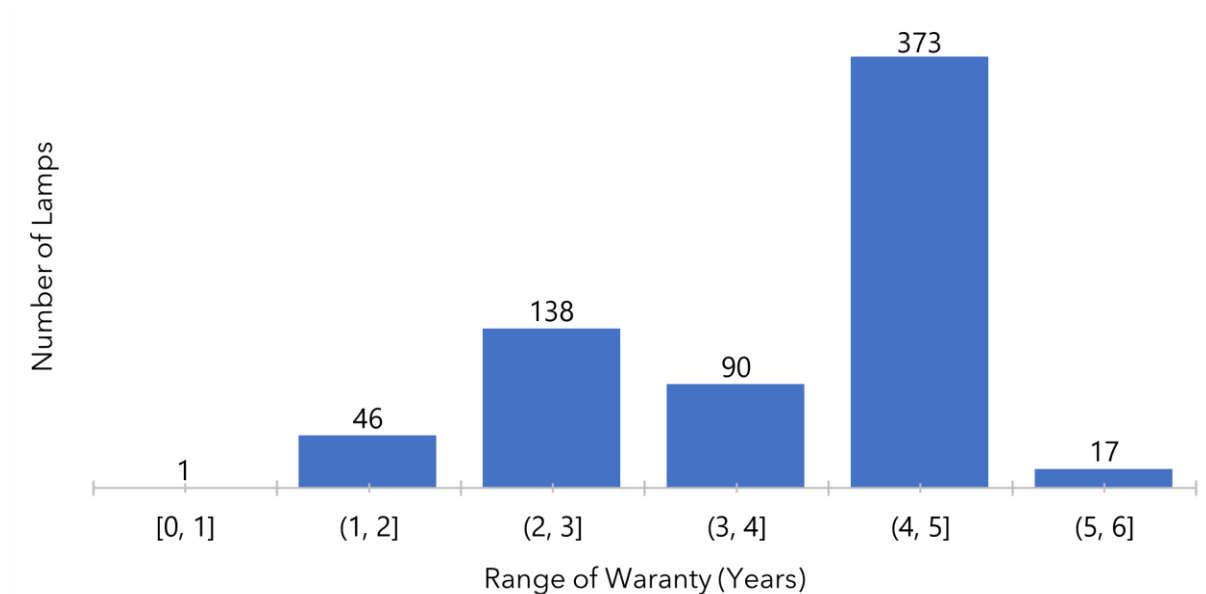
Figure 3.14 The stated lifespan of local and imported high bays

Most local street lights have a lifespan of around 50,000 hours, as shown in Figure 3.15. The lowest lifespan is 25,000 hours, and the average is 44,000 hours. Imported street lights have a lifespan of between 15,000 to 45,000 hours with an average of 27,000 hours. With such a high lifespan, local street light industries generally provide a five-year warranty, and, at most, several industries may give a six-year warranty, as shown in Figure 3.16.



Source: CLASP and PwC [1]; n = 36 local lamps and 4 imported lamps

Figure 3.15 The stated lifespan of the local and imported street lights



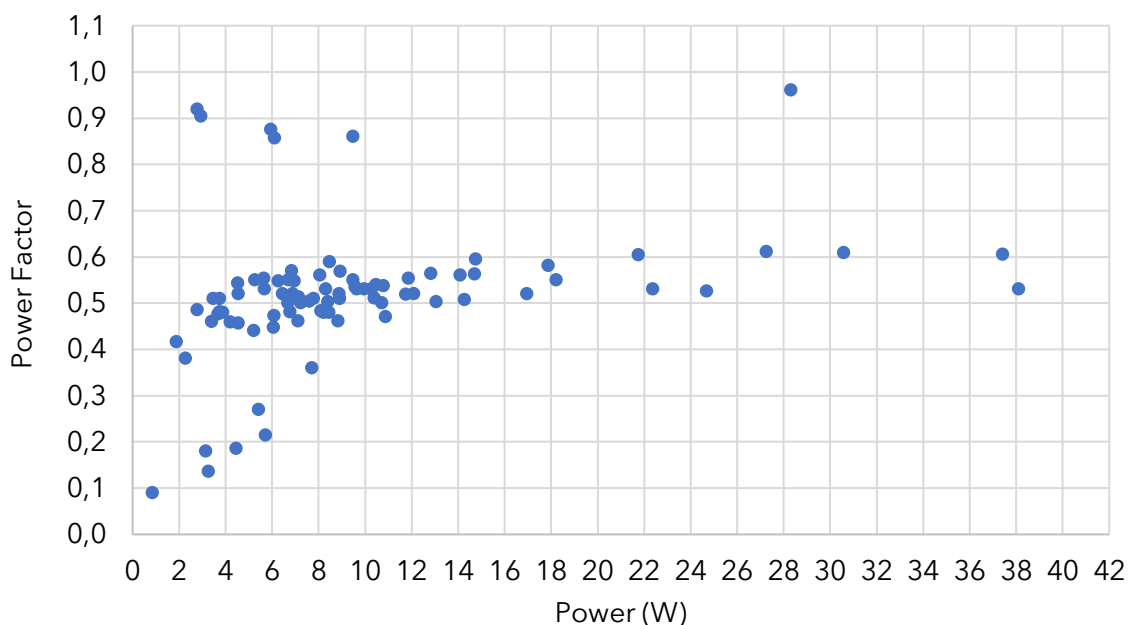
Source: LKPP [8]; n = 665 lamps

Figure 3.16 The warranty of LED street lights at the LKPP Electronic Catalog.

3.3. Power Factor

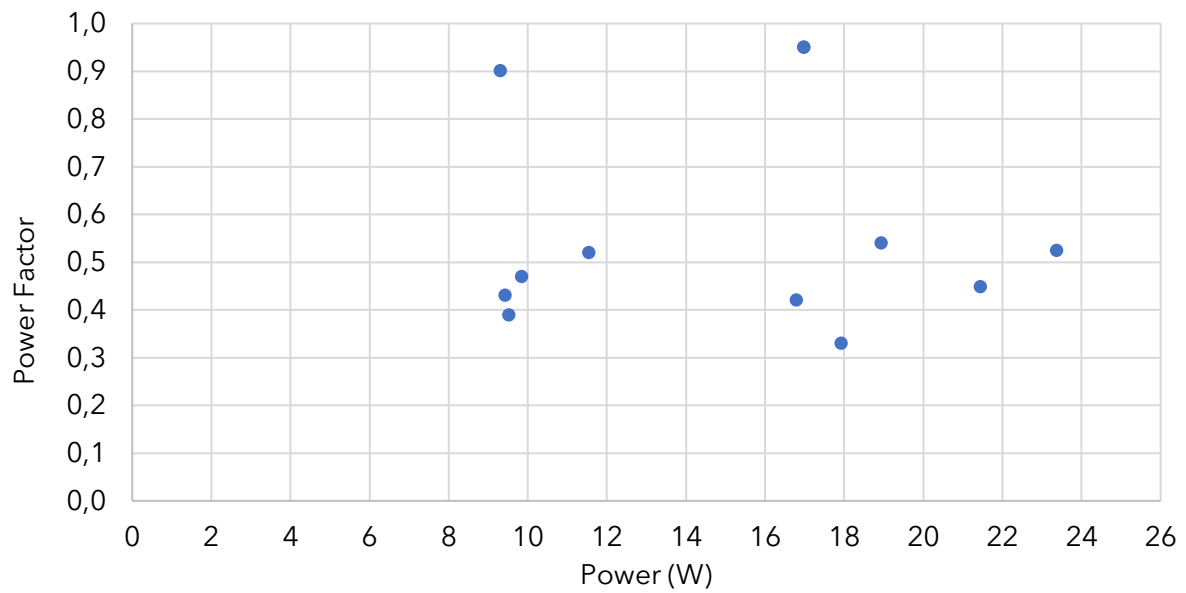
The quality of the power factor of local LED lamps is quite diverse, as shown in Figures 3.17, 3.18, and 3.19. Measurement results by ADLIGHT [9] in Figure 3.17 show that a local LED bulb has a low power factor (i.e., 0.09), but some bulbs have a power factor of 0.96. The average measured power factor of the 120 local LED bulbs is around 0.52. The LED tube lights also have a low average power factor of 0.6 from sampled 15 lamps. The power factors of the sample range from 0.33 to 0.95, as shown in Figure 3.18.

The measured power factors of LED street lights and high bay vary from 0.38 to 0.99, as shown in Figure 3.19. The average power factor of the 58 samples is 0.94. The measurement results are similar to the average power factor data of 665 street lights in the Electronic Catalog [8], equal to 0.9. Figure 3.20 shows that the most common power factors for street lights in the Electronics Catalog [8] are around 0.85 to 0.9. Another typical power factor range is 0.95 to 1, found on 233 street lights.



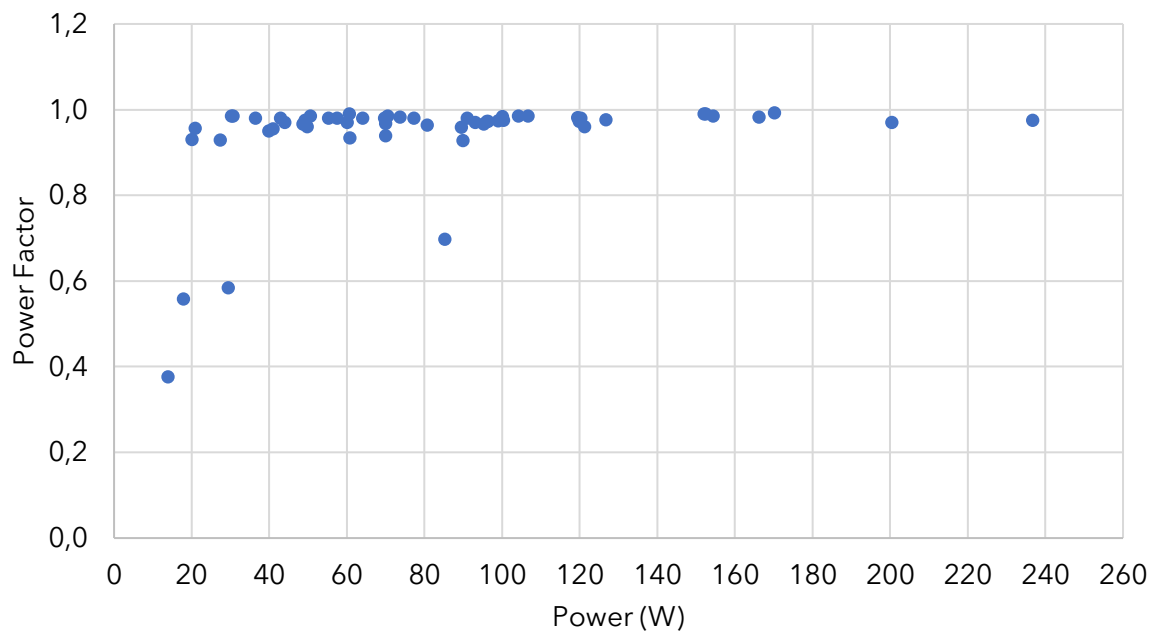
Source: ADLIGHT [9]; n = 102 local lamps

Figure 3.17 The measurement results of power factor of local LED bulbs



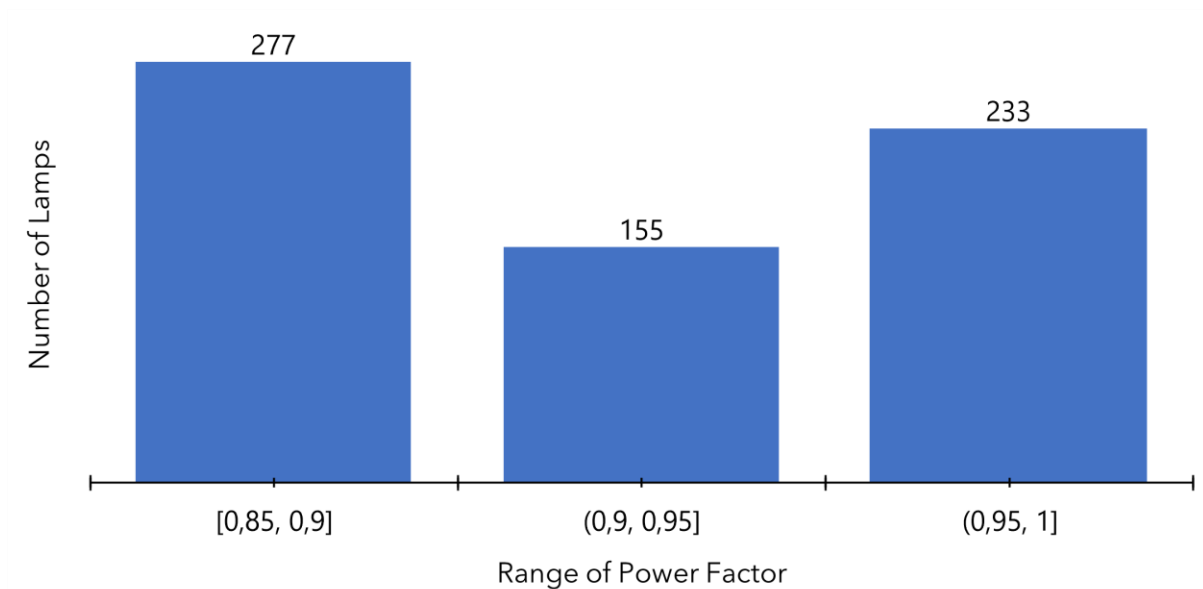
Source: ADLIGHT [9]; n = 15 local lamps

Figure 3.18 The measurement results of power factor of local LED tube lights



Source: ADLIGHT [9]; n = 58 local lamps

Figure 3.19 The power factor measurement results of local street lights and high bay



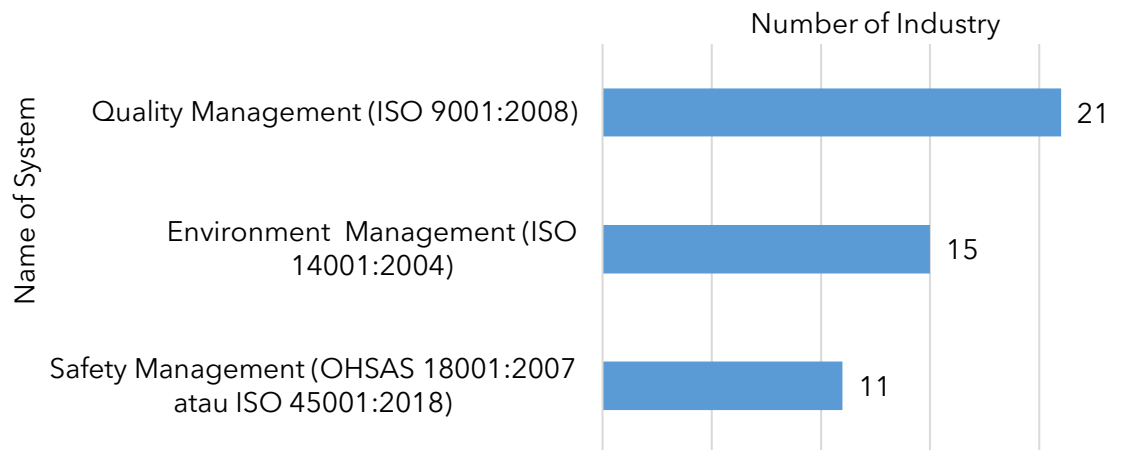
Source: LKPP [8]; n = 665 lamps

Figure 3.20 The capacity factor of LED street lights in the LKPP Electronic Catalog

3.4. Standardization

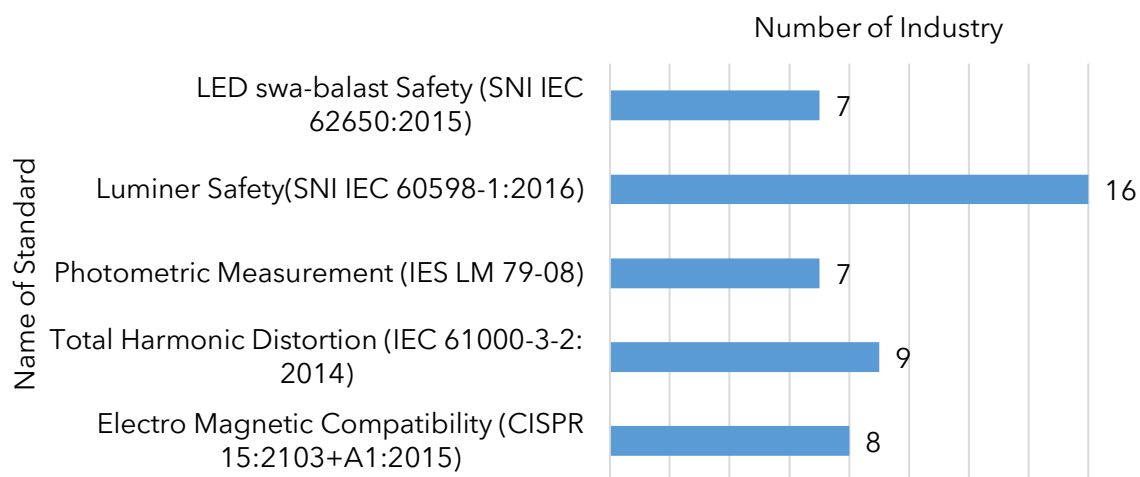
Most surveyed industries have implemented a management system, as shown in Figure 3.21. Industries applying the ISO 9001:2008 quality management system and the ISO 14001:2004 environmental management system are 21 and 15 industries, respectively. 11 industries implement occupational health and safety (K3) management systems, i.e., OHSAS 18001 and ISO 45001. Seven industries also comply with the national standard for LED lamp safety (i.e., SNI IEC 62560:2015). In Figure 3.22, industries for street lights and other LED-based luminaires have obeyed various standards requested in government procurement, i.e., SNI IEC 60598-1:2016 (16 industries), photometric measurement test results (7 industries), total harmonic distortion standard (THD) (9 industries), and electromagnetic compatibility (EMC) standards (8 industries). The website for goods complying with the national standard [10] records that at least 52 local LED bulbs have SNI IEC 62560:2015 [11] as in Figure 3.23. The number of local LED bulbs with SNI IEC 62560:2015 is potentially higher because not all industries report their lamps with SNI to the website, managed BSN [10]. Moreover, the website shows LED bulbs with SNI 04-6504-2001 [12], the safety standard for CFLs. This condition may occur due to an error in inputting

the SNI number and incorrect use of the SNI. BSN cannot verify each case because BSN only inputs data from Product Certification Agencies and industries into the website.



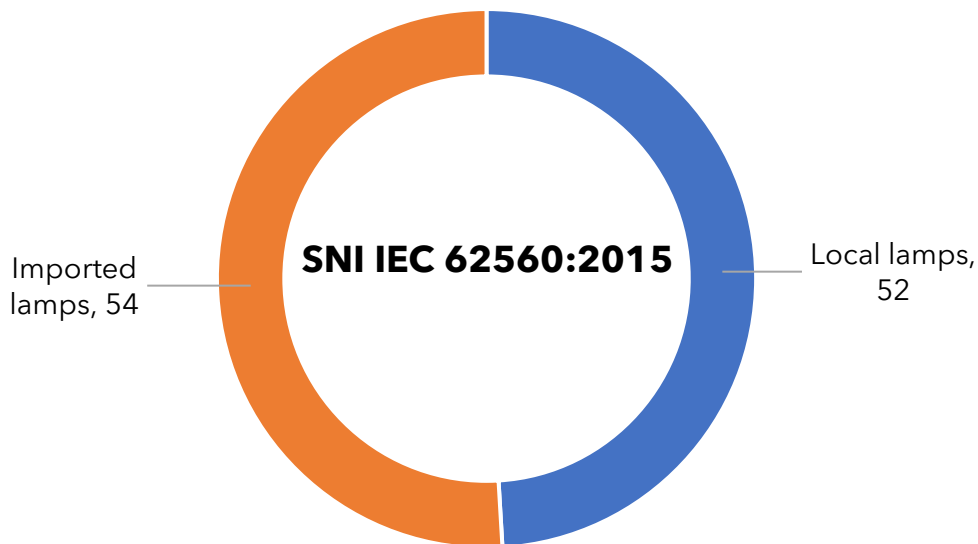
Base (n) = 26 respondents

Figure 3.21 Management system applied by local industries



Base (n) = 26 respondents

Figure 3.22 Test standards used by local industries

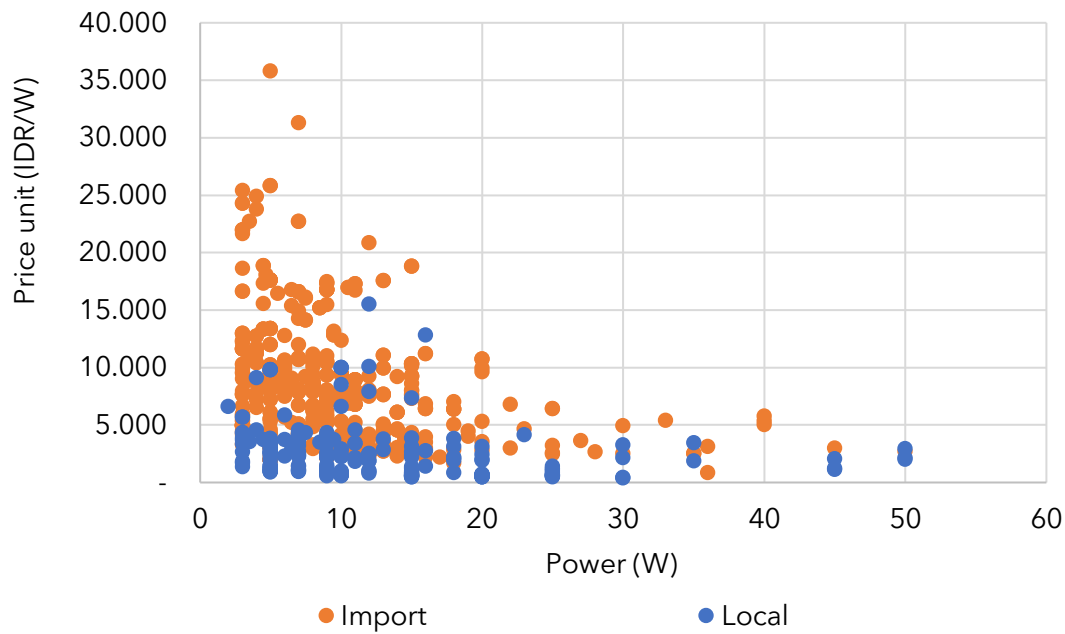


Source: BSN [10]

Figure 3.23 Number of LED bulbs complying with SNI IEC 62560:2015

3.5. Price

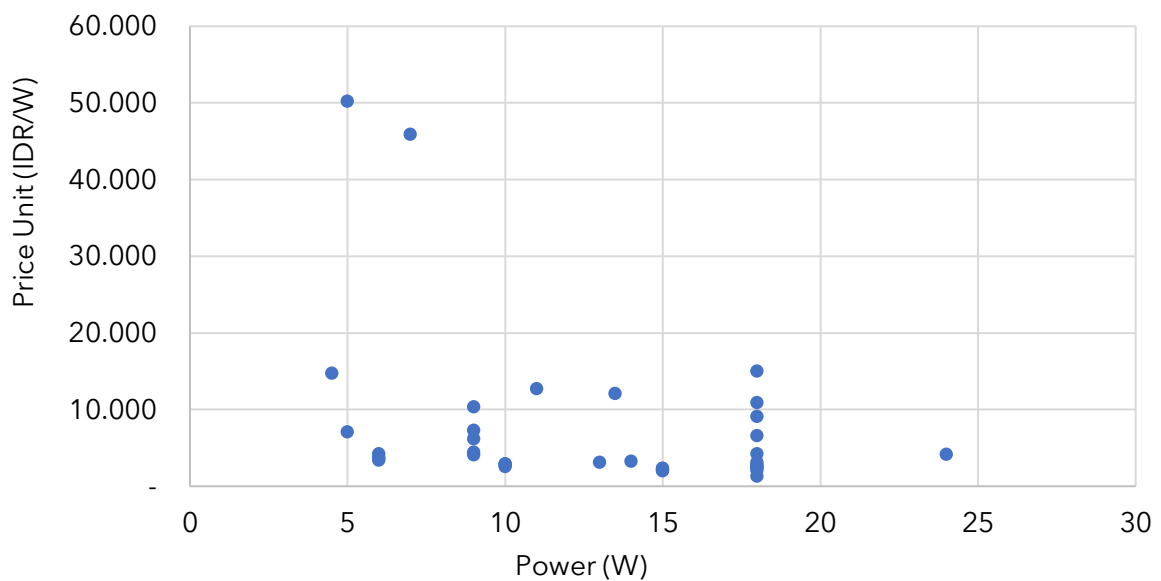
Imported LED lamps generally come from China, and the ASEAN-China Free Trade Area (ACFTA) agreement imposes zero import duty on those imported LED lamps. On the other hand, imports of raw material components are subject to import duties whose values vary unless imports use a Certificate of Origin form E. Other factors determining prices are labor, income taxes, factory operating costs, and investment costs. As a result, the entire surveyed industries stated that their production costs were not competitive compared to the price of imported lamps. However, Figure 3.24 shows that local LED bulb prices are generally cheaper than imported LED bulbs. The prices of local LED bulbs range from IDR 556 /W to IDR 15,500 /W, with an average price of IDR 3,972 /W. The price units of imported LED bulbs range from IDR 831 to 35,800 /W, with an average of IDR 8,264 /W. Data for imported LED bulbs are from CLASP and PwC [1], conducting market surveys to electrical shops, building shops, mini markets, supermarkets, traditional markets, and online markets. Meanwhile, data for local LED bulbs were from lamps sold in the online market, so prices for local LED bulbs in Figure 3.24 are competitive.



n = 200 local lamps and 522 imported lamps. Source: Prices of imported lamps using data CLASP and PwC [1]; local lamp prices based on price surveys in the online market.

Figure 3.24 Unit prices for local and imported LED bulbs

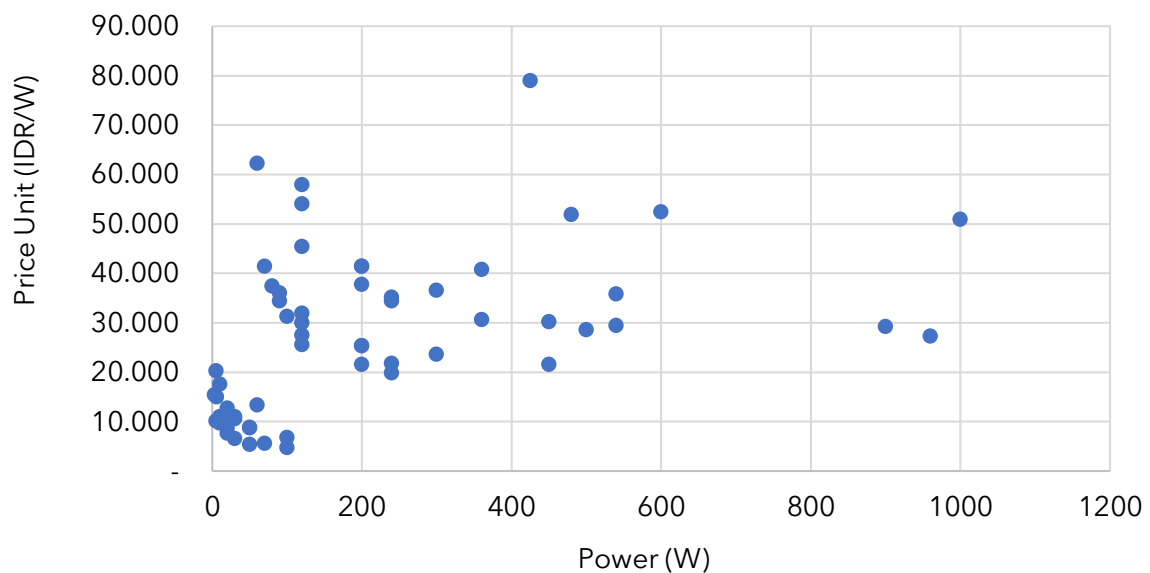
The price unit of LED tube lights is more expensive than LED bulbs. Figure 3.25 shows that the lowest price unit of local LED tube lights is IDR 1,250 /W, and the highest price unit is IDR 50,160 /W. The smart feature and brand influence the price unit. On average, an LED tube light price is IDR 7,395 /W.



n = 38 lamps

Figure 3.25 Unit prices of local LED tube lights

Compared to LED bulbs and tube lights, the LED floodlights have a higher price unit for IDR 27,274 /W, as shown in Figure 3.26. The price unit of LED floodlights ranges from IDR 4,725 /W to 78,956 /W for surveyed 59 lamps.

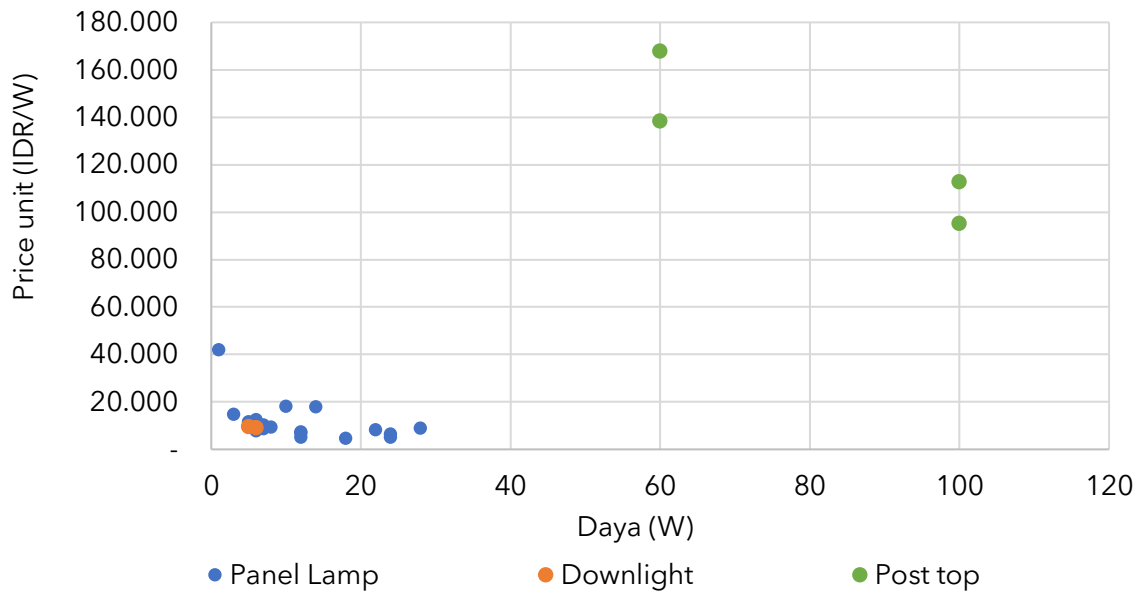


n = 59 lamps

Figure 3.26 The unit price of local LED floodlights

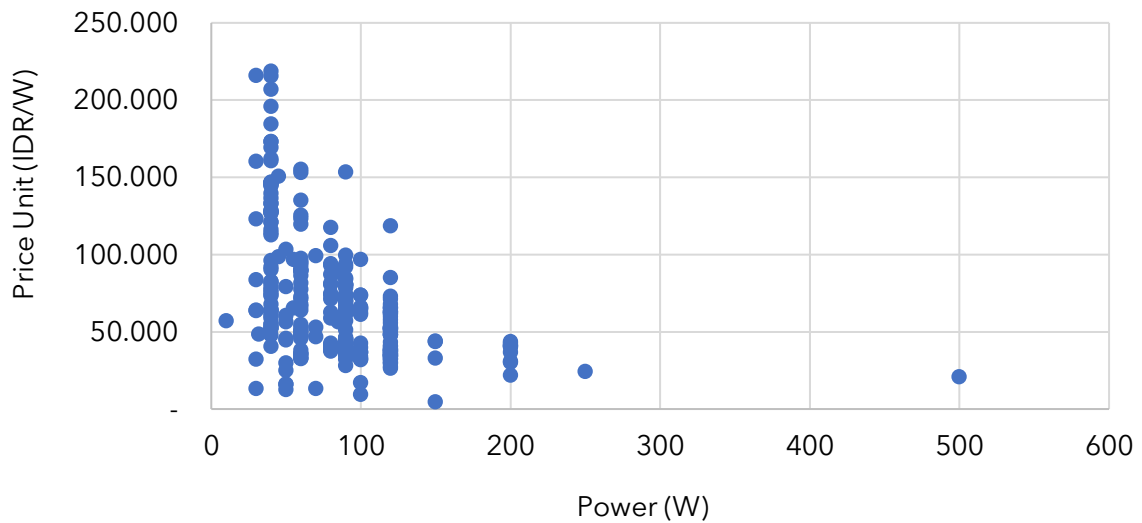
The prices for LED panel lamps, downlights, and post-top LED lamps are in Figure 3.27. The price of LED panel lamps ranges from IDR 4,767 to 330,221 per watt, while the price of LED downlights ranges from IDR 9,100 to 9,500 per watt. The post-top type has a higher price between IDR 95,099 and 167,893 per watt. The average price for LED lamps in Figure 3.27 is IDR 11,342 /W for LED panel lamps, IDR 9,300 /W for LED downlights, and IDR 128,515 /W for post-top lamps.

The prices of LED street lights in Figure 3.28 have a wide range from IDR 4,767 /W to IDR 218,725 /W. This range includes prices of street lights with smart technology, i.e., remote monitoring and reporting technology. The average price of 292 models of LED street lights is IDR 68,883 /W.



n = 19-panel lamps, two downlights, and 4 top post lamps

Figure 3.27 Unit prices for LED lamps type panel, downlights, and post-top



n = 292 lamps

Figure 3.28 The price unit of local street lights



POLICY ACTION PLANS

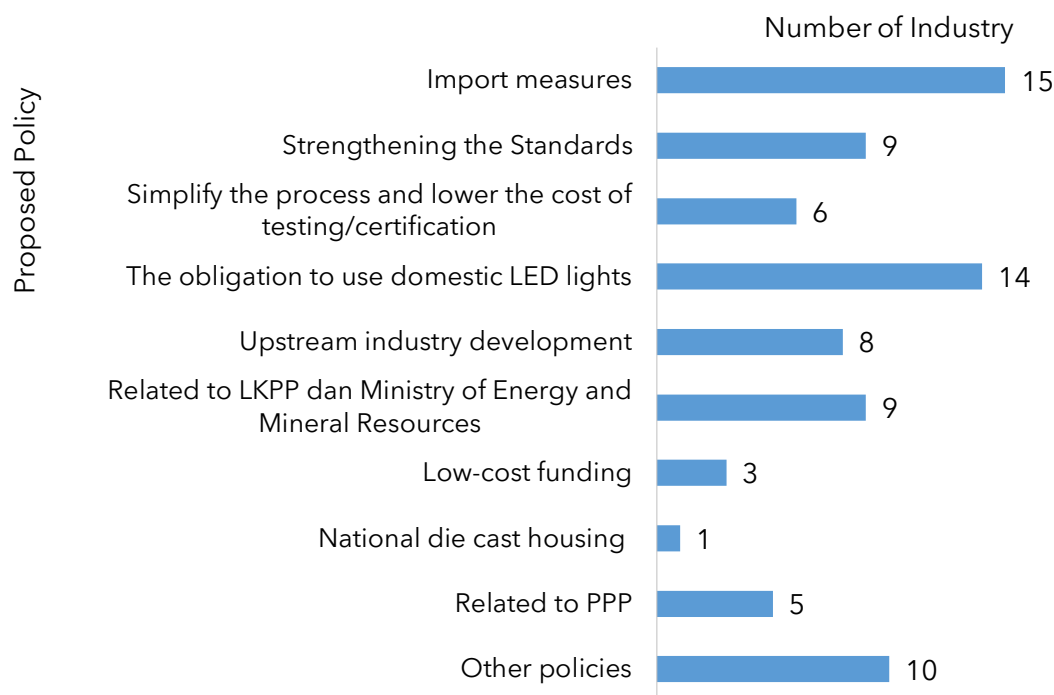
4.1. Challenges Hindering Local Lamp Industries

Local industries feel that current policies do not support them. The government often provides facilities for importing finished products, such as import duty exemption and using specifications of imported lamps for public procurement. Industries discern that government supports are only for free certifications for SNI and TKDN. The ACFTA agreement has exempted import duties on lamp components if industries use form E. However, the ACFTA agreement also dismisses the import duty on LED lamps. Local lamp industries cannot compete with the prices of imported lamps even though the industries have used various strategies. Local industries have costs not borne by importers, such as investment costs, labor, and warehouse rentals. Importers may avoid the warehouse rental cost by directly distributing the imported lamps to retailers who can pay later.

Therefore, in Figure 4.1, 15 out of 24 respondents expect stricter import measures. The industries suspect that illegal CFL without SNI enters Indonesia through hundreds of informal and unmonitored ports. The implementation of import measures will increase lamp prices in the short term, but it will reduce the production costs of local lamps in the long term. The industry proposes the following import measures:

- a. Higher import duties.
- b. The obligation to build factories if an industry wants to sell lamps in Indonesia.
- c. The mandatory SNI and a subsidy of the SNI certification cost for local industries.
- d. Supervision of imported lamps to meet the mandatory SNI. In the experience of mandatory SNI for CFLs, the industry found many imported CFLs without SNI in the market. Therefore, the industries expect stronger regulations to protect the market from illegally imported lamps.

Several industries expect the existing standard requirements to be strengthened, especially safety, performance, and EMC standards. Apart from as an import measure, applying these standards also protects consumers. Regarding lamp performance, one industry proposes the Minimum Energy Performance Standard (MEPS) of 120 lm/W to ensure high-quality lamps distributed in Indonesia. Apart from being an import measure, applying these standards will also protect consumers.

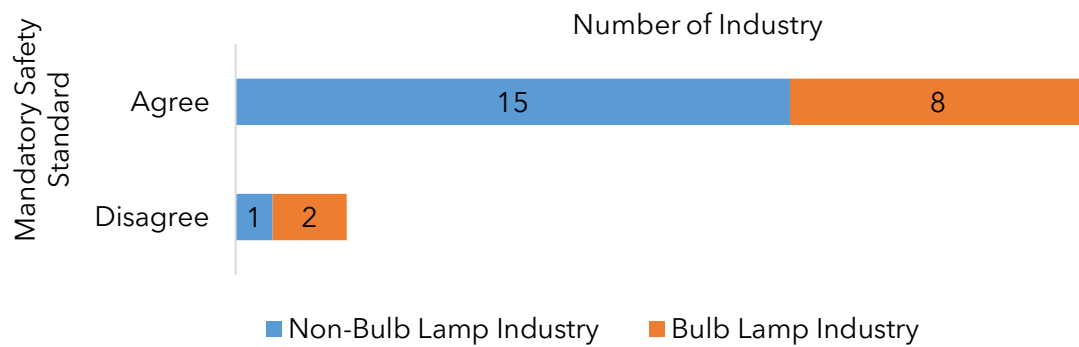


Base (n) = 26 respondents.

Figure 4.1 Policy proposals from local industries

However, not all industries and associations agree on the mandatory SNI, as shown in Figure 4.2. Industries rejecting the mandatory SNI have three reasons: rapid changes in lamp models, supervision only harming domestic industries, and reduced competitiveness of local industries. The LED lamp model can change every 6 to 8 months following the demand trend in the market. As a result, the industry must bear the certification cost, which is quite expensive while sales are insignificant. The circulated lamps in the retail market do not run out in two years, while the SNI certificate has validity. Meanwhile, the recall of the unsold lamp incurs transportation costs and compensation costs to retailers.

On the other hand, industries supporting the mandatory SNI view that the SNI certificate will increase their lamp quality credibility and, in the end, increase the sales volume. The mandatory SNI will reduce the price gap between high-quality and low-quality lamps so the industries can compete fairly. Those industries hope that the mandatory SNI is accompanied by strict import supervision because importers often change their lamp models/types but do not re-certificate their new lamps. Six industries expect the government to simplify and limit the certification costs for SNI, MEPS, and other permits. Moreover, several industries also expect free certification programs.



Base (n) = 26 respondents.

Figure 4.2 Opinions on the mandatory safety SNI

Fourteen industries expect the government to create a local LED market, such as replacing conventional lamps with LED lamps in government institutions, hospitals, State-owned enterprises (SOEs), and local government-owned enterprises. Moreover, industries also expect the government to mandate using local lamps when issuing the Building Approvals (PBG) for apartments, malls, and other new buildings. The policy should be accompanied by applying SNI and TKDN requirements on lamp procurement.

Implementing the TKDN policy for lamps is feasible due to supporting industries in the country. Indonesia already has industries for die-cast molding and plastic injections. Indonesia still does not have LED chips and other semiconductors manufacturers since Sharp Indonesia closed its semiconductor factory. Eight industries expected investments in upstream lamp industries such as semiconductors. Currently, industries have difficulty getting semiconductors supplies. Moreover, relying on imported semiconductors is vulnerable to import blockades and rising exchange rates.

Two industries expect low-cost funding for new product development investments. The industries have difficulty getting loans from conventional banks during the Covid-19 pandemic even though the loans will be used to finance government projects. One industry explained that Bank Indonesia had cut its benchmark interest rate to 3.5% per year, but conventional banks still set high-interest rates in practice. In comparison, the loan interest rate in China has been around 4.35% per annum since 2015 [13].

Another support needed is the easy and simple access to services and consultations with government agencies. The association already has this role, but the industry hoped to

directly consult regulatory issues with relevant institutions. One industry proposed national component research to increase TKDN, such as a national die-cast for street light housing. However, not all respondents welcomed the proposal. Other industries think that the national die-cast can cause business competition conflicts, and each industry has different housing designs. Therefore, one industry suggested that the government only need to set a standard for housing to be followed by all industries. Regarding PPPs, five industries expected a simplification of the PPP procurement mechanism and the requirements to establish new business entities.

Formulating action plans to resolve the challenges faced by the industry is carried out in 3 stages. The first stage is to present the challenges at one-on-one meetings with the following 11 ministries, agencies, and professional associations:

- a. Ministry of Industry.
- b. Ministry of Trade.
- c. Ministry of Finance.
- d. Coordinating Ministry for Maritime Affairs and Investment.
- e. Minister For Public Works and Housing.
- f. Ministry of Transportation.
- g. Ministry of Energy and Mineral Resources.
- h. Ministry of Internal Affairs.
- i. National Public Procurement Agency (LKPP).
- j. Association of Indonesian Electrical Experts (HAEI).
- k. Indonesian Illumination Engineering Association (HTII).

The second stage discussed proposed policy options from the one-on-one meeting with lamp industries and their associations. The proposed policy options are then divided into short, medium, and long-term action plans based on the priority needs of industries. The third stage finalized the roadmap concept, especially the action plans, with all parties simultaneously.

4.2. Legal Basis

The formulation of policy interventions takes into account the existing legal basis as follows:

- a. Law Number 6 of 1994 concerning Ratification of the United Nations Framework Convention on Climate Change [14].
- b. Law Number 7 of 1994 concerning Ratification of the Agreement Establishing the World Trade Organization [15].
- c. Law Number 8 of 1999 concerning Consumer Protection [16].
- d. Law Number 30 of 2007 concerning Energy [17].
- e. Law Number 32 of 2009 concerning Environmental Protection and Management [18].
- f. Law Number 3 of 2014 concerning Industry [19].
- g. Law Number 16 of 2016 concerning Ratification of the Paris Agreement to the United Nations Framework Convention on Climate Change [20].
- h. Law Number 11 of 2017 concerning Ratification of the Minamata Convention on Mercury [21].
- i. Government Regulation Number 58 of 2001 concerning the Guidance and Supervision of the Implementation of Consumer Protection [22].
- j. Government Regulation Number 70 of 2009 concerning Energy Conservation [23].
- k. Government Regulation Number 79 of 2014 concerning National Energy Policy (KEN) [24].
- l. Government Regulation Number 2 of 2017 concerning the Development of Industrial Facilities and Infrastructure [25].
- m. Government Regulation Number 29 of 2018 concerning Industrial Empowerment [26].
- n. Government Regulation Number 45 of 2019 concerning Amendments to Government Regulation Number 94 of 2010 concerning Calculation of Taxable Income and Payment of Income Tax in the Current Year.
- o. Presidential Regulation Number 79 of 2010 concerning Ratification of the Agreement on the ASEAN Harmonized Electrical and Electronic Equipment Regulatory Regime [27].
- p. Presidential Regulation Number 61 of 2011 concerning the National Action Plan for Reducing Greenhouse Gas Emissions [28].
- q. Presidential Regulation Number 38 of 2015 concerning Government Cooperation with Business Entities in the Provision of Infrastructure [29].
- r. Presidential Regulation Number 22 of 2017 concerning the General National Energy Plan [30].

- s. Presidential Regulation Number 47 of 2017 concerning Provision of Energy-Efficient Solar Lamps (LTSHE) for Communities Who Have Not Obtained Access to Electricity [31].
- t. Presidential Regulation Number 21 of 2019 concerning the National Action Plan for Mercury Reduction and Elimination.
- u. Presidential Regulation Number 12 of 2021 concerning Amendments to Presidential Regulation Number 16 of 2018 concerning Government Procurement of Goods/Services [2].
- v. Regulation of the Minister of Energy and Mineral Resources Number 18 of 2014 concerning Affixing Energy Saving Sign Labels for Self-Based Lamps [32].
- w. Regulation of the Minister of Energy and Mineral Resources Number 33 of 2017 concerning Procedures for Providing Energy-Efficient Solar Lamps for People Who Have Not yet Accessed Electricity [33].
- x. Regulation of the Minister of Energy and Mineral Resources Number 5 of 2018 concerning Amendments to Regulation of the Minister of Energy and Mineral Resources Number 33 of 2017 concerning Procedures for Providing Energy-Efficient Solar Lamps for People Who Have Not Accessed Electricity [34].
- y. Regulation of the Minister of Transportation Number 27 of 2018 concerning Road Lamp Equipment [35].
- z. Decree of the Minister of Industry and Trade Number 337/MPP/Kep/11/2001 concerning the Compulsory Application of the Indonesian National Standard (SNI) for Self-Ballast Lamps for General Lamp-Safety Requirements (SNI 04-6504-2001 and its Revisions) [36] and Decree of the Minister of Industry and Trade Number 442/MPP/Kep/5/2002 concerning Amendment to Decree of the Minister of Industry and Trade Number 337/MPP/Kep/11/2001 [37].
- aa. Regulation of the Minister of Industry Number 51/M-IND/PER/3/2012 concerning Procedures for Recognition of Certification of Electrical and Electronic Equipment Products from Conformity Assessment Agencies in ASEAN Countries [38].
- bb. Regulation of the Minister of Industry Number 15 of 2020 concerning the Strategic Plan of the Ministry of Industry for the Year 2020-2024 [39].
- cc. Regulation of the Minister of Industry Number 22 of 2020 concerning Provisions and Procedures for Calculation of the Value of Domestic Component Levels for Electronic and Telematics Products [40].
- dd. Minister of Finance Regulation 153 of 2020 concerning Provision of Gross Income Reductions for Certain Research and Development Activities in Indonesia.

- ee. Decree of the Head of Bappenas Number 2 of 2020 concerning Amendments to the Regulation of the Minister of National Development Planning/Head of the National Development Planning Agency Number 4 of 2015 concerning Procedures for Implementing Government Cooperation with Business Entities in Infrastructure Provision [41].
- ff. Regulation of the National Standardization Agency (BSN) Number 7 of 2020 concerning Procedures for Compulsory Implementation of Indonesian National Standards [42].

4.3. Short Term Action Plan

The short-term action plan consists of 4 independent action plans and one integrated action plan, as shown in Table 4.1. The action plan has three objectives: environmental protection, increasing local light market share, as well as increasing TKDN and gender equality. The first independent action plan is import governance for LED lamps with Harmonized System (HS) code as follows:

- 8539.50.00: Light-emitting diode (LED) lamps;
- 9405.10.91: Spotlights;
- 9405.10.92: Fluorescent lamps and lighting fittings
- 9405.20.90: Others;
- 9405.30.00: Lighting sets of a kind used for Christmas trees;
- 9405.40.40: Other spotlights;
- 9405.40.50: Other, of a kind used for lamp public open spaces or thoroughfares;
- 9405.40.60: Another exterior lighting.

Table 4.1 Short Term Action Plan (2022 – 2025)

Action plans	Ministry of Energy and Mineral Resources	Ministry of Environment and Forestry	Ministry of Industry	LKPP	ADLIGHT	Ministry of Finance	BRIN	Ministry of WECP
ENVIRONMENTAL PROTECTION								
MEPS 80 lm/W for bulbs, 90 lm/W for tube lights, and 120 lm/W for street lights.	2022							
Phasing out lamps that contain mercury in government agencies and SOEs buildings.	← 2022	↓ 2023						
Lamp waste disposal regulation.								
INCREASING MARKET SHARE OF LOCAL LAMPS								
Import Management (HS Code: 8539.50.00; 9405.10.91; 9405.10.92; 9405.20.90; 94053000; 9405.40.40; 9405.40.50; 9405.40.60).			2022					
Prototyping non-street lights meet the national safety standard and MEPS with minimum TKDN and BMP of 40%.	← 2022		2022					
An obligation of government agencies and SOEs to use local lights (TKDN and BMP at least 40%) that meet the national safety standard and MEPS.	→ 2023		2023					
The LKPP Electronic Catalogue contains local non-street lights that meet the national safety standard and MEPS.				→ 2023				
Disseminations of local lamp brands (TKDN and BMP at least 40%) that the national safety standard and MEPS.					→ 2023			
TKDN ENHANCEMENT								
Research and development of national molding and drivers for street lights.							2023 2024	
Providing super deduction tax for lamp industries that conducts research						2025		
GENDER EQUALITY								
A guideline for gender mainstreaming in the lamp industry.								2023

In 2015, LED lamps were included in 32 deregulations giving the high opportunity for importing finished goods. The regular import duty for LED lamps is already low at 5% because LED lamps are environmental goods. The Most Favored Nation (MSN) tariff applies to countries with no cooperation. Meanwhile, import duties from countries with cooperation refer to preferential tariffs. In the ACFTA cooperation, the import duty for raw materials is 0% if using Certificate of Origin Service - Form E, and the import duty for whole lamps is 0%. Raising preferential tariffs in ACFTA requires a mutual agreement with all ASEAN countries and China. Other than that, Regulation of the Minister of Trade 28/2020 concerning the Eighth Amendment to the Regulation of the Minister of Trade Number 87/M-DAG/PER/10/2015 concerning Provisions for the Import of Certain Products is an economic policy package that simplifies imports of finished goods. The regulation facilitates the import of LED lamps by inspecting imported lamps at the post border by the Ministry of Trade instead of the Directorate General of Customs, Ministry of Finance. Surveyors only record imports of LED lamps. The regulation applies to finished goods entering 12 seaports, five airports, and a border station.

However, import policy is dynamic so that the government can tighten or relax imports. The Ministry of Industry proposes import governance to change the inspection of imported lamps from post-border to the border. This governance will impact the import requirements for LED lamps, which are now surveyor reports to become Import Approval (PI) by considering lamp import surge data.

The second to third independent action plans are related to increasing TKDN through research on LED lamp components, especially street lights. The second separate action plan is to conduct research collaborations between industrial associations and BRIN or universities to produce national housing molding and drivers for street lights. The research aims to produce high-quality national products managed by associations and used by all industries. The initial funding sources are LPDP research funds and the BRIN budget. For further research, industrial associations should use profits from the commercialization of previous research results.

The third independent action plan is to provide tax incentives for lamp industries conducting research. Tax reduction or super deduction tax for research has been regulated in Minister of Finance Regulation Number 153/PMK.010/2020 concerning Provision of Gross Income Reduction for Certain Research and Development Activities in Indonesia [43].

Gross income is deducted by 100% of research costs incurred. The gross income will be reduced again by 200% with the following conditions:

- An additional 50% reduction if a patent is registered at the patent office in Indonesia;
- An additional 25% reduction if it also produces a patent registered at an international patent office;
- Additional 100% reduction if research results reach the commercialization stage; and
- An additional 25% reduction if the patent reaches the commercialization stage and is carried out in collaboration with government research institutions or higher education institutions in Indonesia.

The application of the super deduction tax incentives for research should be submitted to the Electronically Integrated Business Licensing application or the Online Single Submission (OSS). Submitted documents include proposals, fiscal certificates, and research expense reports.

The fourth independent action plan is to develop a gender mainstreaming guide in the lamp industry by the Ministry of Women's Empowerment and Child Protection (WECP). This gender equality action plan is an implementation of Law 7/1984 [44], Law 17/2007 [45], Presidential Regulation 59/2017 [46], and Presidential Regulation 18/2020 [47]. These regulations stipulate that economic development needs to be accompanied by equally improving the quality of human resources, both men and women. Therefore, the government has implemented gender mainstreaming in various sectors, such as budgeting [48, 49] and work programs in several ministries/ agencies [50-53]. Likewise, the lamp sector is related to gender issues from the production stage (e.g., equal employment opportunities for female and male workers) until the consumer side (e.g., children and housewives who are mostly affected by lightings at home). For this reason, the Ministry of WECP with ADLIGHT facilities will prepare a gender mainstreaming guideline for the lamp industry.

The integrated action plan in Table 4.1 aims to create a local lamp market in government institutions and state-owned enterprises. Instructions to use local lamps in the procurement of goods and services in the government are allowed because it is not yet bound by an agreement at the World Trade Organization (WTO). All lamp industries, ministries,

agencies, and associations, who attended the Finalization FGD, agreed on this action plan as the primary policy. Local industries are willing to produce high-quality LED lamps, but it is burdened by the low- and unstable demands of local lamps. Local industries expect a definite and sustainable market from government projects. The demand for lamps in government projects is quite remarkable, including:

- a. The Directorate General of EBTKE procures LED lamps every year for three projects, i.e., solar-powered street lights, LTSHE, and APDAL-IRAS. The number of solar-powered street lights procurements is around 19 to 20 thousand units/year. The Directorate General of EBTKE has also retrofitted lights in Islamic boarding schools in 2019, but this activity only runs for one year. LED lamps for solar-powered street lights and LTSHE must have SNI and a certificate of TKDN and BMP of at least 40%. The mandatory SNI is regulated in the Minister of Energy and Mineral Resources Regulation Number 2 of 2018 concerning the Compulsory Enforcement of Indonesian National Standards in the Electricity Sector [54]. LED lamps for APDAL - IRAS are not required to have SNI, but the winning bidder already has SNI for the supplied LED lamps. The LED lamps used are direct current (DC) types that are not produced domestically, so they are imported (0% TKDN). The DC LED lamps will be for 36 thousand residentials in 285 villages. Each residential receives three lamp units, so that the total procured lamps are 36,000 units.
- b. Another market for local LED lamps is toll roads that reach 2,430 km in length throughout Indonesia. The additional length of the toll road until 2024 is about 2,000 km. Street lights for toll roads must be installed at gates, accesses, tunnels, rest areas, interchanges, and main roads. However, BPJT does not issue mandatory directives to use local LED street lights. Even so, toll road operators are already aware of the benefits of LED street lights so that most operators of toll roads already use LED street lights, reaching 84.4% of total street lights on toll roads. BPJT cannot impose on existing operators to use local street lights if the price is higher than imported street lights. However, BPJT can mandate to use local LED lamps for all new toll roads under the planning process.
- c. On the other hand, the Directorate of Toll Road, Directorate General of Highways - Ministry of Public Works and Housing has encouraged toll road operators to use local LED lamps. On August 9, 2021, the Director of Toll Road issued a Circular to use the local street lights. Nevertheless, implementing the Circular mentioned

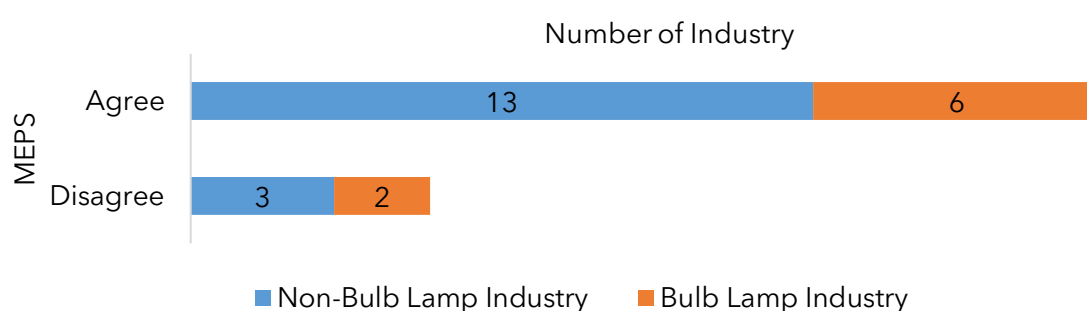
should also consider quality, competitive prices, after-sales service, and the proximity of manufacturers to toll roads to minimize shipping costs.

- d. The Strategic Plan of the Ministry of Transportation states that the street light procurement will be 2,500 units in 2022. Another potential market for local street lights is in Presidential Regulation Number 55 of 2018 concerning the Transportation Master Plan for Jakarta, Bogor, Depok Tangerang, and Bekasi for 2018 - 2019 [55].
- e. The existence of the LKPP E-Catalog has boosted the sale of local street lights. Street light demand in the E-Catalog reached IDR 1 trillion in 2020. LKPP does not prohibit imported products, but the electronic catalog display products with a TKDN certificate on the front page. In addition, the LKPP E-Catalog has pop-ups for local products. Moreover, LKPP requires an Industrial Permit where only local industries can have this permit. The E-catalog has 655 street lights from 34 industries. The 309 street light products have a TKDN certificate, but no product has a 100% TKDN.
- f. The government has the PPP scheme to maintain a significant and sustainable street light demands. PPP projects have been directed to use local lamps since the planning stage.
- g. An alternative to PPP is the bundling service or Service Level Agreement (SLA) for street lights, whose regulations are prepared by the Ministry of Transportation. SLA is similar to PPP with a period of three years or longer. The SLA scheme regulates monthly payments for a street light operated at 18.00 to 05.30 with a minimum efficacy of 100 lm/W and lifespan of 36,000 hours. If this requirement is not met, the SLA payment is reduced. Moreover, the SLA will use local lamps only. SLA is expected to solve issues on solar-powered street lights, which are often vandalized, especially the theft of VRLA batteries. SLA can also solve the problem of unpaid monthly electricity bills for street lights installed by the Ministry of Transportation. Some local governments pay the bills, but many local governments do not pay it because they view that street lights on national roads are the responsibility of the Ministry of Transportation. The estimated SLA payment is around IDR 100 thousand per day or almost IDR 5 million per year. SLA will use smart technology because the payment will be based on the lighting service, so it needs sensors for continuous measurement. Regional offices of the Ministry of Transportations are already using smart street lights to monitor their street light conditions.
- h. One potential market for non - street lights is the housing development project by the Ministry of Public Works and Housing. The Directorate General of Housing

builds 30% of the total houses built throughout Indonesia. The Directorate General of Housing has a target for housing construction as stated in the RPJMN 2021 to 2024 for 51 thousand flats, 813 thousand house renovations, and 10 thousand special housing units. All houses built by the Directorate General of Housing already use LED lamps. The housing procurement process already uses local products, but the Directorate General of Housing can only supervise the leading mechanical and electrical (M&E) companies. In practice, these companies generally sub-contract again to other smaller M&E companies.

Central and local governments have generally procured local street lights. Therefore, the focus of the action plan in Table 4.1 is to replace energy-intensive or mercury-containing lamps in government and BUMN buildings with high-efficiency local lamps. The action plan requires an integrated policy from several ministries and agencies as follows:

- a. The Ministry of Energy and Mineral Resources will implement the MEPS harmonization in ASEAN of 80 lm/W for non- street lights and 130 lm/W for street lights. The MEPS harmonization plan in ASEAN of 80 lm/W in 2023 will impact a small number of local LED lamps. 14.3% of sampled local LED bulbs had efficacy lower than the MEPS. The percentages of other local LED lamps with lower efficacy than MEPS are 4.7% for tube lights, 33.3% for downlights, 27.8% for floodlights, 39.1% for high bay lights, and 10.4% for street lights. Most local lamp industries are ready to support the MEPS harmonization, as shown in Figure 4.3.



Base (n) = 24 respondents.

Figure 4.3 Industry opinion on MEPS harmonization in ASEAN

- b. The Ministry of Environment and Forestry will issue a circular for ministries, agencies, and SOEs to no longer use mercury-containing lamps. Phasing out the lamps has

become the government's plan, as stated in Law Number 11 of 2017 concerning the Ratification of the Minamata Convention on Mercury [21].

- c. Following the MEPS and phasing-out program, the Ministry of Environment and Forestry will also prepare regulations for handling lamps and other electronic waste.
- d. Together with lamp industries, the Ministry of Industry prepares local lamps that satisfy MEPS, do not contain mercury, have a certificate of TKDN and BMP of at least 40%, and meet the safety SNI. Lamps prepared at least type of bulbs and tube lights. After that, the Ministry of Industry will issue a circular to the central government institutions, local governments, and state-owned enterprises to use these local lamps. These circular letters have the following legal basis:
 - Law Number 3 of 2014 concerning Industry [19].
 - Government Regulation Number 29 of 2018 concerning Industrial Empowerment [26].
 - Presidential Regulation Number 12 of 2021 concerning Amendments to Presidential Regulation Number 16 of 2018 concerning Procurement of Government Goods/Services [2].
 - Presidential Decree Number 24 of 2018 concerning the National Team of Increased Use of Domestic Production [56].
 - Decree of the Coordinating Minister for Maritime Affairs and Investment Number 84 of 2019 concerning the National Team Working Group of Increased Use of Domestic Production [57].
 - Regulation of the Minister of Industry 02/M-IND/PER/1/2014 concerning Guidelines for the Use of Domestic Products in the Procurement of Government Goods and Services [58].

The Ministry of Industry has sent a similar circular to use local street lights to the Directorate General of EBTKE, Directorate General of Land Transportation, and the Ministry of Public Works and Housing.

- e. The ADLIGHT, together with the Ministry of Industry, will create a database of the local LED lamps to be submitted to LKPP and request to add non- street lights on the E-Catalog. Subsequently, industries will register their lamps to the E-Catalog. ADLIGHT also needs to introduce these local LED lamps to the public, SOEs, planning consultants, and contractor associations.

4.4. Medium Term Action Plan

The action plan in the medium term focuses on increasing the efficacy, market share, and local concerns, as shown in Table 4.2. The first action plan is to increase MEPS by the Ministry of Energy and Mineral Resources to 130 lm/W for non- street lights and 180 lm/W for street lights lamps. The MEPS increase considers the increasing efficacy trend of LED lamp technology from 95 lm/W in 2016 to 169 lm/W in 2020 and is estimated to be 203 lm/W in 2025 [59]. The second action plan is the mandatory safety SNI by the Ministry of Industry. All industries and their associations ideally support the policy because their products for lamp replacement policy in the short term already have certificates of the safety SNI and MEPS.

The third action plan is to expand the phasing-out policy for mercury-containing lamps in all professional buildings. CLASP and PwC [1] projected that this condition would naturally occur in 2029. To accelerate this condition in 2027, the Ministry of Environment and Forestry should release a circular to prohibit the use of mercury-containing lamps. The fourth action plan is that the Ministry of Public Works and Housing requests a commitment from planning consultants and construction contractors to use local lamps that meet the safety SNI and MEPS.

The next action plan is to increase the TKDN of local lamps. The fifth action plan is to use research results in the short term, i.e., the massive usages of national housing molding and drivers for street lights. The sixth action plan is to continue the research collaborations between BRIN, industries, and their associations for SPD components in 2026. The seventh action plan is the investment of LED chips and other semiconductor industries in 2029. This action plan is according to the Strategic Plan of the Ministry of Industry.

The Ministry of Finance has two incentive regulations to attract new investments in high-efficiency lamps to support the seventh action plan. The first incentive is a tax holiday, in which a reduction in corporate income tax can be granted for 5 to 20 years. Minister of Finance Regulation No. 150/PMK.010/2018 concerning Provision of Corporate Income Tax Reduction Facility [60] regulates corporate income tax deductions for 5 to 20 years depending on the value of the investment. The tax holiday rules only apply to 18 pioneer industries, and one of them is the manufacturing industry for the main components of electronic or telematics equipment, including the semiconductor industry [60].

Table 4.2 Medium Term Action Plan (2026 – 2030)

Action plan	Ministry of Energy and Mineral Resources	Ministry of Environment and Forestry	Ministry of Industry	Ministry of PWH	Association/ Industry	Ministry of Finance	BRIN
ENVIRONMENTAL PROTECTION							
MEPS 130 lm/W for non-streetlights bulb, and 180 lm/W for street lights.	2026						
Mandatory national safety standards of lamps for public procurement.			2026				
Phasing out lamps that contain mercury in all professional buildings.		2027					
INCREASING MARKET SHARE OF LOCAL LAMPS							
Commitments of construction planners and contractors to use local lamps (TKDN and BMP at least 40%) that the national safety standard and MEPS.				2026			
TKDN ENHANCEMENT							
Lamp industries use lamp housing molding and national drivers for street lights.					2026		
Investments in LED chip and semiconductor industry.			2028				
Investment incentives						2030	
Research and development of national SPD for street lights.							2026

The second incentive is the tax allowance regulated in Government Regulation Number 78 of 2019 concerning Income Tax Facilities for Investment in Certain Business Fields and Certain Regions [61]. The tax allowance is in the form of a reduction in net income of 50% of the investment value in the form of tangible fixed assets, which is charged for six years or, in other words, a tax allowance of 5% per year for six years. Lamp-related industries that can receive this tax allowance are the semiconductor industry and other electronic components (KBLI 26120) and the LED lamp industry (KBLI 27404). The tax allowance application is made through the OSS application before starting commercial production. The completion of LED chip or semiconductor industry investment is expected at 2029, so incentives can begin in 2030.

4.5. Long Term Action Plan

In the long term, the action plan for developing high-efficiency lamps focuses on increasing MEPS, market share, and TKDN, as shown in Table 4.3. The Ministry of Energy and Mineral Resources needs to prepare a work program to increase the MEPS to 150 lm/W for non-street lights and 210 lm/W for street lights in 2032.

Action plans to increase market share will focus on the mandatory use of local lamps in all new professional buildings. Together with the Ministry of Home Affairs and the Ministry of Public Works and Housing, the Ministry of Industry will release a regulation requiring to use local lamps with TKDN and BMP of at least 40% in buildings requesting the Function-worthy Certificate (SLF). Based on the Minister Regulation of Public Works and Housing Number 27/PRT/M/2018 [62], SLF is a certificate issued by regional governments except for Special Function Buildings owned by the central government. The SLF states the condition feasibility of the building function. This policy needs supports from building assessment experts in the Ministry of Public Works and Housing to promote local lamp brands.

To increase the market share of local lamps in the general market, the Ministry of Trade will prepare a regulation of domestic purchasing obligation for lamp importers. This regulation requires importers to also sell local lamps. In this case, importers can cooperate with the local lamp industry under an original equipment manufacturer (OEM) scheme to produce lamps with importer's brands.

Table 4.3 Long Term Action Plan (2031 – 2035)

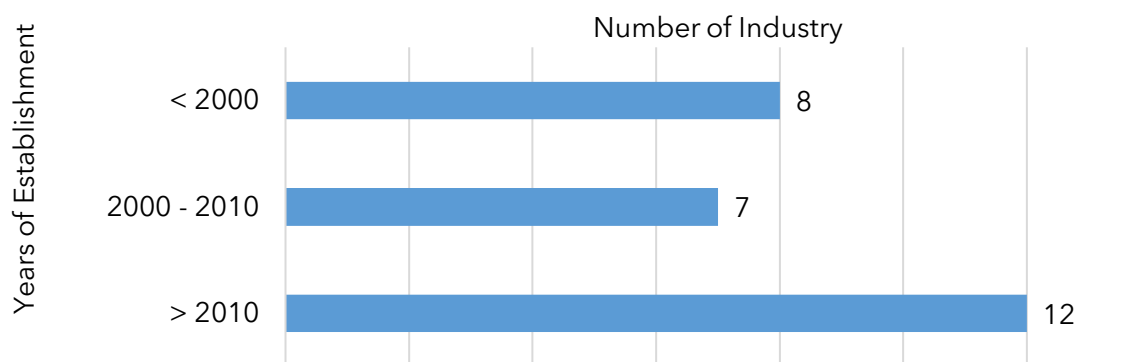
Action plan	Ministry of Energy and Mineral Resources	Ministry of Trade	Association/ Industry	Ministry of Industry
ENVIRONMENTAL PROTECTION				
MEPS 150 lm/W for non-streetlights bulb, and 210 lm/W for street lights.	2032			
INCREASING MARKET SHARE OF LOCAL LAMPS				
Provision of a Function-worthy Certificate (SLF) accompanied by conditions for the use of lamps that meet the national safety standard and MEPS with TKDN and BMP at least 40%				2033
Domestic purchasing obligation (some lamps sold by importers are required to have TKDN and BMP at least 40%)		2035		
TKDN ENHANCEMENT				
LED lamp industries use the national SPD			2031	
Minimum TKDN and BMP requirements are 60% for government agencies' procurement of street lights.				2034

In the long term, all local industries should use national components (i.e., LED chips, semiconductors, lamp housing moldings, drivers, and SPD), resulting from researches and investments in short- and medium-terms. Therefore, the Ministry of Industry should increase the minimum TKDN and BMP to at least 60% for street light procurements in government agencies. Currently, the Ministry of Transportation has TKDN and BMP of at least 60% in their procurement of street lights.



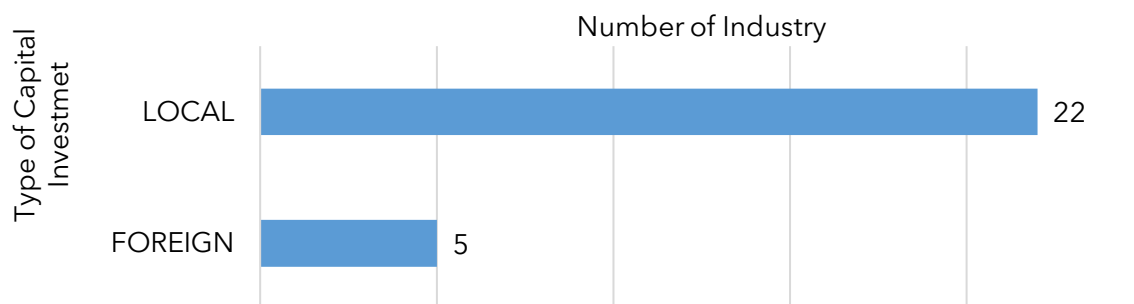
CAPACITY INCREASE

The LED industries in Indonesia are generally new. Figure 5.1 shows 44% of the respondent established after 2010, 26% between 2000 and 2010, and 30% before 2000. Industries generally started their business as lamp importers or other equipment manufacturers and slowly started producing lamps domestically. Two industries established before 2000 have experience in exporting lamps until now. Figure 5.2 shows that 22 of the 27 industries surveyed are domestic investments, and the remaining industries are foreign investments. The foreign industries generally have a higher production capacity and a higher sales volume than domestic investment industries.



Base (n) = 27 respondents

Figure 5.1 The establishment year of local industries



Base (n) = 27 respondents

Figure 5.2 Type of capital ownership

At least 22 out of 27 respondents plan to improve their lamp technology. As in Figure 5.3, the investment plans include increasing production, developing new products, increasing TKDN, and developing supporting products such as batteries. One industry plans to open a new factory in Solo Techno Park to meet the market demands of low to middle-class

households in Central Java. Four industries have investment plans to manufacture non-LED lamp products, i.e., CFL, LFL T12, induction lamps, and UV-C lamps (222 nm).

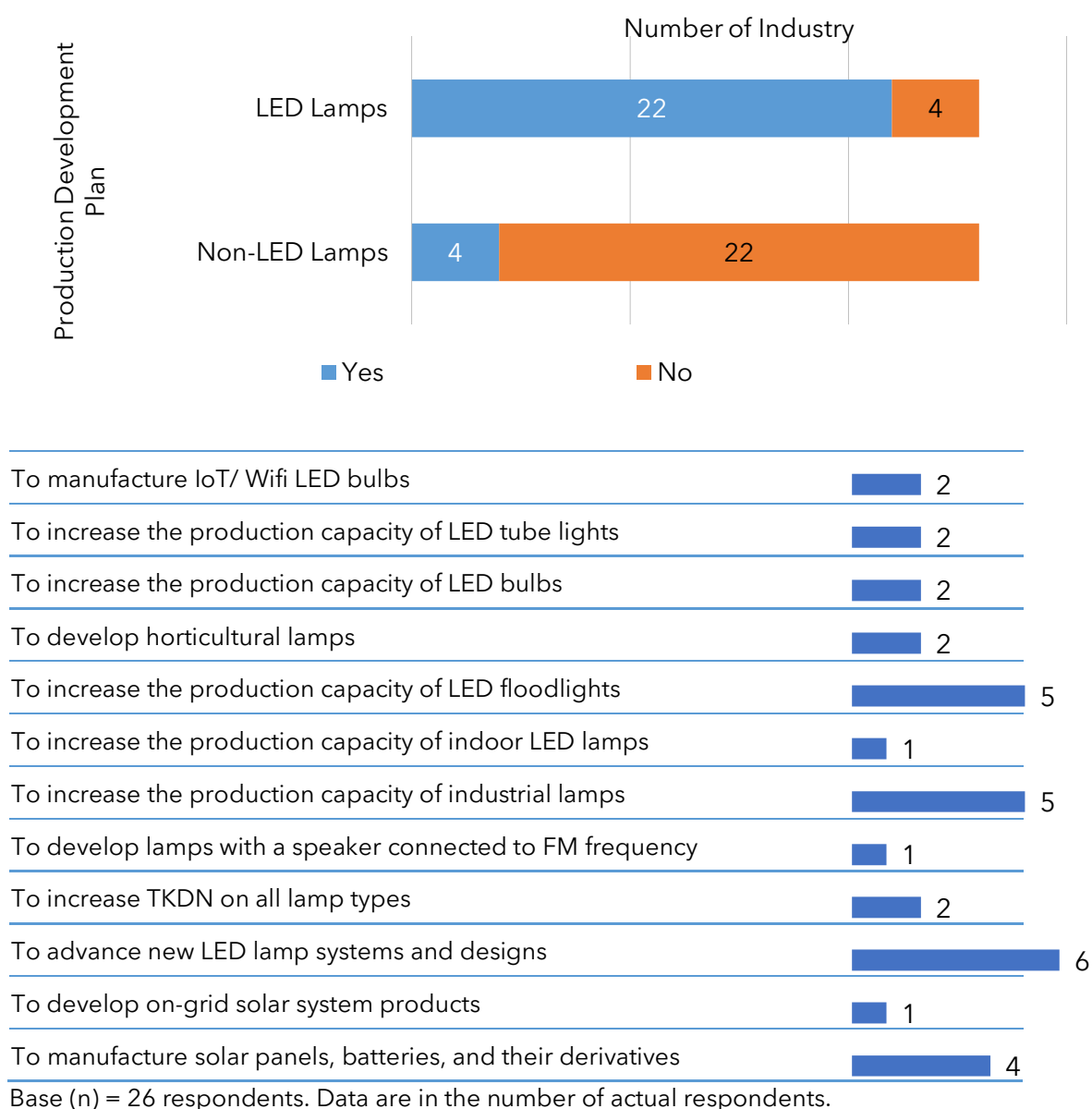


Figure 5.3 Investment and development plans

Local lamp industries should anticipate increasing demand for local lamps due to short, medium, and long-term action plans. Discussions with lamp industries and associations in two FGDs agreed to the target market share in Figure 5.4. The market share of high-efficiency lamps for the professional sector is expected to increase from 12% in 2019 to 19% in 2025 (short term), 50% in 2030 (medium-term), and 75% in 2035 (long-term). Replacing the inefficient and mercury-containing lamps with the lamps having certificates

of SNI, MEPS, TKDN and BMP can support the target to increase the market share of the commercial sector. This action plan, together with import governance, will boost the sales volume of local lamps for the residential sector. Figure 5.4 shows that the residential market shares for local lamps will increase from 12% in 2019 to 19% in 2030 and 75% in 2035. On average, the market share of local lamps in these two user sectors will be 15% in 2025, 35% in 2030, and 75% in 2035.

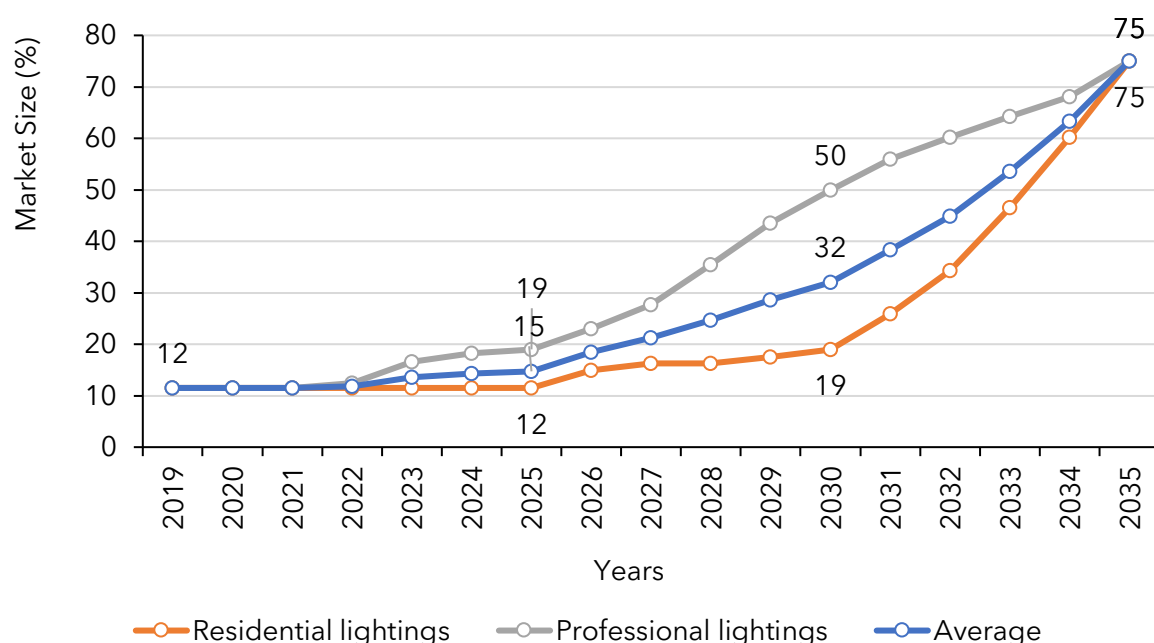


Figure 5.4 Local LED lamp market share projection

Figure 5.5 shows the sales projection for high-efficiency lamps in the residential sector. The Holt-Winters Exponential Smoothing technique [63-65] is used to interpolate the projection in 2019 - 2030 by CLASP and PwC [1] for the projection from 2031 to 2035. The total demand for high-efficiency local lamps will increase from 3.8 million units in 2020 to 7.4 million units in 2025, 17.3 million units in 2030, and 88.9 million units in 2035. The market share of each type of lamp technology will not change because there will be no policy intervention to ban mercury-containing lamps in the residential sector. Figure 5.6 shows the same market share with the projection by CLASP and PwC [1] in Figure 1.4.

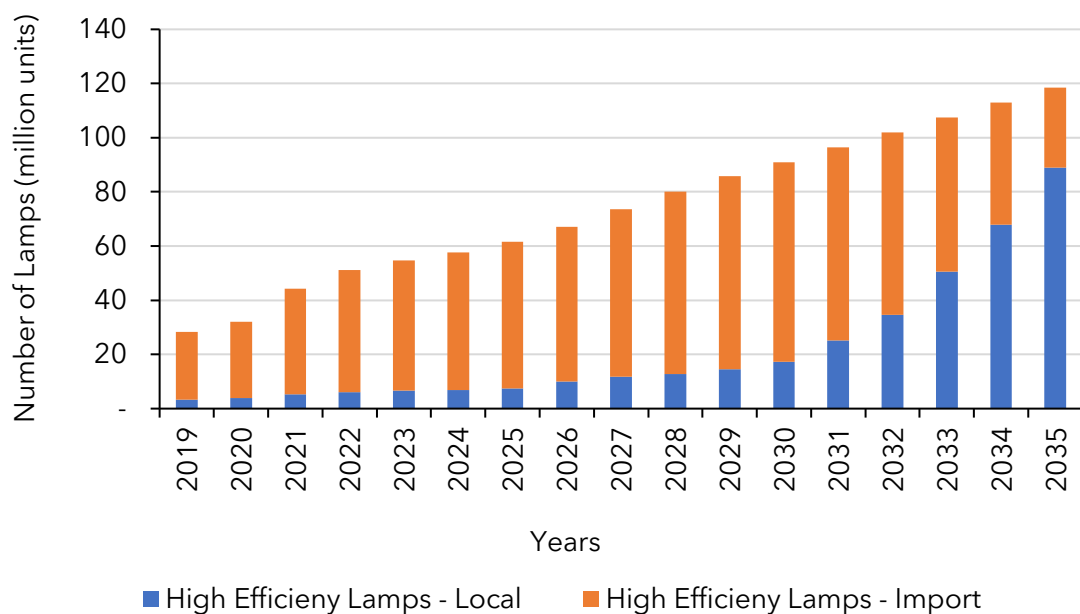


Figure 5.5 Sales projections of high-efficiency lamps in the residential sector

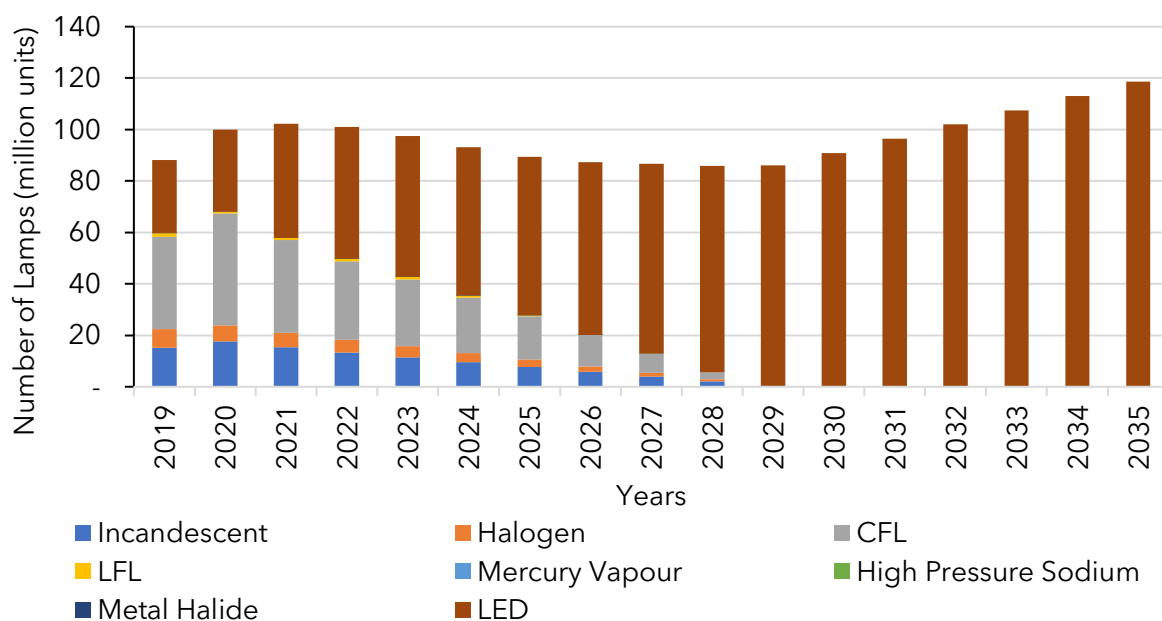


Figure 5.6 Projection of lamp sales in the residential after the action plans

The demand for high-efficiency lamps in the professional sector will increase significantly from 26 million units in 2020 to 47.8 million units in 2025, 66 million units in 2030, and 75.3 million units in 2035, as shown in Figure 5.7. The action plans phasing-out mercury-containing lamps with local lamps (i.e., TKDN and BMP at least 40%) in government and SOE buildings in 2023 and BUMN, as well as other professional buildings in 2026, increase

sales of high-efficiency local lamps from 3.1 million units in 2020 to 10 million units in 2025, 33 million units in 2030, and 56.5 million units by 2035. The action plan also accelerates the use of 100% high-efficiency lamps from initially in 2030 [1] to 2026, as in Figure 5.8.

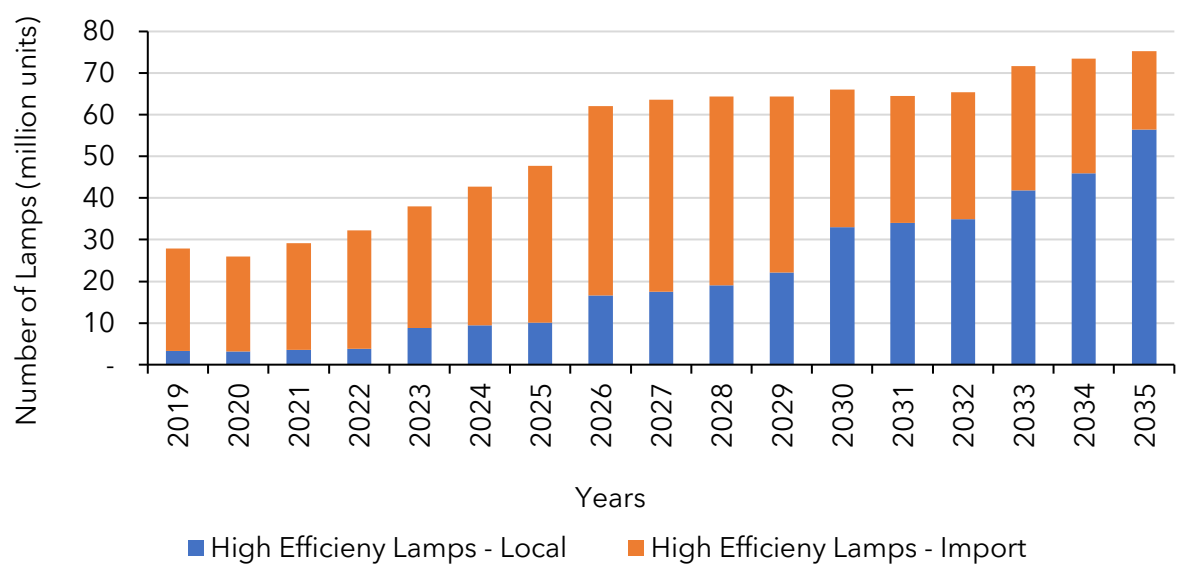


Figure 5.7 The sales projection of LED lamps for the professional sector

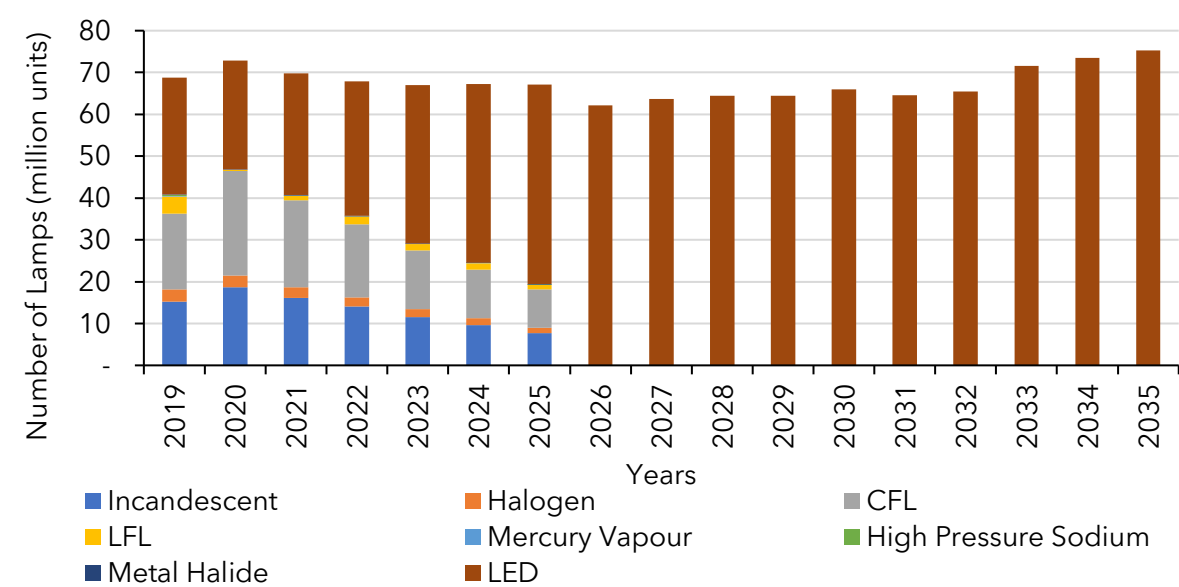


Figure 5.8 The sales projection of all lamp types for professionals (post-action plans)

Figure 5.9 shows that outdoor lamp sales will increase from 4 million units in 2020 to 6.2 million units in 2025, 7.7 million units in 2030, and 9.4 million units in 2035. Action plans in

the short and medium-term will accelerate 100% usages of high-efficiency lamps from initially in 2030 [1] to become in 2023, as in Figure 5.10.

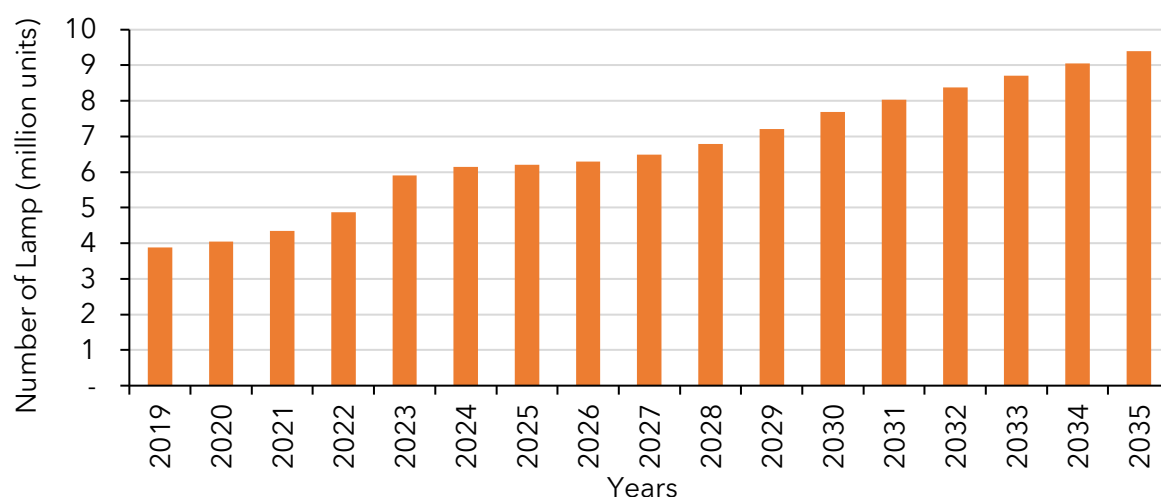


Figure 5.9 The sales projection of LED outdoor lamps

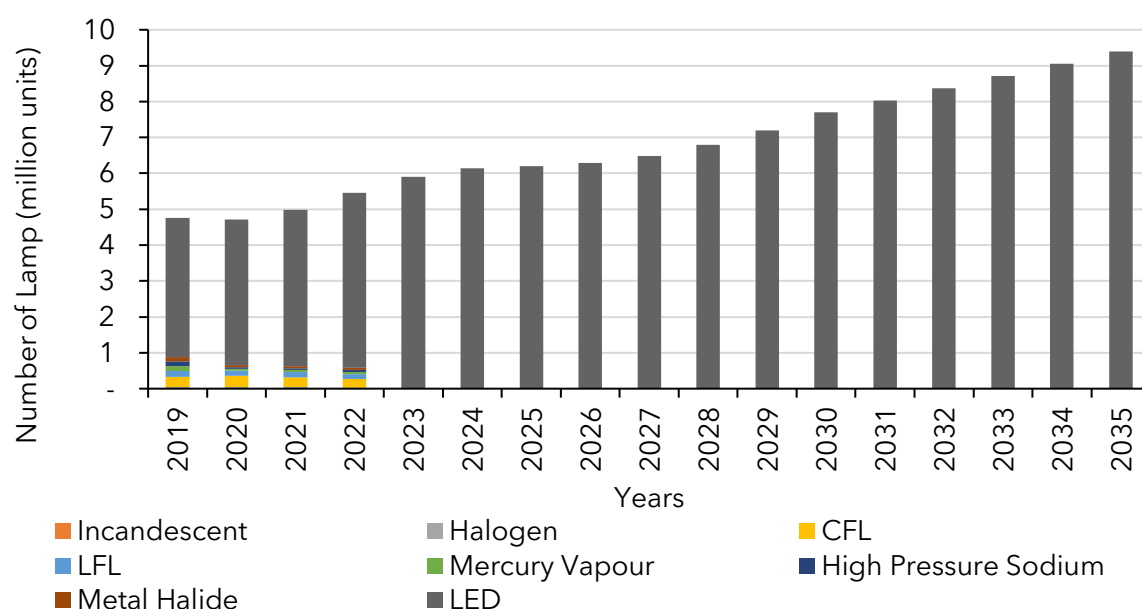


Figure 5.10 The sales projection of all outdoor lamp types (post-action plans)

Most industries believe they can meet the increasing demands for local lamps. The Ministry of Industry stated that the utility of local lamp industries is around 15 to 16% of their total production capacity. Many local lamp industries only use one production line without an additional shift in the afternoon and evening. During the heyday of the lamp industry in Indonesia, industries operated in multiple production lines that worked full-time for three shifts (i.e., 24 hours). As an illustration, one industry had 26 production lines for

incandescent lamps, 16 production lines for tube lights, and three production lines for CFL. Each production line worked 24 hours to produce 25,000 lamps per day. Therefore, the industry can simply add laborers to anticipate the demand for local lights.

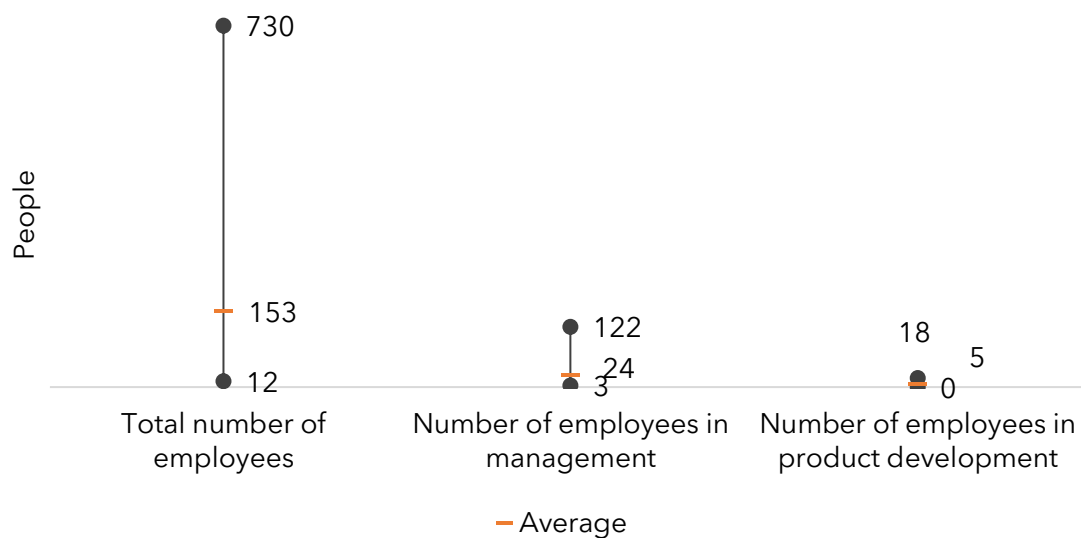
The government does not have a low-interest rate policy for financing new equipment investments in the industry. This policy is more attractive than fiscal policy (i.e., tax holidays and tax allowances) because the interest rates strongly influence investment feasibility. The lower the interest rate, the better the Internal Rate of Return (IRR) and Net Present Value (NPV) and vice versa. The government has Sarana Multi Infrastruktur (Persero) Ltd providing low-interest financing. However, the financing is only eligible for infrastructure projects like new renewable energy projects and other strategic projects.



GENDER EQUALITY AND ENVIRONMENTAL PROTECTION

6.1. Gender Equality

The number of employees between industries has a reasonably high disparity, as shown in Figure 6.1. The number of employees in 20 industries ranges from 12 to 730 people, with the average number of employees being 144 people. The number of employees in the management department is between 3 and 122 people with an average of 23 people. The number of employees in the product development department is lower, between 0 to 18 people with an average number of 5 people. The tendency is that the greater the total number of employees, the greater the employee number in the management and product development.



Base (n) = 23 respondents.

Figure 6.1 Number of employees

The role of women in the LED lamp industry is significant, as in Figure 6.2. The percentage of female employees to total employees is around 10% to 70%, with an average percentage of 34%. The percentage of female employees in management is also quite good, ranging from 2% to 66% with an average percentage of 34%. Regarding product development, female employees in one industry reached 78% of the total employees, but some industries do not have female employees in the product development division. The average percentage of female employees in the product development division is 10%.

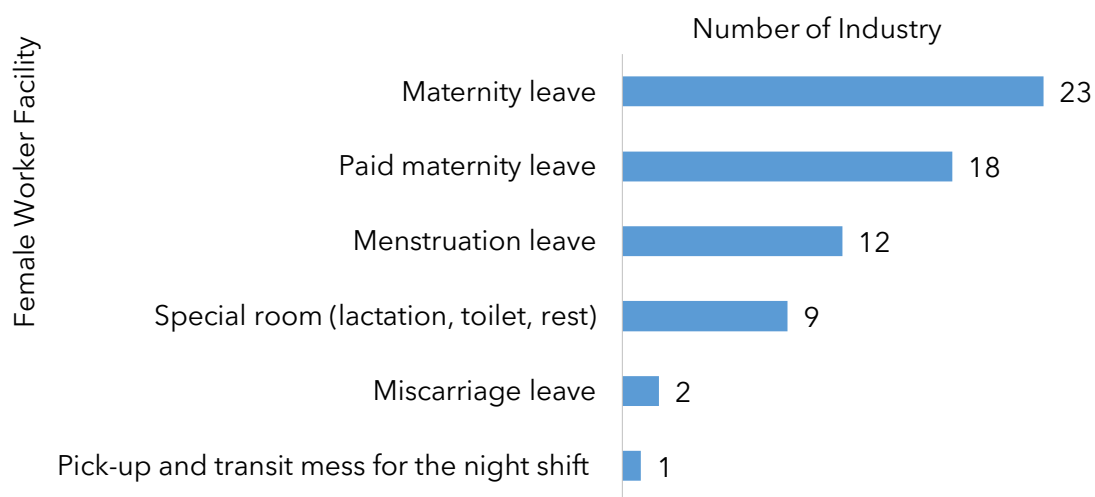
All industries have provided special facilities for female employees, as shown in Figure 6.3. The most common facility is the maternity leave for three months divided into two periods, i.e., before and after giving birth unless the doctor/midwife gives other medical

considerations. Eighteen industries give paid maternity leave ranging from 1.5 to 3 months, and 13 industries give menstruation leave for 1 to 2 days. Two industries give miscarriage leave for three months, proved by a certificate from the doctor/midwife. Four industries have special rooms for women, e.g., lactation rooms, bathrooms, and rest areas. One industry provides pick-up and transit facilities for female employees working night shifts.



Base (n) = 23 respondents.

Figure 6.2 Percentage of the number of female employees



Base (n) = 23 respondents.

Figure 6.3 Facilities for employees

6.2. Environmental Protection

Action plans of MEPS and phasing-outs in the short, medium, and long term will reduce electricity consumption in all sectors. In the residential sector, the cumulative electricity consumption from the usages of lamps sold from 2019 to 2035 will be lower by 13 TWh than the business-as-usual scenario, as shown in Figure 6.4. Other cumulative electricity reductions from 2019 to 2035 will be 17 TWh for the commercial sector (Figure 6.5) and 12 TWh for the outdoor lamp (Figure 6.6). Thus, the total accumulative electricity saving from the usage of lamps sold to these three sectors in 2019 - 2035 will be 41 TWh, as shown in Figure 6.7.

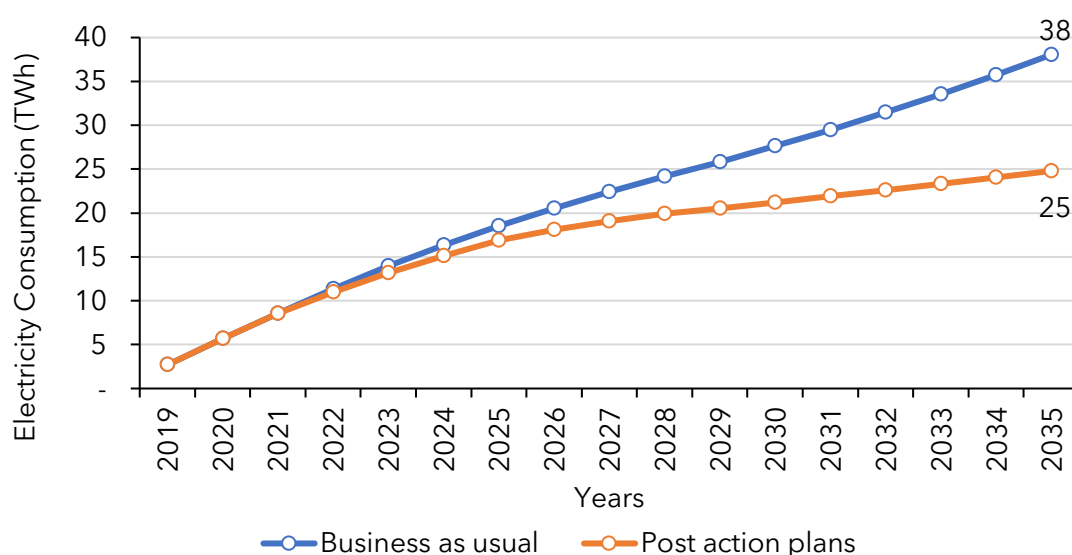


Figure 6.4 Accumulative electricity consumption from lamp use for household

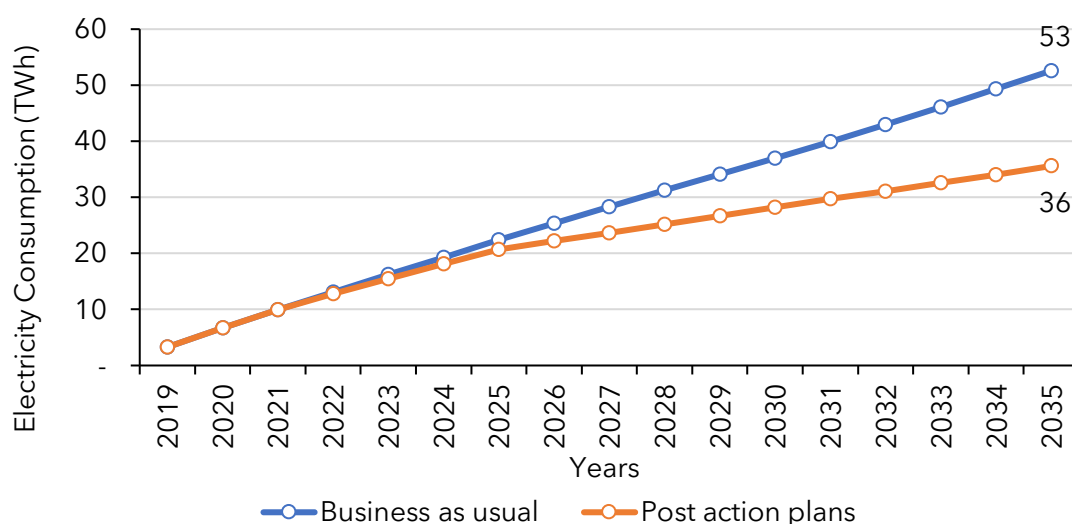


Figure 6.5 Accumulative electricity consumption from lamp use for professionals

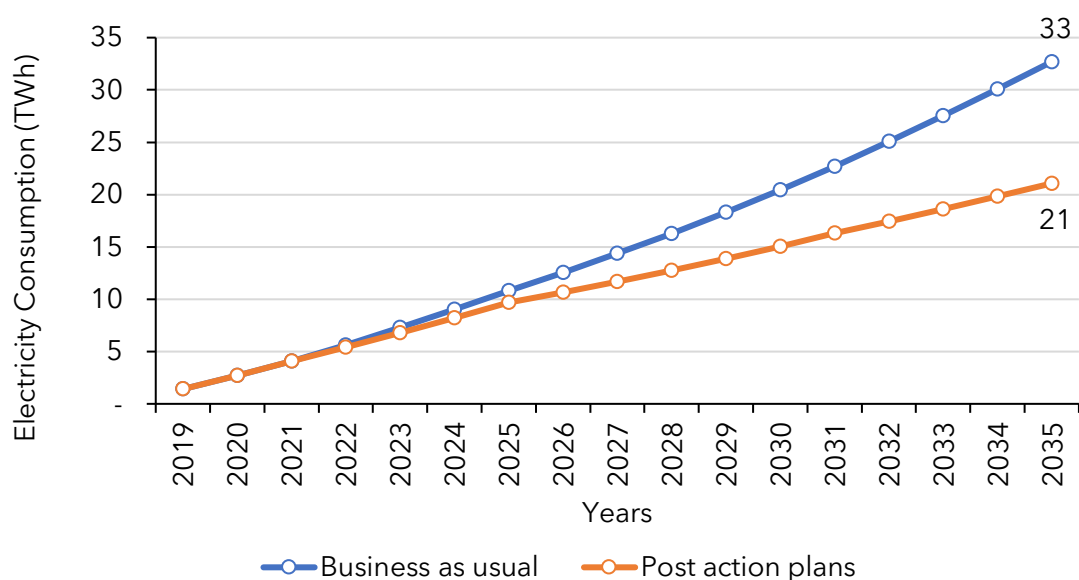


Figure 6.6 Accumulative electricity consumption from using outdoor lamps

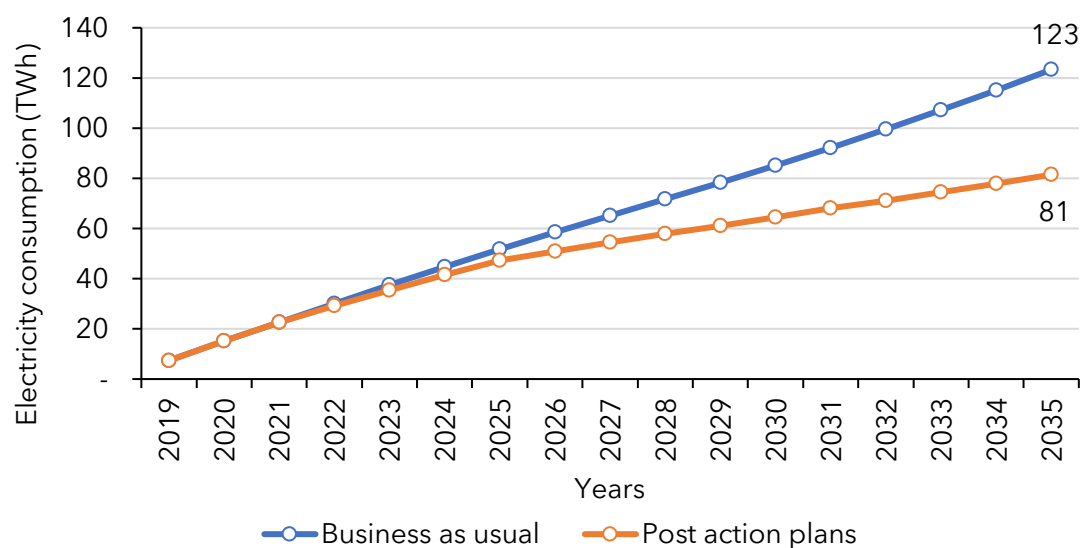


Figure 6.7 Accumulative electricity consumption from lamp sales 2019 - 2035

Figures 6.8, 6.9, 6.10, and 6.11 show the effects of the action plans on reducing emissions estimated by using JAMALI's average emission factor of 0.87 kWh [66]. In Figure 6.8, the action plans will reduce emissions from the usage of lamps sold in the residential sector from 2019 to 2035 by 11 million tons of CO₂. The emission reductions from usages of lamps sold to professional and outdoor sectors during 2019 - 2035 will be around 15 million tonnes CO₂ (Figure 6.9) and 10 million tonnes CO₂ (Figure 6.10), respectively. The total emission reduction potential in all sectors is 36 million tons of CO₂, as in Figure 6.11.

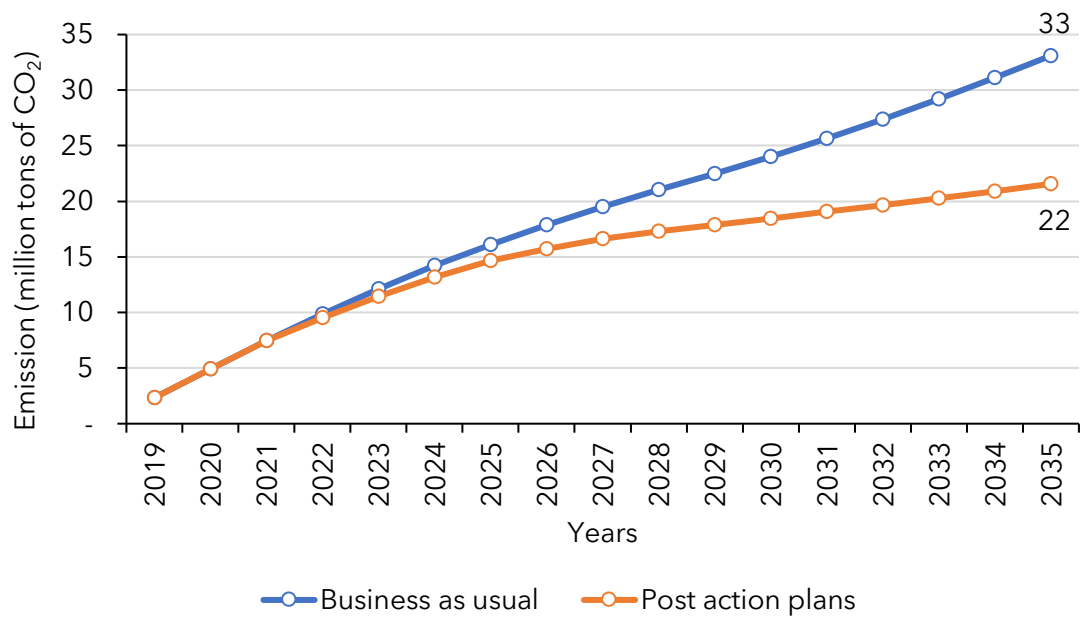


Figure 6.8 Accumulative emissions from the use of lamps sold to the residential sector

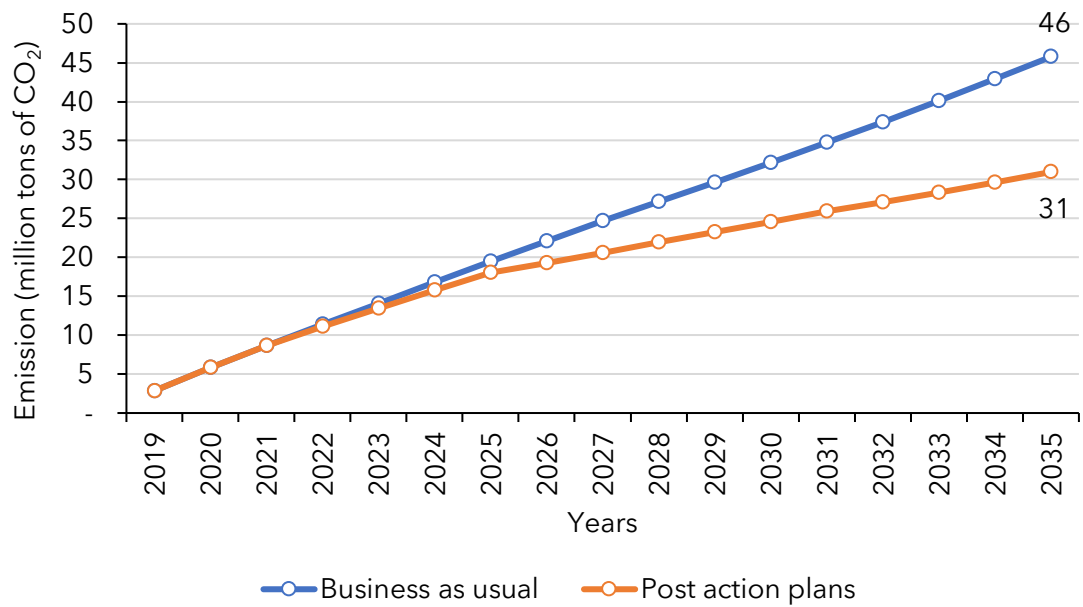


Figure 6.9 Accumulative emissions from the use of lamps sold to the professional sector

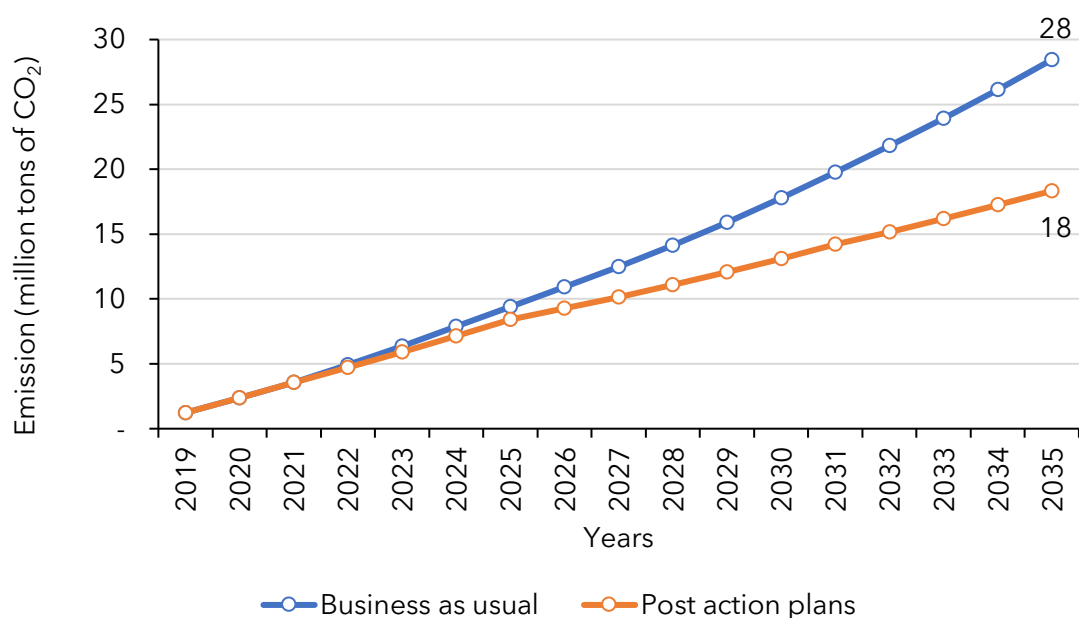


Figure 6.10 Accumulative emissions from the use of sold outdoor lamps

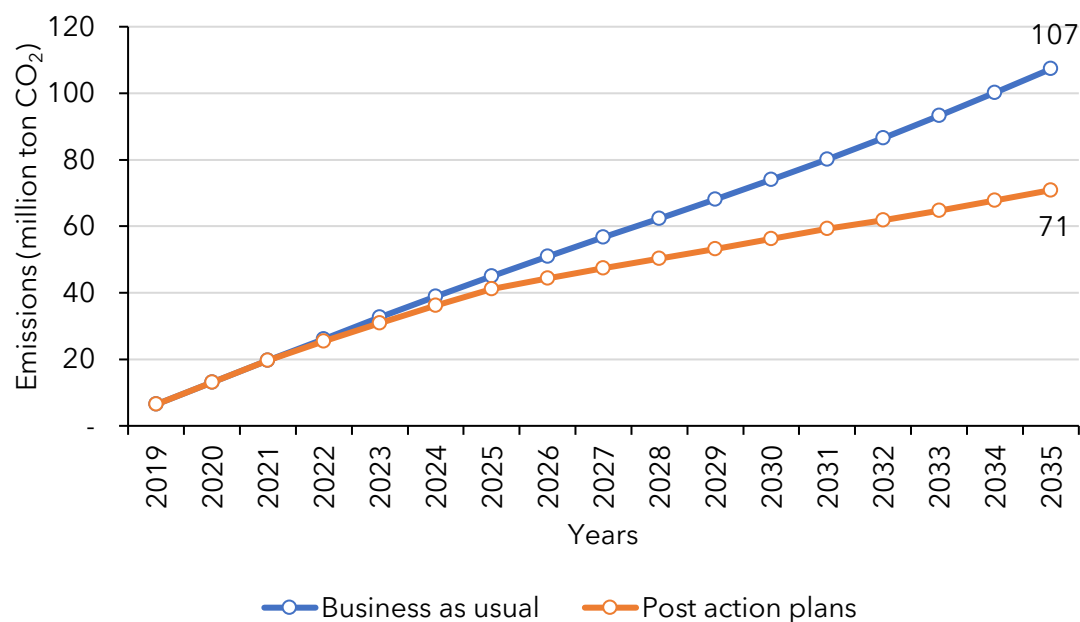


Figure 6.11 Accumulative emissions from the use of lamps sold in 2019 - 2035

The impact on mercury reduction only occurs from lamp sales for the professional and outdoor sectors, which must stop using mercury-containing lamps. The cumulative mercury reduction from lamp sales during 2019 - 2035 will be 105 kg for professional lamps (Figure 6.12) and 20 kg for outdoor lamps (Figure 6.13). The mercury reduction in outdoor lamps

is low because current outdoor lamp sales are mostly LED lamps that do not contain mercury (see Figure 1.6). The total cumulative mercury reduction in 2019 - 2035 is 125 kg, as shown in Figure 6.14.

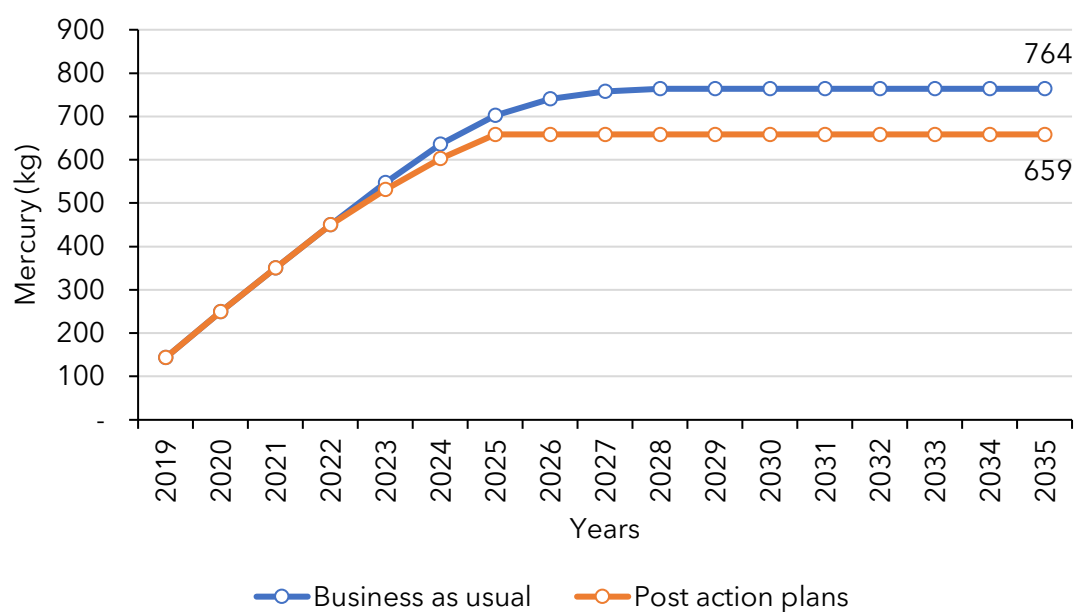


Figure 6.12 Accumulative mercury amount from the usages of lamps sold to the professional sector

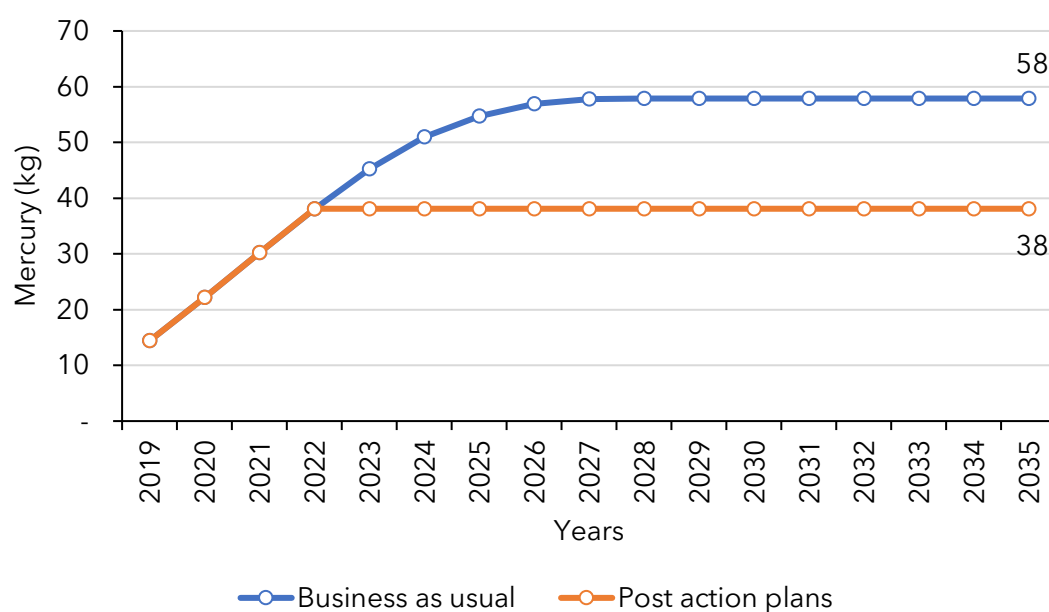


Figure 6.13 Accumulative mercury amount from the usages of sold outdoor lamps

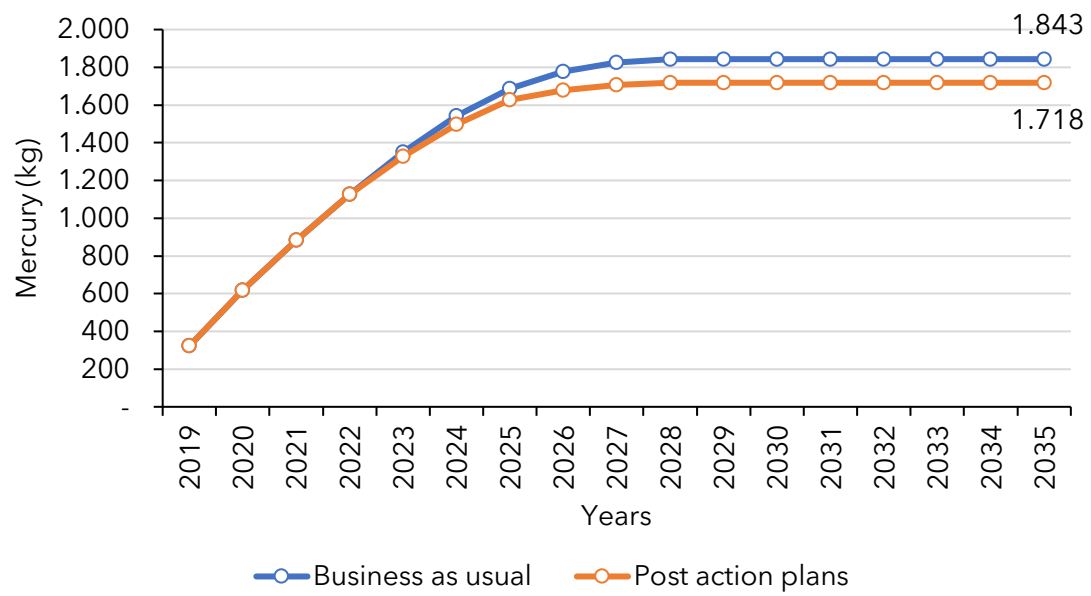


Figure 6.14 Accumulative mercury amount from the usages of lamps sold in 2019 - 2035



REFERENCES

- [1] CLASP and PwC, "Indonesia Lighting Market Study and Policy Analysis," Collaborative Labeling and Appliance Standards Program (CLASP) & PricewaterhouseCoopers (PwC), Jakarta, Indonesia, 2020.
- [2] Peraturan Presiden Nomor 12 Tahun 2021 tentang Perubahan Atas Peraturan Presiden Nomor 16 Tahun 2018 tentang Pengadaan Barang/Jasa Pemerintah, 2021.
- [3] M. A. McNeil, V. E. Letschert, and R. D. Van Buskirk, "Methodology for the Policy Analysis Modeling System (PAMS)," The Ernest Orlando Lawrence Berkeley National Laboratory (LBNL) & the Collaborative Labeling and Appliance Standards Program (CLASP), 2007.
- [4] Peraturan Presiden Nomor 21 Tahun 2019 tentang Rencana Aksi Nasional Pengurangan dan Penghapusan Merkuri, 2019.
- [5] S. Di Mauro, S. Musumeci, and A. Raciti, "Analysis of electrical and photometric quantities of CFL and LED bulb lamps," in 2017 IEEE Industry Applications Society Annual Meeting, 1-5 Oct. 2017 2017, pp. 1-8, doi: 10.1109/IAS.2017.8101720.
- [6] BPS. Ekspor dan Impor [Online] Available: <https://www.bps.go.id/exim/>
- [7] UN. UN Comtrade Database [Online] Available: <https://comtrade.un.org/data/>
- [8] LKPP. "Data Spesifikasi Alat Penerangan Jalan." Lembaga Kebijakan Pengadaan Barang/Jasa Pemerintah (LKPP). <https://e-katalog.lkpp.go.id/> (accessed 30 September, 2021).
- [9] ADLIGHT, "Pengujian Round Robin Lampu Standar dan Pengujian Kesesuaian Produk Lampu LED," ed. Bogor, Indonesia: UNEP/ADLIGHT Project Management Unit dan Ministry of Energy and Mineral Resources (MEMR), 2021, p. 44.
- [10] BSN. "SI Bang Beni Aplikasi Barang Ber-SNI." Badan Standarisasi Nasional (BSN). <https://bangbeni.bsn.go.id/> (accessed 1 Agustus, 2021).
- [11] SNI/ IEC 62560:2015 Lampu LED swa-balast untuk layanan pencahayaan umum dengan tegangan > 50 V Spesifikasi keselamatan, BSN, Jakarta, Indonesia, 2015.
- [12] SNI 04-6504-2001 Lampu swa-balast untuk pelayanan pencahayaan umum-persyaratan keselamatan, BSN, Jakarta, Indonesia, 2001.
- [13] WB. World Development Indicators - Lending interest rate (%) in China [Online] Available: <http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators>
- [14] Undang-Undang Nomor 6 Tahun 1994 tentang Pengesahan United Nations Framework Convention on Climate Change (Konvensi Kerangka Kerja Perserikatan Bangsa-Bangsa Mengenai Perubahan Iklim), 1994.
- [15] Undang-Undang Nomor 7 Tahun 1994 tentang Pengesahan Agreement Establishing the World Trade Organization (Persetujuan Pembentukan Organisasi Perdagangan Dunia), 1994.
- [16] Undang-Undang Nomor 8 Tahun 1999 tentang Perlindungan Konsumen, 1999.
- [17] Undang-Undang Nomor 30 Tahun 2007 tentang Energi, 2007.
- [18] Undang-Undang Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup, 2009.
- [19] Undang-Undang Nomor 3 Tahun 2014 tentang Perindustrian 2014.
- [20] Undang-Undang Nomor 16 Tahun 2016 tentang Pengesahan Paris Agreement to the United Nations Framework Convention on Climate Change (Persetujuan Paris atas Kerangka Kerja Perserikatan Bangsa-Bangsa Mengenai Perubahan Iklim), 2016.
- [21] Undang-Undang Nomor 11 Tahun 2017 tentang Pengesahan Minamata Convention on Mercury (Konvensi Minamata Mengenai Merkuri), 2017.
- [22] Peraturan Pemerintah Nomor 58 Tahun 2001 tentang Pembinaan dan Pengawasan Penyelenggaraan Perlindungan Konsumen, 2001.
- [23] Peraturan Pemerintah Nomor 70 Tahun 2009 tentang Konservasi Energi, 2009.
- [24] Peraturan Pemerintah Nomor 79 Tahun 2014 tentang Kebijakan Energi Nasional, 2014.

- [25] Peraturan Pemerintah Nomor 2 Tahun 2017 tentang Pembangunan Sarana dan Prasarana Industri, 2017.
- [26] Peraturan Pemerintah Nomor 29 Tahun 2018 tentang Pemberdayaan Industri, 2018.
- [27] Peraturan Presiden Nomor 79 Tahun 2010 tentang Pengesahan Agreement on the ASEAN Harmonized Electrical and Electronic Equipment Regulatory Regime (Persetujuan ASEAN Mengenai Harmonisasi Tata Cara Pengaturan Peralatan Listrik dan Elektronika), 2010.
- [28] Peraturan Presiden Republik Indonesia Nomor 61 Tahun 2011 tentang Rencana Aksi Nasional Penurunan Emisi Gas Rumah Kaca, 2011.
- [29] Peraturan Presiden Nomor 38 Tahun 2015 tentang Kerjasama Pemerintah dengan Badan Usaha dalam Penyediaan Infrastruktur, 2015.
- [30] Peraturan Presiden Republik Indonesia Nomor 22 Tahun 2017 tentang Rencana Umum Energi Nasional (RUEN), 2017.
- [31] Peraturan Presiden Nomor 47 Tahun 2017 tentang Penyediaan Lampu Tenaga Surya Hemat Energi (LTSHE) Bagi Masyarakat yang Belum Mendapatkan Akses Listrik, 2017.
- [32] Peraturan Menteri ESDM Nomor 18 Tahun 2014 tentang Pembubuhan Label Tanda Hemat Energi Untuk Lampu Swabalast, M. E. d. S. D. M. (MESDM), 2014.
- [33] Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 33 Tahun 2017 tentang Tata Cara Penyediaan Lampu Tenaga Surya Hemat Energi Bagi Masyarakat yang Belum Mendapatkan Akses Listrik, 2017.
- [34] Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 5 Tahun 2018 tentang Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 33 Tahun 2017 tentang Tata Cara Penyediaan Lampu Tenaga Surya Hemat Energi Bagi Masyarakat yang Belum Mendapatkan Akses Listrik, 2018.
- [35] Peraturan Menteri Perhubungan Nomor 27 Tahun 2018 tentang Alat Penerangan Jalan, 2018.
- [36] Keputusan Menteri Perindustrian dan Perdagangan Nomor 337/MPP/Kep/11/2001 tentang Penerapan Secara Wajib SNI Lampu Swa Ballast untuk Pencahayaan Umum-Persyaratan Keselamatan (SNI 04-6504-2001 dan Revisinya), 2001.
- [37] Keputusan Menteri Perindustrian dan Perdagangan Nomor 442/MPP/Kep/5/2002 tentang Perubahan Atas Keputusan Menteri Perindustrian dan Perdagangan Nomor 337/MPP/Kep/11/2001 tentang Penerapan Secara Wajib SNI Lampu Swa Ballast untuk Pencahayaan Umum-Persyaratan Keselamatan (SNI 04-6504-2001 dan Revisinya), 2002.
- [38] Peraturan Menteri Perindustrian Nomor 51/M-IND/PER/3/2012 tentang Tata Cara Pengakuan Terhadap Sertifikasi Produk Peralatan Listrik dan Elektronika dari Lembaga Penilaian Kesesuaian di Negara-negara ASEAN, 2012.
- [39] Peraturan Menteri Perindustrian Nomor 15 Tahun 2020 tentang Rencana Strategis Kementerian Perindustrian Tahun 2020-2024, 2020.
- [40] Peraturan Menteri Perindustrian Nomor 22 Tahun 2020 tentang Ketentuan dan Tata Cara Penghitungan Nilai Tingkat Komponen Dalam Negeri Produk Elektronika dan Telematika, 2020.
- [41] Keputusan Kepala Bappenas Nomor 2 Tahun 2020 tentang Perubahan Atas Peraturan Menteri Perencanaan Pembangunan Nasional/Kepala Badan Perencanaan Pembangunan Nasional Nomor 4 Tahun 2015 Tentang Tata Cara Pelaksanaan Kerja Sama Pemerintah Dengan Badan Usaha Dalam Penyediaan Infrastruktur, M. o. N. D. P. (BAPPENAS), 2020.
- [42] Peraturan Badan Standardisasi Nasional Nomor 7 Tahun 2020 Tentang Tata Cara Pemberlakuan Standar Nasional Indonesia Secara Wajib, BSN, Jakarta, Indonesia, 2020.

- [43] Peraturan Menteri Keuangan Nomor 153/PMK.010/ 2020 tentang Pemberian Pengurangan Penghasilan Bruto Atas Kegiatan Penelitian dan Pengembangan Tertentu di Indonesia, 2020.
- [44] Undang Undang Nomor 7 Tahun 1984 tentang Ratifikasi Konvensi PBB tentang Penghapusan segala Bentuk Diskriminasi terhadap Perempuan (disingkat sebagai Konvensi Wanita), 1984.
- [45] Undang-Undang Nomor 17 Tahun 2007 tentang Rencana Pembangunan Jangka Panjang Nasional (RPJPN) Tahun 2005 - 2025, 2007.
- [46] Peraturan Presiden Republik Indonesia Nomor 59 Tahun 2017 tentang Pelaksanaan Pencapaian Tujuan Pembangunan Berkelanjutan, 2017.
- [47] Peraturan Presiden Nomor 18 Tahun 2020 tentang Rencana Pembangunan Jangka Menengah Nasional Tahun 2020-2024, 2020.
- [48] Surat Edaran Bersama tentang Strategi Nasional Percepatan Pengarusutamaan Gender (PUG) Melalui Perencanaan dan Penganggaran yang Responsif Gender (PPRG), 2012.
- [49] KI, "Panduan dan Perencanaan Penganggaran yang Responsif Gender (PPRG) Bidang Perindustrian," Kementerian Perindustrian (KI), Jakarta, Indonesia, 2012, vol. 2.
- [50] Peraturan Menteri Luar Negeri Nomor 21 Tahun 2020 tentang Pedoman Pelaksanaan Pengarusutamaan Gender di Lingkungan Kementerian Luar Negeri, 2020.
- [51] KKP, "Road Map Pelaksanaan Pengarusutamaan Gender (PUG) di Lingkungan Kementerian Kelautan dan Perikanan," Kementerian Kelautan dan Perikanan (KKP), Jakarta, Indonesia, 2012.
- [52] Peraturan Menteri Lingkungan Hidup dan Kehutanan Nomor P.31/MENLHK/SETJEN/SET.1/5/2017 tentang Pedoman Pelaksanaan Pengarusutamaan Gender Bidang Lingkungan Hidup dan Kehutanan, 2017.
- [53] IESR, "Laporan Workshop Penyusunan Panduan Teknis Integrasi Gender dalam Energi Terbarukan," Institute for Essential Services Reform (IESR), Jakarta, Indonesia, 2017.
- [54] Peraturan Menteri ESDM Nomor 2 tahun 2018 tentang Pemberlakuan Wajib Standar Nasional Indonesia di Bidang Ketenagalistrikan, 2018.
- [55] Peraturan Presiden Nomor 55 Tahun 2018 tentang Rencana Induk Transportasi Jakarta, Bogor, Depok, Tangerang, dan Bekasi tahun 2018 - 2019, 2018.
- [56] Keputusan Presiden Nomor 24 Tahun 2018 tentang Tim Nasional Peningkatan Penggunaan Produk Dalam Negeri, 2018.
- [57] Keputusan Menteri Koordinator Bidang Maritim dan Investasi Nomor 84 Tahun 2019 tentang Pokja Tim Nasional Peningkatan Penggunaan Produk Dalam Negeri, 2019.
- [58] Peraturan Menteri Perindustrian 02/M-IND/PER/1/2014 tentang Pedoman Penggunaan Produk Dalam Negeri dalam Pengadaan Barang dan Jasa Pemerintah, 2014.
- [59] P. Morgan Pattison, M. Hansen, and J. Y. Tsao, "LED lighting efficacy: Status and directions," *Comptes Rendus Physique*, vol. 19, no. 3, pp. 134-145, 2018/03/01/2018, doi: <https://doi.org/10.1016/j.crhy.2017.10.013>.
- [60] Peraturan Menteri Keuangan Nomor 150/PMK.010/2018 tentang Pemberian Fasilitas Pengurangan Pajak Penghasilan Badan, 2018.
- [61] Peraturan Pemerintah Nomor 78 tahun 2019 tentang Fasilitas Pajak Penghasilan untuk Penanaman Modal di Bidang-Bidang Usaha Tertentu dan/atau di Daerah-Daerah Tertentu, 2019.
- [62] Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 27/PRT/M/2018 Tentang Sertifikat Laik Fungsi Bangunan Gedung, 2018.
- [63] W. Jiang, X. Wu, Y. Gong, W. Yu, and X. Zhong, "Holt-Winters smoothing enhanced by fruit fly optimization algorithm to forecast monthly electricity consumption," *Energy*, vol. 193, p. 116779, 2020.

- [64] C. C. Holt, "Forecasting seasonals and trends by exponentially weighted moving averages," International journal of forecasting, vol. 20, no. 1, pp. 5-10, 2004.
- [65] P. R. Winters, "Forecasting sales by exponentially weighted moving averages," Management science, vol. 6, no. 3, pp. 324-342, 1960.
- [66] DJK. Faktor Emisi GRK Sistem Ketenagalistrikan Tahun 2019, Direktorat Jenderal Ketenagalistrikan (DJK). [Online]. Available: https://gatrik.esdm.go.id/assets/uploads/download_index/files/96d7c-nilai-fe-grk-sistem-ketenagalistrikan-tahun-2019.pdf

RESPONDENT PROFILE

8.1. CV. Sentosa Electric

CV. Sentosa Electric	
Address	Jl. Hegar No. 3 Cibaligo, Leuwi Gajah-Cimahi Bandung, Indonesia
Website	http://keibu-electric.com/
Brand	Keibu, Sook, Mona
Lamp types	Bulb, tube, street lights, solar-powered street lights, ceiling, downlight panel, emergency, high bay, floodlight
Association	GAMATRINDO

The main product of CV. Sentosa Electric is the LED bulb under the Keibu, Sook, and Mona brands. Other LED lamps produced are ceiling, fan, downlight panels, emergency, street lights, solar-powered street lights, tube lights, high bays, 12 Vdc LED bulbs, and spotlights. Sentosa Electric has comprehensive production equipment such as plastic injection machines to fabricate bodies and lampshades. Sentosa Electric is also an Original



Keibu brand LED lamp made by CV. Sentosa Electric

Equipment Manufacturer (OEM) of other domestic brands of LED lamps. The LED lamp bulbs manufactured by Sentosa Electric have passed the Indonesian National Standard (SNI) / IEC 62560:2015 for the safety specifications for LED lamps, although the SNI is not mandatory yet. Lamp efficacy already reaches 110 lm/W, and Sentosa Electric commits continuously increases their lamp products' efficacy.

8.2. PT. Artolite Indah Mediatama

	<i>PT. Artolite Indah Mediatama</i>
Address	Jl. Raya Jakarta Bogor Km 34.5 - Cimanggis, Depok - West Java
Website	https://artolite.co.id/ .
Brand	artolite
Lamp types	Tubes, indoor and outdoor luminaires for architectural, decorative, PJU, emergency, and special lamp needs
Association	APERLINDO



The Production Process PT. Artolite Indah Mediatama

Artolite Indah Mediatama is a lamp armature manufacturer established in 1976. The company's main office and factory are in Depok but the company has branch offices/ showrooms in Jakarta, Bandung, Semarang, Surabaya, Medan, Pekanbaru, Balikpapan, Bali, and Makassar. Artolite Indah Mediatama

manufactures various indoor and outdoor lighting products for architectural, decorative needs, street lamps, emergency lamps, and special lamps tailored to customer orders. Artolite Indah Mediatama uses LED lamps from several well-known manufacturers but Artolite Indah Mediatama also has tube lights with the Artolite trademark. The tube lights are produced by another factory (i.e., Original Equipment Manufacturer).

8.3. PT. Catur Mukti Pratama

	PT. Catur Mukti Pratama
Address	kaw. Industrial Cikupamas 2, JL. Bhumimas VI/1, Cikupa - Banten
Website	https://siklon.co.id/
Brand	Siklon, Samson
Lamp types	PJU, electricity usage monitoring system
Association	-



The production process at PT. Chess Mukti Primary

Since starting the production of street lights in 2014, Catur Mukti Pratama has expanded its market to various regions reaching 280 regencies/ cities. The marketing strategy is by educating the specifications and design of good street lights and providing after-sales service. Catur Mukti Pratama

only uses pure aluminum housing because it has better heat sink properties than the die-cast housing type. Another innovation by Catur Mukti Pratama is a Siklon Asset Management System Online (SAMSON), a remote electricity usage monitoring tool for street lights. The advantage of SAMSON is low capital and operation costs.

8.4. PT. Cipta Sinergi Asia

	<i>PT. Cipta Sinergi Asia</i>
Address	Jl. Raya Gombang No.37 Blok Pelita RT.12/RW.03 Gombang Village, District, Plumbon Kab. Cirebon - West Java
Website	http://www.ledcsa.com/
Brand	Luxon, Zeron and Ecolux
Lamp types	LED tube, LED bulb, downlight, flat panel, other indoor, PJU, floodlight, high bay, explosion-proof lamps
Association	-



PJU LED lamps produced by PT. Create Asian Synergy

Cipta Sinergi Asia is a representative of a Korean lamp company in Indonesia. Cipta Sinergi Asia was established in 2007 as an importer and built a factory in Indonesia in 2018. Cipta Sinergi Asia has direct affiliations with LED

manufacturers in Korea, e.g., Dongbu, Kumho, Daejin, Posco, and LG. Cipta Sinergi Asia manufactures various lamp products such as LED bulbs, tube lights, spotlights, and street lights. The trademarks used are Luxon and Zeron. Cipta Sinergi Asia has modern equipment for light source tests, IP 65 testing, and goniophotometers. The sales is through agents (90%), and retailers (10%).

8.5. PT. Daya Mandiri Terbarukan

<i>PT. Daya Mandiri Terbarukan</i>	
<i>Address</i>	Jl. Baetussa'adah No. 3, Curug, Tangerang, Banten 15810
<i>Website</i>	https://www.linkedin.com/company/pt-daya-mandiri-terbarukan/about/
<i>Brand</i>	FujiLED
<i>Lamp types</i>	Bulb, tube, street lights, solar-powered street lights, showcase, high bay, floodlight
<i>Association</i>	-

The main product of Daya Mandiri Terbarukan is LED street lights. Other lamp products are solar-powered street lights, LED bulbs, LED tube lights, showcase, high bay, and floodlights. Daya Mandiri Terbarukan has its brand of FujiLED and an OEM of several other leading lamp brands. Daya Mandiri Terbarukan commits to producing high-quality LED lamps with a power factor above 95% and an efficacy higher than 100 lm/W. Daya Mandiri Terbarukan, in the future, aims to cooperate with other companies both at home and abroad in producing LED lamps.



High bay lamp made by PT. Mandiri Daya Terbarukan

8.6. PT. Fokus Indo Lighting

PT. Fokus Indo Lighting	
Address	South Industrial Jl Blok LL no 4 Jababeka II Industrial Estate, South Cikarang, Bekasi, West Java 17530
Website	https://www.fokuslamp.co.id/
Brand	Street lights (Cosmic, Opera, Galaxy, Bimasakti, and Mars brands), solar-powered street lights (Atria and Aludra brands), floodlights (Caves, Samba, and Serayu brands), pedestrian lights (Jupiter, Mars brands)
Lamp types	Street lights, solar-powered street lights, floodlights, pedestrian lights
Association	ALINDO

The experience of Fokus Indo Lighting, established in 2003 in the lighting field, started as an OEM for Phillips. In 2015, Fokus Indo Lighting started to produce various lamp types with its brands, such as street lights (i.e., Cosmic, Opera, Galaxy, Bimasakti, and Mars brands), solar-powered



The production process at PT. Fokus Indo Lighting

street lights (i.e., Atria and Aludra brands), floodlights (i.e., Caves, Samba, and Serayu brands), and pedestrian lights (i.e., Jupiter and Mars brands). Fokus Indo Lighting focuses on supplying project needs in the central and local governments, including the Government and Business Entity Cooperation (KPPBU) scheme in managing and saving energy at street lights. Fokus Indo Lighting has three smart street light technologies based on Radio Frequency (RF), Power Line Communication (PLC), and Global System for Mobile Communications (GSM).

8.7. PT. Honoris Industry

	PT. Honoris Industry
Address	Jl. Raya Sukabumi Km. 2, Ciawi - Bogor 16720
Website	https://www.honorisindustry.com/ .
Brand	Hori
Lamp types	Bulb, tube, street lights, solar-powered street lights, ceiling, downlight panel, emergency, high bay, floodlight
Association	APERLINDO

Honoris Industry was initially known as the OEM of Fujifilm's camera. After the demand for film cameras decreased, Honoris Industry diverted its production to other products, including LED lamps, candles, floodlights, street lights, solar-powered street lights, high bays, downlights, and T8 tube lights. Honoris Industry uses the Hori brand for lamp products. Its production equipment includes plastic injection machines, automatic soldering machines, and SMT machines for the automatic and precise installation of electronic components. Honoris Industry commits to producing high-quality products to preserve the environment and reduce global warming. Honoris Industry is currently trusted as an OEM for a global lamp brand with a market share in the United States.



Hori LED bulb made by PT. Honoris Industry

8.8. PT. Jaya Eco Energi

	<i>PT. Jaya Eco Energi</i>
<i>Address</i>	Jl. Gading Kirana Utara No.3, RT.11/RW.8, Kelapa Gading, Jakarta 14240
<i>Website</i>	www.jayaecoenergi.com
<i>Brand</i>	Jishan, Chikara
<i>Lamp types</i>	Street lights, LED bulbs, floodlights
<i>Association</i>	ALINDO



Street light products of PT. Jaya Eco Energi

Since its establishment in 2014 in Jakarta, Jaya Eco Energi has committed to developing and promoting LED lamps as a form of contribution to nature conservation. The main products of Jaya Eco Energi are street lights, floodlights, and LED bulbs. Jaya Eco Energi aims to increase TKDN by proposing local components that can be mass-produced

domestically so that Jaya Eco Energi can obtain a competitive production price. The local industries can then share these local components to meet LED lamp demand in Indonesia.

8.9. PT. Kingled Indonesia

	<i>PT. Kingled Indonesia</i>
<i>Address</i>	Jl. Agarwood No. 131/46, Medan City, North Sumatra, 20235
<i>Website</i>	http://kingledindonesia.com/
<i>Brand</i>	Kingled and Mcleod
<i>Lamp types</i>	Bulb, emergency, downlight, floodlight, high bay, street lights, solar-powered street lights
<i>Association</i>	APERLINDO

Kingled Indonesia manufactures LED lamps under the Kingled and Mcled trademarks. Around 230 LED lamp models are produced, such as bulbs, tube lights, downlights, emergency lamps, street lights, spotlights, and decoration lamps. TKDN of Kingled Indonesia reaches 25%, and the market of their



The showroom of PT. Kingled Indonesia in Jakarta

lamps is projects and online sales. Kingled Indonesia provides a 2 to 5-year warranty depending on the buyer's request.

8.10. PT. LED Pro IDN

PT. LED Pro IDN	
Address	Jl. Raya Light Kav. H10 28, Leuwinutug Village, Citeureup District, Bogor Regency, 1680
Website	https://ledproidn.com
Brand	Led
Lamp types	Street lights, luminaires
Association	There is not any



Street lights made by PT. LED Pro IDN

LED Pro IDN was established in September 2017 and is a subsidiary of a Korean company VITSRO, Co. Ltd., which produces indoor and outdoor LED lamps. The main products of LED Pro IDN are street lights (30 to 200 W). Other products are floodlights (40 to 120 W) and office luminaires. All products of LED Pro IDN use high-

quality components and have SNI certificates, ISO 9001: 2015, ISO 14001: 2015, and OHSAS 18001: 2007. LED Pro IDN commits to continuously improving product quality to be energy efficient and environmentally friendly.

8.11. PT. Makarim Berjaya

	<i>PT. Makarim Berjaya</i>
Address	Jatinegara Indah Housing, Jl. Mount Bromo Block AG1, No.1 Jakarta-East 13930 - INDONESIA
Website	https://makarimberjaya.com/
Brand	SuryaLED
Lamp types	Street lights, solar-powered street lights, floodlights, pedestrian lights, bulbs
Association	-



LED Solar Lamps produced by PT. Makarim Berjaya

Makarim Berjaya was founded in 2010 with its current factory location in Bogor. In 2015, PT. Makarim Berjaya started to produce various LED lamps such as bulbs, street lights, lamps for planting, and ultraviolet (UV) lamps under the SuryaLED brand. Some of the profits from the lamp sales are donated to the Amil Zakat Infaq and Alms Muhammadiyah (Lazismu) Institute. In addition, PT. Makarim Berjaya, together with the Ministry of Industry,

provided free training on producing LED lamps to the public in several areas and Islamic boarding schools.

8.12. PT. Moradon Berlian Sakti

	<i>PT. Moradon Berlian Sakti</i>
<i>Address</i>	Jl. Agung Karya II Block D No 12A , Sunter Agung Podomoro, Jakarta 14340
<i>Website</i>	http://www.ledmoradon.com
<i>Brand</i>	Moradon
<i>Lamp types</i>	Street lights, solar-powered street lights, floodlights
<i>Association</i>	GAMATRINDO

Moradon Berlian Sakti manufactures various types of LED lamps with the trademark Moradon. The main product of Moradon Berlian Sakti is LED street lights with various sizes, power, spare parts, and accessories. In addition, Moradon Berlian Sakti also produces armatures supported by molding machines for street lights, spotlights, warehouse lamps, tunnel lamps, and



The production process at PT. Moradon Berlian Sakti

Hayman lamps. Moradon Berlian Sakti commits to producing high-quality LED lamps with efficacy above 100 lumens/W, environmentally friendly, economical, and long-lasting (up to 30,000 hours of lifespan).

8.13. PT. Niko Elektronik Indonesia

PT. Niko Elektronik Indonesia	
Address	Jl. Raya Semarang - Demak Km 7, Banjardowo Industrial Environment Block B 8 - 9, Semarang - Central Java 50117
Website	https://nikoelectronic.com/
Brand	Niko
Lamp types	LED bulbs
Association	APERLINDO



The production process at PT. Niko Elektronik Indonesia

Niko Elektronik Indonesia was established in 2001 and started to build a factory in 2002. Since the first production in 2004, Niko Elektronik Indonesia has continued to grow to produce various household appliances, ranging from CFL, irons, fans, rice cookers, blenders, and gas stoves. Niko

Elektronik Indonesia expanded its business by adding factories from 3 buildings to 11 buildings with 800 employees. In the era of CFL, Niko Elektronik Indonesia had to stop producing CFL because they could not compete with imported CFL lamps. However, since 2021, PT. Niko Elektronik Indonesia is starting to produce LED bulbs to supply a large market for LED bulbs in the future. Moreover, Niko Elektronik Indonesia can increase the utilization of its existing production equipment, e.g., plastic injection machines, to produce LED bulbs.

8.14 PT. Panasonic Gobel Life Solutions

	<i>PT. Panasonic Gobel Life Solutions</i>
<i>Address</i>	Pier Industrial Estate, Jl. Industrial Rembang No. 47, North Bunut, Pejangngkang, Rembang Pasuruan
<i>Website</i>	https://www.panasonic.com/id/consumer/lamp/led-lamp.html
<i>Brand</i>	Panasonic
<i>Lamp types</i>	Street lights, portable light, bulbs, desk lamp, floodlight, wall washer, pixel, fountain light, high bay, explosion-proof, emergency light, recessed mounting, panel, ceiling, outbow, wall light, exit panel, strip, batten, linear recessed, base light
<i>Association</i>	APERLINDO



Panasonic LED lamp type *emergency* exported to *Thailand*.

Panasonic Gobel Life Solutions is a global company in Indonesia, with one of its factories in Pasuruan. Panasonic Gobel Life Solutions, established in 1996, currently produces LED lamps such as emergency lamps and street lights. The markets of Panasonic Gobel Life Solutions are domestic and various countries (e.g., ASEAN countries, Australia, Japan, and Europe).

Panasonic Gobel Life Solutions also manufactures LED lamp drivers exported to Japan. Its street light products have efficacy higher than 160 lumens/watt and have been installed in 186 cities in Indonesia.

8.15. PT. Pandawa LED Indonesia

PT. Pandawa LED Indonesia	
Address	Palebon, Pedurungan, Semarang, Central Java 50246
Website	https://www.instagram.com/pandawaledofficial/?hl=en
Brand	Pandawa, MP
Lamp types	LED bulb, TL, downlight, floodlight
Association	APERLINDO



LED bulbs produced by PT. Pandawa LED Indonesia

Pandawa LED Indonesia has experience in lamp businesses as a distributor. On April 21, 2019, Pandawa LED Indonesia started selling its lamp brand, focusing on markets outside urban areas. Pandawa LED Indonesia uses its existing distribution network and various promotional techniques to

increase its sales volume reaching 300 thousand units per month. Pandawa LED Indonesia also continues to innovate lamp designs following global trends. Pandawa LED Indonesia hopes that the government can impose the mandatory safety SNI for LED bulbs to eradicate low-quality imported LED lamps. In addition, Pandawa LED Indonesia expects LKPP to include LED bulbs in the Electronic Catalog.

8.16. PT. Prisled Innovative Lighting Indonesia

	<i>PT. Prisled Innovative Lighting Indonesia</i>
Address	Union Industrial Park Complex, Blok A No.9&10, Batu Ampar - Batam
Website	http://www.prisled.com.sg
Brand	Prisled
Lamp types	Crane lamps for port/hangar, street lights, solar-powered street lights, floodlight, explosion-proof light, indoor light, and smart street lights
Association	ALINDO

A LED industry in Batam is Prisled Innovative Lighting Indonesia, a foreign investment company founded in 2015. Prisled Innovative Lighting Indonesia accordingly uses Prisled and Prisoli brands for lamp and solar panel products. Both products are for domestic and export markets. The main products of Prisled Innovative Lighting Indonesia are crane lamps for ports and hangars. Other lamps produced are street lights, floodlights, explosion-proof lamps, indoor lamps, lamp-integrated with solar panels, smart LED lamps, solar panels, inverters, and lithium batteries. The efficacy of Prisled street lights is

between 120 to 150 lumens/watt. Prisled Innovative Lighting Indonesia has comprehensive testing and production facilities, e.g., a water spray test chamber, goniophotometer, LED automation, temperature and humidity chamber, sun simulator, solar cell laminating, and solar cell framing.



The factory of PT. Prisled Innovative Lighting Indonesia

8.17. PT. Saka Agung Karya Abadi

	<i>PT. Saka Agung Karya Abadi</i>
<i>Address</i>	East Ring Road No.9, Kebonsar, Kebonsari, Kec. Temple, Sidoarjo Regency, East Java 61271
<i>Website</i>	https://www.saka-lamp.com/
<i>Brand</i>	Saka, Global, Total
<i>Lamp types</i>	Street lights, solar-powered street lights, floodlights, high bay, downlights, pedestrian lights
<i>Association</i>	ALINDO, APERLINDO

Saka Agung Karya Abadi was established in 1993 and its current factory is in Sidoarjo. Saka Agung Karya Abadi initially manufactured panel boxes, hydrant boxes, cable trays, and lamp housings made of iron plates. In 2018, Saka Agung Karya Abadi expanded its business

to manufacturing various LED lamps such as luminaires, street lights, and other indoor lamps under the Saka brand. Saka Agung Karya Abadi possesses production equipment such as cutting machines, bending machines, welding machines, printing machines, CNC machines for making molding, and die-cast aluminum machines to produce street light luminaires.

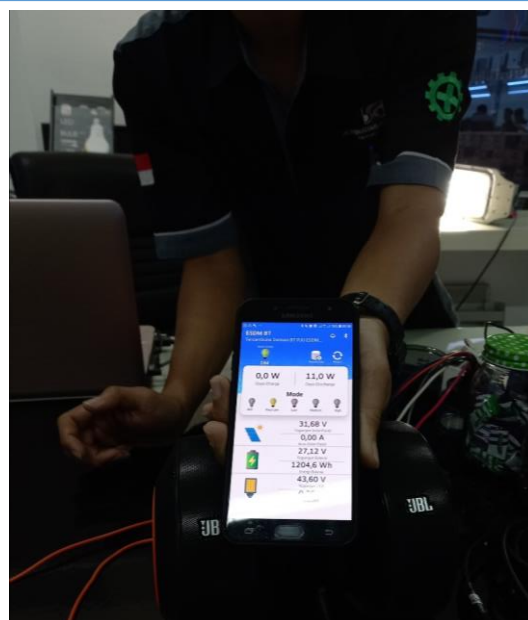


The product development room at PT Saka Agung Karya Abadi

8.18. PT. Santinilestari Energi Indonesia

	<i>PT. Santinilestari Energi Indonesia</i>
<i>Address</i>	Jl. Raya Surabaya - Malang No.Km.40, Pasuruan, East Java 67155
<i>Website</i>	https://www.sei-gforcebell.com/
<i>Brand</i>	G-Force Bell and e-Sun
<i>Lamp types</i>	Street lights, solar-powered street lights, smart street lights, solar-powered bulbs, bulbs, smart bulbs
<i>Association</i>	ALINDO

Santinilestari Energi Indonesia established the Pasuruan factory in 2012 to produce various LED lamps and supporting equipment (e.g., solar charge controllers (SSC), smart driver systems, smart system communication gateways, solar module panels, energy-efficient solar lamps). The brands of its street lights are G Force Bell and e-Sun with TKDN above 40% and efficacy at least 160 lumens/watt. Santinilestari Energi Indonesia collaborated with state universities in East Java to develop smart street light technology. The technology feature can remotely monitor and control street lights and diagnose damaged components.



The applications of smart street lights made by PT. Energy Santinilestari Indonesia

8.19. PT. Sarana Karya Solusindo

PT. Sarana Karya Solusindo	
Address	Sinar Buduran Warehousing, 1 No. B22, Gesing, Banjarsari, Buduran, Sidoarjo Regency, East Java 61252
Website	https://bandell-lamp.com/
Brand	Bandell
Lamp types	Street lights, solar-powered street lights, facade lights, tunnel lights, floodlights
Association	APERLINDO

Sarana Karya Solusindo was founded in 2013 to produce electrical and mechanical technology and LED street lights with the Bandell trademark, which means strong and durable in Javanese. Bandell street lights have power between 30 W to 200 W and have been used in East Java, DKI Jakarta, and South Kalimantan. Production machines owned by Sarana Karya Solusindo are relatively new and modern, such as SMT. Sarana Karya Solusindo also uses local die-cast to increase the TKDN of Bandell street lights.

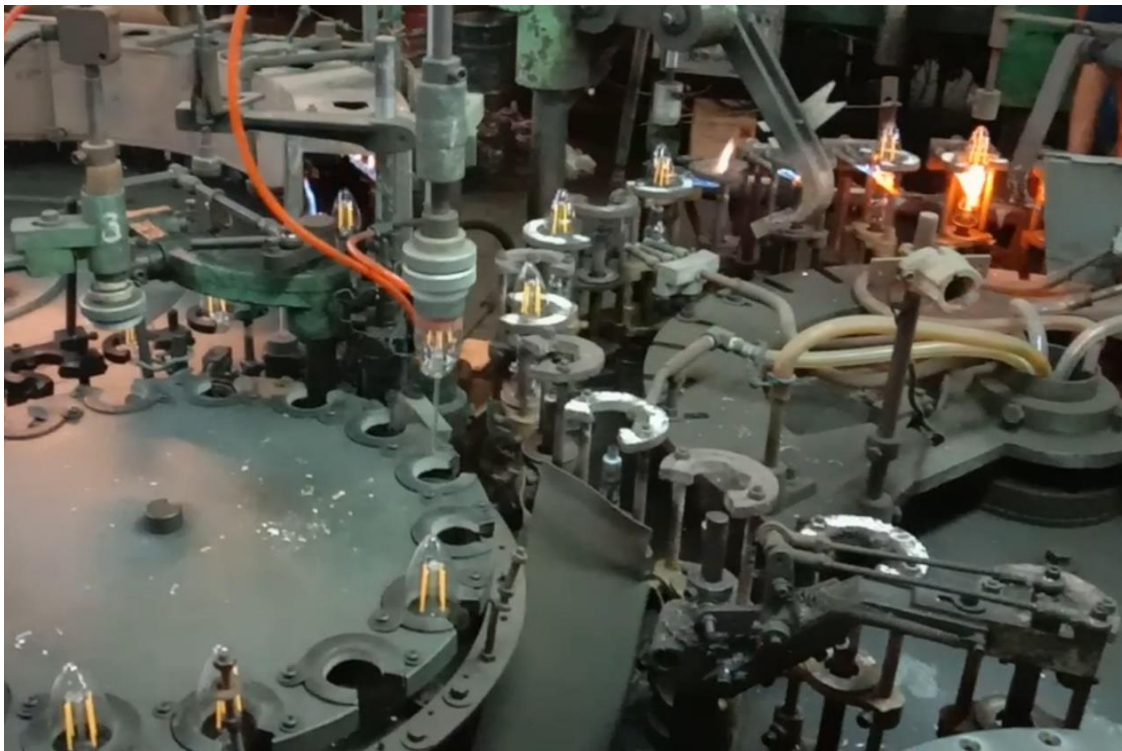


The production process at PT. Sarana Karya Solusindo

8.20. PT. Sinar Angkasa Rungkut

	<i>PT. Sinar Angkasa Rungkut</i>
Address	Jl. Rungkut Industri I No. 8, Kendangsari, Surabaya, East Java 60292
Website	https://chiyoda-lamp.com/ .
Brand	Chiyoda
Lamp types	Incandescent lamp, reflector lamp, candle lamp, filament led, bulb, nano LED, tube, downlight, spotlight, floodlight, street lights, high bay, a high discharge lamp, PAR.
Association	GAMATRINDO

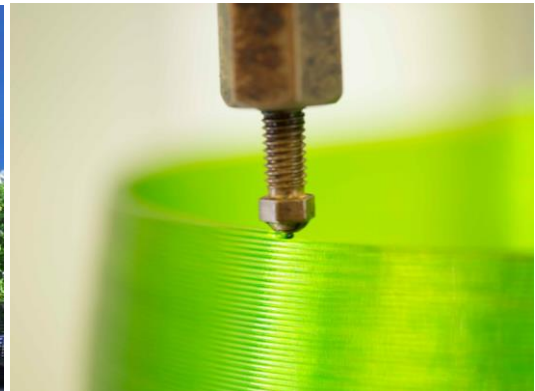
Sinar Angkasa Rungkut founded in 1975 is a lamp manufacturer in Surabaya with the Chiyoda brand. The flagship product is an incandescent lamp, but Sinar Angkasa Rungkut has also produced LED bulbs, LED filaments, and LED tube lights with an efficacy of at least 100 lumens/watt. Sinar Angkasa Rungkut has complete equipment for incandescent lamp production so Sinar Angkasa Rungkut excels in producing filament-type LED lamps. JW Marriott Hotel Surabaya and several other large consumers have used its LED lamp products. Sinar Angkasa Rungkut still exports its lamp products.



The production process of LED filament lamps at PT. Sinar Angkasa Rungkut

8.21. PT. Signify Commercial Indonesia

<i>PT. Signify Commercial Indonesia</i>	
<i>Address</i>	Jl. Buncit Raya Kav.99, Jakarta 12510
<i>Website</i>	https://www.signify.com/en-id
<i>Brand</i>	Phillips, Interact, Phillips Hue, Color Kinetics, Strand, Vari-Lite, UHP, Modular, Zero88
<i>Lamp types</i>	Bulbs, tube lights, downlights, high bay, street lights, and 3D Printing Luminaire
<i>Association</i>	APERLINDO



The factory of PT Signify Commercial Indonesia and 3D printing luminaire facilities

Signify Commercial Indonesia, previously known as PT. Philips Lighting Indonesia, changed its name in 2018. With the vision of unlocking the incredible potential of lamps for a brighter life and a better world, Signify Commercial Indonesia has superior lamp products, including the Philips brand and Interact (connected lamp system with active data services). Currently, Signify Commercial Indonesia has factories to produce street lights in the Karawang plant and 3D printed luminaires in the Bumi Serpong Damai site.

8.22. PT. Solarens Ledindo

	<i>PT. Solarens Ledindo</i>
<i>Address</i>	Industrial Estate De Primaterra B2-3B, Jalan Sapan - Gedebage, Tegalluar, Bandung
<i>Website</i>	http://solarens.co.id/
<i>Brand</i>	Solarens
<i>Lamp types</i>	Aviation and marine, light engine, street lights, solar-powered street lights, industrial lamps, floodlights, and smart street lights.
<i>Association</i>	ALINDO, APERLINDO

As a member of Alindo, the main product of Solarens Ledindo is street lights. Moreover, Solarens Ledindo also produces tube lights, high bay, aviation and marine lamps, floodlights, industrial lamps, and other outdoor lamps. The lamps of Solarens Ledindo have an efficacy of 160 lm/W, and ready to use smart technology features such as smart dimmer and light sensors. Solarens Ledindo commits to developing LED lamp products, especially street lights in Indonesia.



The factory of PT. Solarens Ledindo

8.23. PT. Sumber Klik Sejahtera

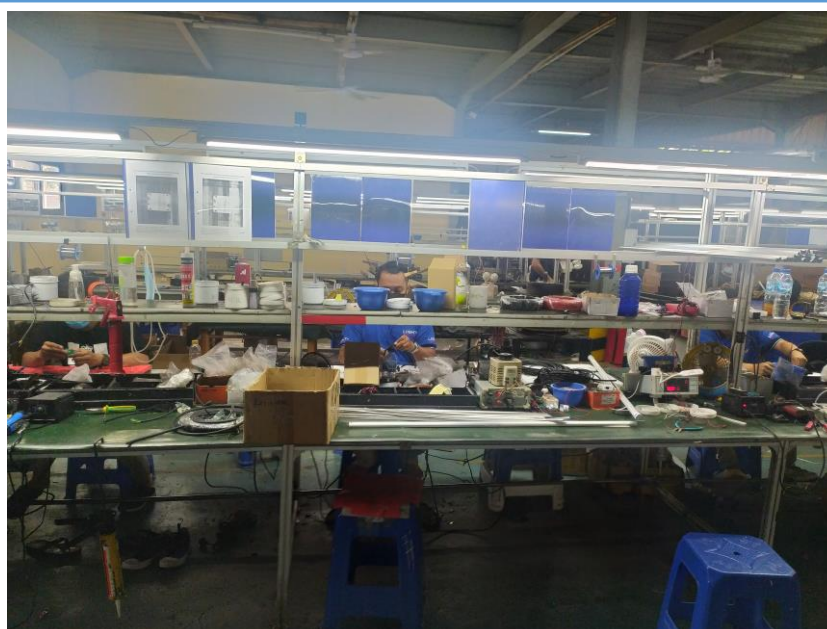
	<i>PT. Sumber Klik Sejahtera</i>
Address	Jl.Sultan Iskandar Muda No. 100B, Kebayoran Lama - South Jakarta
Website	http://www.stark-indonesia.com/
Brand	STARTLED, STARK
Lamp types	LED bulbs
Association	APERLINDO

Sumber Klik Sejahtera has been producing LED lamps under the STARK brand since May 2013. The strategies implemented by Sumber Klik Sejahtera are (1) Leading in innovating quality products, (2) Trusted both quality and warranty, and (3) Affordable prices for all consumer classes. The main features of STARK LED lamps are: (1) being able to operate in conditions of fluctuating voltage between 85 and 265 volts, (2) excellent heat dissipation, and (3) high quality LED chip avoiding flickers. Another feature is that lamps will automatically turn on when the electricity supply from PLN is interrupted.



8.24. PT. Surya Citra Teknik Cemerlang

PT. Surya Citra Teknik Cemerlang	
Address	Jl. Raya Narogong Pangkalan 1B No.80, Bantargebang, Bekasi, West Java 17151
Website	https://lightplusled.com/
Brand	LIGHT+
Lamp types	Bulbs, tube lights, emergency lamps, spotlights, ceiling lights, floodlights, high bay, and street lights
Association	APERLINDO



The production process at PT. Surya Citra Teknik Cemerlang

Surya Citra Teknik Cemerlang founded in 2009 is an LED lamp manufacturer in Bekasi. Surya Citra Teknik Cemerlang produces various electrical products under the LIGHT+ brand, such as LED lamps, solar panels, power supplies, running text, and LED Videotron. Manufactured LED lamps consist of bulbs, tube lights, emergency lights, spotlights, ceiling lights, floodlights, high bay, and street lights.

The efficacy of LIGHT+ lamps reaches 120 lumen/ watt for indoor lamps and 160 lumen/ watt for street lights. Surya Citra Teknik Cemerlang continues to grow and will add new products, i.e., lamp posts for street lights.

8.25. PT. Surya Utama Putra

PT. Surya Utama Putra	
Address	Jalan Raya Bandung - Garut KM. 23, Rancaekek, Bandung, West Java 40394
Website	https://suryautamaputra.co.id/
Brand	Surya Utama Putra
Lamp types	Street lights, solar-powered street lights
Association	ALINDO

Surya Utama Putra, founded in 2009, has a 3,240 m² factory on an area of 8,090 m² in the Rancaekek, Bandung. Surya Utama Putra manufactures solar panels, street lights, lithium batteries, and other solar energy-based products. The efficacy of street lights produced by Surya Utama Putra has continued to increase until now, reaching above 150 lm/W. The street lights of Surya Utama Putra have



The production process at PT. Surya Utama Putra

been included in the LKPP Electronic Catalog and are widely used by ministries, state-owned enterprises, local governments, and other industries. Surya Utama Putra has a laboratory equipped with various test equipment such as integrated sphere photometry and humidity chamber.

8.26. PT. Tjipto Langgeng Abadi

	<i>PT. Tjipto Langgeng Abadi</i>
Address	Jl Gatot Subroto 121, Gedangan, Sidoarjo - East Java , Indonesia 61254
Website	http://www.focuselectric.com/focus_divisions.html
Brand	Focus, Lightning, Lightning, Badalex, and Panda
Lamp types	Incandescent, CFL, tube lights, LED bulbs, street lights, solar-powered street lights, downlights
Association	APERLINDO

Tjipto Langgeng Abadi was established in Surabaya in 1976. Tjipto Langgeng Abadi produced various indoor and outdoor lamps, e.g., incandescent, CFL, tube lights, and LED lamps branded Focus, Petir, Halilintar, Badalex, and Panda. In



LED Lamps Produced by PT. Tjipto Langgeng Abadi

addition, Tjipto Langgeng Abadi also produces various cables types. Tjipto Langgeng Abadi commits to producing high-quality lamps but affordable for the underprivileged. Tjipto Langgeng Abadi has sales branches in various areas such as Jakarta, Semarang, Denpasar, Makassar, NTT, and NTB.