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Local Content Requirements Policy in Indonesia's Power Plant Development: The Opportunity Costs Perspective

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ABSTRACT

One of the elements that can increase national resilience is the strength of the domestic industrial sector. A proven and reliable electricity supply is very important in supporting the operations of the industrial sector. Accordingly, a reliable electricity supply is an important and strategic element in the realization of national security. To reduce dependency on imported materials, the Government of Indonesia (GOI) has imposed local content requirements (LCR) mechanism in the electricity sector, especially for the major components of power plants, namely steam turbines, and generators. The ambitious electricity infrastructure development program which dominantly relies on the coal-fired power plant (CFPP) requires reliable electrical components that support upstream industries which face problems if LCR should be applied. The objective of this study is to analyze the opportunity costs of replacing the required import of steam turbines and generators, as well as to provide recommendations on how LCR would be best be applied in Indonesia, despite its controversies to support the economic development of a country. The result of the study shows the total value of opportunity cost that GOI is likely to gain from imported steam turbines and generators cost for CFPP is ranged at USD 2,896,152,000 - 7,362,750,000 throughout 2019–2028.

Keywords: Coal-Fired Power Plant, Electricity Development, Local Content Requirements, Opportunity Costs, Power Plant Development, Steam Turbine and Generator
JEL Classifications: O20, O39, Q49

1. INTRODUCTION

The electricity sector plays a strategic role in supporting development activities and the stability of the country's economy. The Government of Indonesia (GOI) through the state-owned electricity company, namely PT PLN, regularly issues 10-year electricity supply business plan (RUPTL). The government of Indonesia (GOI) has established a regulation that prioritizes the use of domestic components to increase the impact of electricity development on the national economy, especially in the electricity system. The utilization of these domestic components is regulated in a policy called "Tingkat Kemampuan Dalam Negeri" (TKDN), in this paper termed as the local component requirements (LCR). The LCR in the electricity expenditure system regulates the minimum LCR achievement in every line of the electricity system starting from the generation system and the type of generation, transmission, and distribution. The composition of the LCR in the coal-fired power plant CFPP will be the main focus in this paper, especially the turbines and generators used in the CFPP system. The total installed capacity of PLN's CFPP until 2018 was 17,976 MW of the total installed capacity of all national power plants of 56,509.53 which is equal to 31.8% of the total national power generation capacity (RUPTL 2019–2028) (MEMR, 2019).

In the 2019–2028 period, it is planned to build a power plant with a total capacity of 56.395 MW with a CFPP mix portion of 38% or equivalent to 21.373 MW. This paper explores the LCR policy in the electricity sector, in terms of its economic impact, potential, and challenges in implementing the policy. The LCR will be reviewed in the context of national economic growth, its role in supporting efforts to reduce the burden on the country's trade balance in the perspective of opportunity costs of the imported components, and the challenges of implementing LCR in the country, including the constraints of the steam turbine and generator industry to meet the national needs. This article is part of a study on the technological capabilities of power generation system in Indonesia conducted by the Ministry of Research, Technology and Higher Education (Sitompul, 2019).

2. ELECTRICITY DEVELOPMENT AND THE IMPLEMENTATION OF LCR

The obligation to use domestic products binds all government agencies that use state funds. The LCR level reflects the absorption of domestic products as indicated by the size of the domestic component in the value of goods, services, or a combination of goods and services, in a formula that reflects the economic value of each component in rupiah charged to each of these components. This rupiah value can be seen in fact in the product price structure that forms the cost of production. Thus, the weight of each component in the LCR formula on technology products can be derived from the product price structure determined through an industrial survey so that all components of the product price structure are factually and accurately obtained (Susalit, 2014). Product competitiveness is also an important factor in increasing LCR, as Negara (2016) suggested that LCR policy should consider substitution possibilities in production.

2.1. Economic Aspects of Electricity Development

Burke et al. (2018) stated that electricity use and access are strongly correlated with economic growth. Economic growth is indicated well by both electrification and urbanization, and they are highly correlated with each other, especially for countries that started industrialization late (Ayres and Warr, 2009; Yoo and Kim, 2006). The relationship between GDP fraction and electrification is expressed as electricity consumption per capita. Data of 2001 for 130 countries shows that the relationship is almost linear and the variance is smaller for relatively low-income countries (GDP below 40 percent). This is in line with a study related to the relation of GDP to energy demand, which states that when GDP per capita exceeds USD 30,000, the growth in energy demand per capita is no longer in line with GDP growth. The pattern of energy demand changing along with the increase in GDP of several countries but experiencing a saturation point at a GDP development level above USD 30,000. This does not necessarily indicate that there has been a decline in energy demand at the GDP level, but may reflect the pattern of energy demand shifting from a high concentration of energy use in the industrial and manufacturing sectors to the household and service sectors, where energy demand increased due to an increase in energy consumption and more energy-efficient technology that causes the volume of energy to tend to stagnate (Johansson et al., 2012).

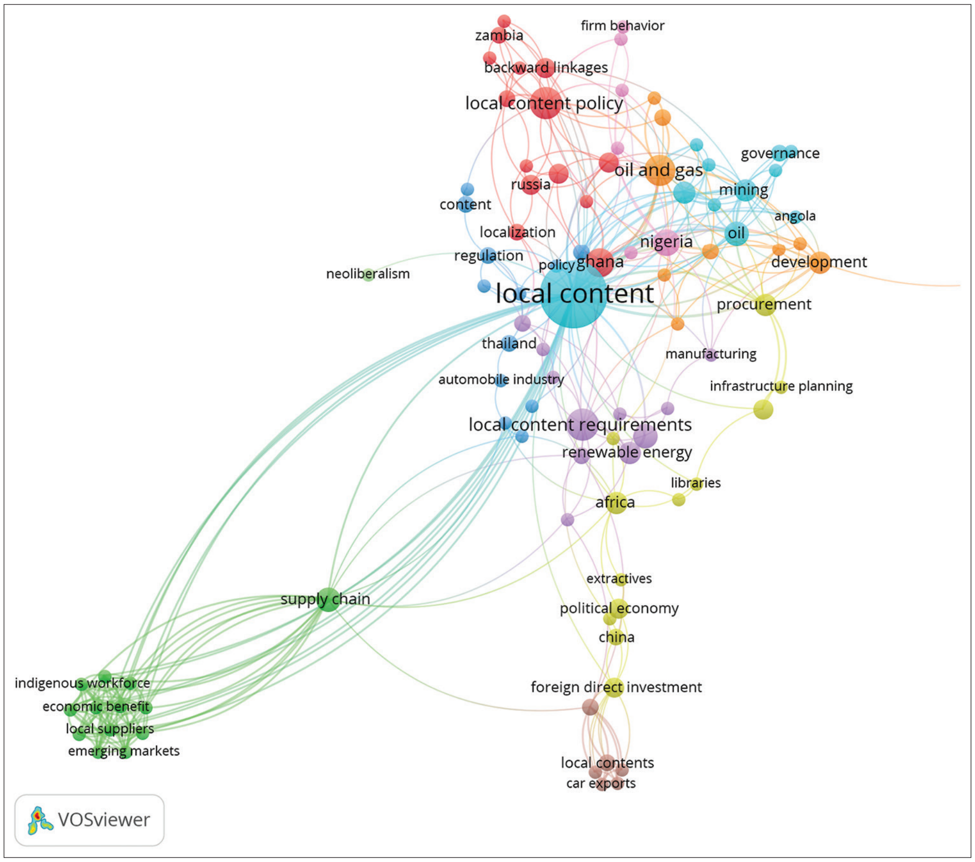
Although it appears that there is a phenomenon of a directly proportional relationship between electricity and GDP to a certain extent, however, in general, the study suggests that electricity use and GDP tend to go concurrently, referring to the success stories of electricity programs in several countries, such as South Korea, China, Thailand, Egypt, and Vietnam. The study concludes that access to electricity tends to be an important factor (enabler) in a country's economic growth (Burke et al., 2018). A case study conducted in Poland shows a causal relationship between electricity consumption and economic growth which identifies a two-way causality relationship between capital and economic growth. Thus, it is possible to state that electricity is a limiting factor for the growth of the Polish economy (Kasperowicz, 2014). Another case study in Taiwan was conducted to investigate the presence and nature of Granger causality between electricity consumption and economic growth in 17 industries in Taiwan, empirical results over the period 1998–2014 show that the panel co-integration test confirms the long-run equilibrium relationship and bidirectional causality, between electricity and economic growth. The results show that a 1% increase in electricity consumption increases real GDP by 1.72% (Lu, 2017).

The growth of the electricity sector has an impact on the national economy, specifically in the electricity procurement sub-sector (Necoechea-Porras et al., 2021). The study shows that each increase in the final demand for the electricity supply sub-sector by one IDR will cause an increase in national output of IDR 2.6469 which is the accumulation of direct influence of industry and consumption.

2.2. Implementation of LCR: Pros and Con

The implementation of LCR attracted different perspectives such as undermining long-term industrial competitiveness (Stone et al., 2015) and the tendency to specialization in less sophisticated or lower value-added parts of the supply chain. It is also subject to political capture and that they tend to remain in place even after they have ceased to be effective (Bazilian et al., 2019). On the other hand, LCRs reduces efficiency (Tomsik and Kubicek, 2006). LCR is oftentimes regarded as a bad policy. However, it is argued that when local content policies are well designed, focused, transparent, adapted to the national context and linked to other policies and useful long-term targets, they can play a crucial role in domestic industrial development and competitiveness (Miriam, 2016). LCR has been implemented in many sector, predominantly in the renewable energy sector, automobile sector, extractive sector, and the oil and gas sector. Figure 1 shows the co-word mapping the global research publications on local content requirement indexed in Scopus database which depicts the predominant sectors and predominant African countries (Zambia, Nigeria, Angola, and Ghana). Key concepts identified related to LCR are: supply chain, foreign direct investment, political economy, procurement, infrastructure planning, and governance. In the pursuit to capture the opportunity cost in energy sector development, government's procurement is setup to localize the value chain for components' technology whereas the LCR's governance and the needed infrastructure planning will be the challenges. Nevertheless, in many cases some of the aggrieved countries decide not to sue them because of other economic or geopolitical reasons (Probst et al., 2020).

Figure 1: The co-word mapping the global research publications on local content requirement indexed in Scopus database



In Tanzania, a study by Poncian and Jose (2019) calls for a re-think of local content policy and regulations to ensure that communities not only participate in natural gas value and supply chains but also have the opportunity and capacity to influence decisions about how they participate and benefit from extractive resources. In Indonesia, the LCR policy potentially impedes project feasibility and attractiveness especially when the technology is still in its infancy. Cost components which are considered as Indonesia-specific costs such as local content, lead to the lower feasibility rate of the project. Most developing and emerging economies are implementing LCR to spur domestic manufacturing, though their costs and benefits are not well understood and difficult to quantify. In India, the local content requirement policies resulted in a 6% per kWh higher of the solar photovoltaic power cost generated compared to without applying the local content requirement policy. Indian solar panels are 14% more expensive than international panels with some evidence of short-term increases in domestic manufacturing capacity, however, though there were no market share increases or export markets break (Probst et al., 2020). In Saudi Arabia, it is expected a significant positive impact of localizing the value chain of the photovoltaic solar energy industry on the socioeconomic development, job creation, and technology transfer in a country (Almarshoud and Adam, 2021). The study by Lin and Weng (2020) shows the effect of LCR on production and productivity at different initial levels. A tighter LCR will increase production but decrease productivity in the domestic intermediate goods industry. However, if the set LCR is higher than a certain level, the opposite result will occur. This shows that one policy cannot achieve two targets and overall, domestic social welfare will have a positive impact through the domestic semi-finished market. Obiri et al. (2019) examine the opportunity costs of LCR in Ghana to stimulate industrial development by indigenizing the needs of the petroleum industry. However, the goal is constrained by the country's infrastructure deficit of around US$2.5 billion per year which is needed to provide an enabling environment for local industrial growth. Implementing LCR in extractive industries can be constrained by potential supplier capacity and low skills, and some other business-enabling factors. In addition, these efforts also encounter difficulties in obtaining appropriate financing, thus hampering the success of several infrastructure projects related to extractive industries, greenfield extractive industry-related infrastructure projects (Östensson, 2017). In a study related to extractive industry, four implications identified namely providing high-power incentives for investor compliance, gathering superior investor information, managing the administrative burden of the host government, and reducing the risk of underestimating local suppliers (Macatangay, 2016).

3. METHODOLOGY

This study uses an exploration approach based on in-depth analysis using both primary and secondary data. Primary data are taken from interviews with selected stakeholders, focus group discussion (FGD), and field surveys. Secondary data are collected from policy, documents, and media analysis. Questionnaires in a semi-structured research interview format were prepared and used during a discussion in the surveys and FGD. Sources of information in this study are gathered from: (1) Literature study:

through research and activity reports and websites of related agencies, (2) institutional surveys: by collecting data from surveys to selected agencies and through national-level discussions in some FGD sessions, (3) industrial purposive surveys: by surveying turbine industrial data covering producers/manufacturers of main and small components, exporters/importers, integrators, and power plant contractors, (4) FGDs and in-depth interviews.

The calculation of the opportunity cost of importing turbines and generators for CFPP is carried out by applying a theoretical approach, using data from the CFPP development plan by the power plant development plans that are documented in RUPTL 2019–2028 which formulates plans for the construction of power plants from 2019 to 2028. The variables used in the calculation are: (1) Number of CFPP per year, built by PLN and Independent Power Producer (IPP), (2) the estimated investment range per MW of CFPP, which is divided into 2 (two) level amount of investment, called Inv1 (USD 1 million) and Inv2 (USD 1.5 million), (3) the portion of the turbine and generator costs for building CFPP, which is also divided into two variables, called V1 (25%) and V2 (13.5%). The output of the calculation is the amount of the investment range of CFPP plan development per year and for the total amount of 10 years, as well as the amount of turbine and generator costs per year and the total costs of 10 years. This amount of turbine and generator costs are assumed as the basic range of the opportunity cost for imported turbines and generators during 2019–2028. The calculation is also made under the assumption that all planned power plants in 2019 and 2020 have not been built. The mechanism of estimating the range of the opportunity costs is depicted in Figure 2.

A simple theoretical approach in estimating the opportunity cost is conducted by calculating the import substitution costs of turbine and generator components. The approach to calculating substitution through the total components of the turbine and generator is carried out in 2 schemes, where version 1 (V1) uses the proportion of the sum of turbine and generator based on Figure 3, which is 25% proportional to the whole CFPP investment, and version 2 (V2) based on the proportion in Table 1, namely 13.59%, the sum of 8.65% of steam turbine and 4.94% of the generator, to the whole cost of CFPP development. By taking into account the total investment cost of CFPP per MW, the estimation range (results of V1 calculation and V2 calculation) of the procurement of turbines and generators cost per MW of CFPP capacity will result. This assumption is made with the consideration that the investment costs are calculated in the same year that the power plant is built. In general, the cost of CFPP development ranges from USD 1–1.5 million per MW (PT PLN (Persero), 2015). The range will be treated as 2 schemes of investment cost, namely Inv1 representing the USD 1 million/MW and Inv2 representing the USD 1.5 million/MW (PT PLN (Persero), 2015), and will be divided as built by PLN and IPP. By multiplying the investment cost of CFPP (Inv1 and Inv2) in the unit of USD/MW, and the portion of turbine and generator to the CFPP in % (USD/USD), with the capacity of the planned CFPP development based on the RUPTL, respectively by PLN and IPP (Table 2), the results consecutively will be the sum of investment Inv1 of total CFPP by PLN and IPP, the sum of the turbine and generator investment cost Inv1 by PLN and IPP V1 and V2, the sum of investment Inv2 of total CFPP by PLN and IPP, the sum of the turbine and generator investment cost Inv2 by PLN and IPP V1 and V2. The lowest and the highest sum of turbine and generator investment costs will become the range of turbine and generator opportunity costs.

$$\sum_{i}^{n} C_n \times Inv_{an} \times V_{bn}$$

where,

C: Capacity of CFPP planned yearly (2019–2028)
Inv: investment cost of CFPP (USD/MW) by PLN or IPP
V: Turbine and generator proportion to CFPP (%)
a: Range of investment 1 or 2 or
b: Turbine and generator proportion version 1 or 2
i to n: Period of year 2019 to year 2028.

4. RESULTS AND DISCUSSION

4.1. LCR Related Regulation for Electricity Infrastructure Development

A set of policies to stimulate LCR was launched to encourage an increase in national production and trigger a multiplier effect. In determining the achievement of LCR, the government publishes an Inventory List of Domestically Produced Goods/Services, namely a list of goods/services that have been verified by an independent surveyor agency (Ministry Regulation No. 02/M-IND/PER/1/2014). The list is available online in the form of an e-catalog, which data is updated should there is a change/addition. The general calculation of LCR based on Industrial Ministry Regulation No. 16/M-IND/PER/2/2011 is described in Figure 4. The LCR policy for electricity infrastructure covers aspects of generation, transmission, and distribution as stated in Law 30 of 2009 concerning Electricity and Ministerial Regulation of Industry Number 54-IND/PER/3/2012 concerning Guidelines for the Use of Domestic Products for Electricity Infrastructure Development. Both regulations contain an obligation to utilize domestic goods and services as an effort to increase LCR in the development of electricity infrastructure. Imports are only permitted if: (i) the goods cannot be produced domestically; (ii) technical specifications of goods produced domestically do not meet the requirements, and (iii) the amount of domestic production is not able to meet the needs.

Specifically, the Minister of Industry Number 54/M-IND/PER/3/2012 states that the minimum LCR Target Value for Electricity Generation System Infrastructure is based on the type of power plant. The amount of LCR is also divided into 3 groups, namely LCR for Goods, LCR for Services, and LCR for Goods and Services. The LCR for Goods is the main component that forms the electricity infrastructure system, while LCR for Services includes Consulting Services, Engineering Contractor Services, Procurement, and Construction (EPC Services), Testing and Certification Services, Training Services, and/or Supporting Services. LCR for Goods and Services is represented by the existence of EPC and procurement activities, namely combined planning/planning/design and procurement of equipment and materials, and implementation of construction services) including

Figure 2: Estimating mechanism of the opportunity costs

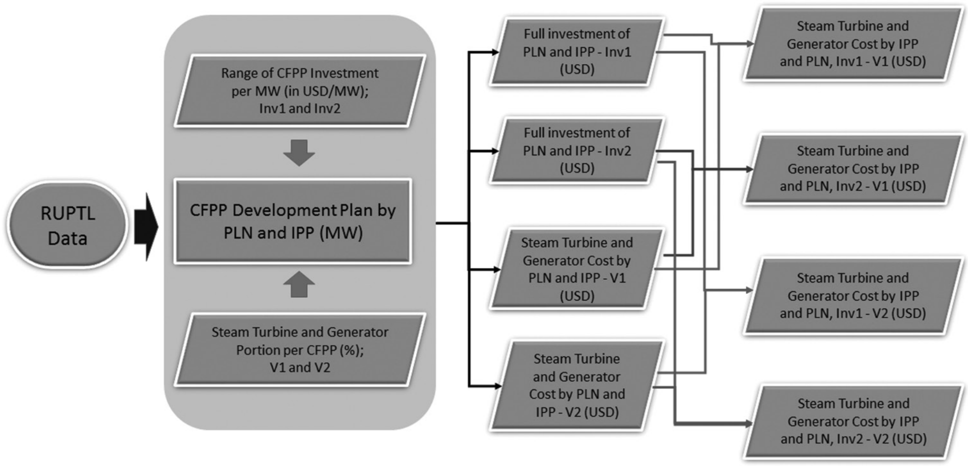
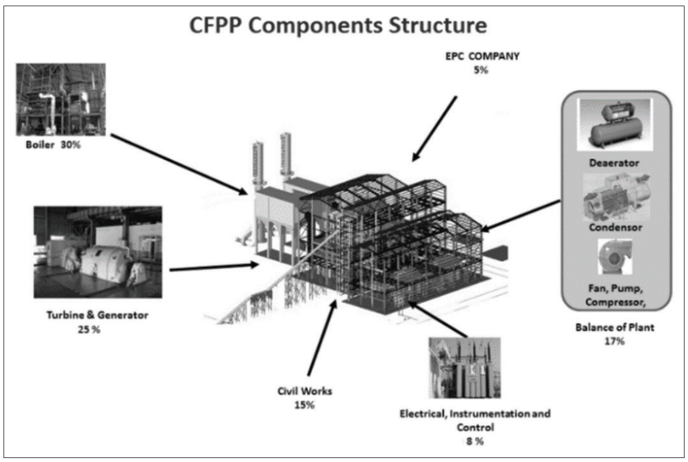


Figure 3: CFPP components reflects cost structure of 100% LCR



Source: B2TE, 2015 (edited)

operations, maintenance, and testing that have certification, classification, and qualifications by laws and regulations. Table 3 shows the LCR amount based on the 3 (three) groups of LCR involved in CFPP development.

The CFPP cost component, based on EPCs and industry practitioners (PLN, 2015), is divided into several components of goods and services (Figure 3). In this figure (B2TE, 2015), the components of procurement of goods and services at CFPP consist of procurement of boilers, turbines and generators, civil works, electrical, instrumentation and control, Balance of Plants (BOP), and costs for EPC. Boiler, Turbine, and Generator (BTG) components are the largest cost component in the cost structure of the CFPP project, amounting to 55%, most of which is still imported, followed by Balance of Plant at 17%, Civil at 15%, Electrical-Instrumentation-and Control at 8% and finally EPC services at 5%, of the total construction cost. The picture represents the condition if all components are met from within the country, the LCR level will be 100%. Regarding turbines in general, there are already few local companies capable of producing turbines of up to 27 MW of capacity and generators with a capacity of up to 10 MW. Another version of the PLTU construction component which contains details of the procurement component is shown in Table 4.

4.2. The Level of LCR Achievement in Power Plant Development

Apart from the potential opportunity cost of import substitution of steam turbines as well as government policy support related to LCR, progress related to the absorption of domestic components in power plant infrastructure development is still limited. Until 2015, LCR achievements was reported only in 36 power plants consisting of 34 PLTUs at all capacity scales, 2 (two) PLTPs on a scale of <5 MW and a scale of 10-60 MW and 1 (one) PLTGU in scale >300 MW. Table 5 shows data on LCR achievement on several scales of CFPP capacity, which shows a trend of lower LCR achievement if CFPP capacity is higher. In CFPP with a scale of >15–25 MW, the achievement of the LCR value has almost reached the set target. Data on the achievement of LCR in CFPP can be seen in the following Table 1. The comparison of the achievement and target of LCR in the CFPP is shown in Figure 5.

Overall performance of the electricity system line is displayed in Table 5 showing the absorption of domestic products for power plants is around 29.33% in 2020.

The technological and economic feasibility factors of a product or service become the basis for selecting the expenditure components of a project. Several constraints in meeting the LCR target in power plants (PT PLN, 2015), namely (1) Lack of local capability in providing the main components of power plants, especially for medium and large-scale power plants (generally for power plants with a scale of >25 MW) and (2) Less competitive prices for existing local products. These two factors cause the electricity sector to continuously import its important components, therefore, are the determining factors in the selection of components required for power plant development. Table 2 shows the LCR level of the steam turbine and generator in CFPP with scale ranges <100 MW and >100 MW is 0% (B2TE, 2015).

In the case of steam turbines and generators, the use of domestic steam turbines and generators has not even been recorded, for a CFPP capacity scale of <25 MW. Seeing these conditions, apart from the massive development efforts of the electricity sector by the government, especially the construction of power plants to support national development goals in increasing the level of the economy and people's welfare, seeking a conducive climate

Figure 4: Indonesia's LCR formula according to Ministry Regulation No. 16/M-IND/PER/2/2011

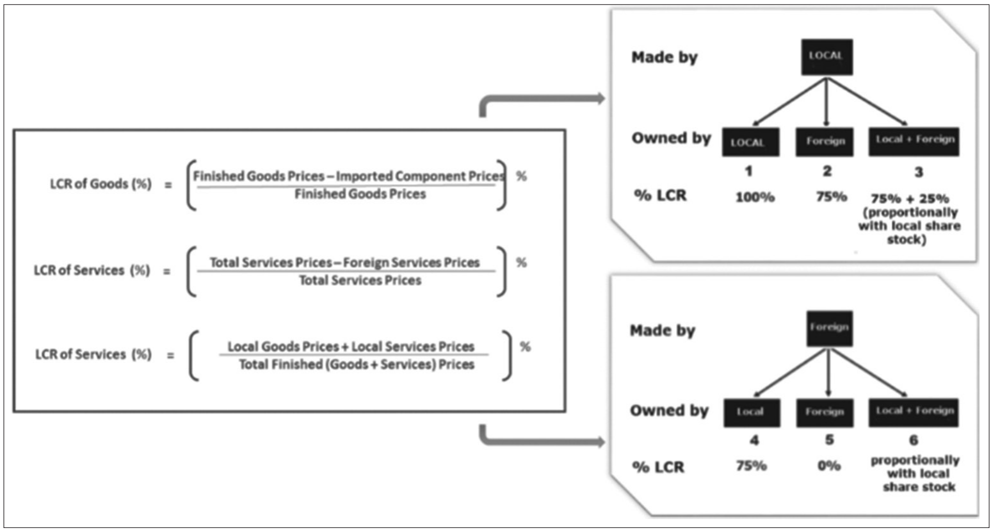


Table 1: CFPP LCR targets and achievements

Type of power plant	Capacity scale	Number inspected	Combined LCR (%)	Realization of combined LCR (%)
CFPP	Up to. 15 MW	8	70.79	61.8
	> 15 up to 25 MW	6	49.09	49
	> 25 up to 100 MW	8	44.14	38.74
	> 100 up to 600 MW	9	40	25.91
	> 600 MW	3	38.21	10.69

Table 2: Cost composition and realization of LCR at CFPP capacity < 100 MW and 100 MW

Goods components procurement			
Component	Weight (%)	LCR (%)	
		<100 MW (%)	≥100 MW (%)
Steam Turbine	8.65	0.00	0.00
Boiler	17.30	9.39	7.58
Generator	4.94	0.00	0.00
Electrical	8.03	4.57	3.11
Instrument & Control	3.09	0.62	0.37
Balance Of Plant	10.51	4.18	3.15
Civil & Steel Structure	9.27	9.27	9.27
Total	61.8	28.03	23.49

to increase domestic capacity to produce qualified electrical components, and with competitive prices, it is very important to support economic independence.

LCR needs to be measured at each stage of power plant construction starting from feasibility studies, engineering projects (development, licensing, and design), procurement and construction, as well as start-up and commissioning. To carry out the feasibility study process, the local consultant is considered capable, and in terms of making basic designs and detailed designs, BPPT has developed a turbine for a 5 MW PLTU in collaboration with NTP, which was at the phase of concept refinement. Turbines and generators seem to show stagnation in their industrial development, however, most of the other BOP needs can already be produced by local industries, especially for vessel components, non-rotating machinery, or high temperature and pressure, as well as non-pressure boilers. Domestic boiler manufacturers already have experiences in producing boilers up to a capacity equivalent to 30 MW, including capabilities in house engineering. One example of the achievement of local industry (a local company established by a foreign company), Alstom Indonesia has been able to produce boiler pressure parts with a capacity of 1,000 MW, which is also exported to Malaysia.

4.3. Major Challenging Problems in Increasing the Level of LCR

Constraints in implementation of LCR involve the availability of products according to the expected quality and prices that meet economic aspects which has generated and influenced a number of aspects including:

4.3.1. Procurement terms

The principle of tender is based on the cheapest price, where domestic materials tend to be more expensive than buying imported components so that it is often become the cause of tender defeats. Existing regulations also do not support multi-lot contracts, which require more detailed calculations.

4.3.2. Importation rules

These materials are expensive because they are not mass-produced and some components are imported separately, making the final product expensive (also included as financial support problems). Tax regulations tend to favor whole imports rather than partial imports of raw materials, where partial imports intended for further production are subject to Import Taxes, thereby increasing the cost burden on the final product.

Table 3: LCR of coal-fired power plant system infrastructure according to Minister of Industry regulation number no. 54/M-IND/PER/3/2012

Type of power plants	Capacity per unit power plant	LCR of goods (%)	LCR of services (%)	LCR of combined goods and services (%)
CFPP	<15 MW	67.95	96.31	70.79
	>15–25 MW	45.36	91.99	49.09
	>25–100 MW	40.85	88.07	44.14
	>100–600 MW	38	71.33	40
	>600 MW	36.1	71.33	38.21

Table 4: CFPP components reflects cost structure of 100% LCR in detailed procurement

Engineering	Procurement		Construction	Commissioning
5%	60.3% (FOB) + 1.5% (CIF)		32.00%	1.20%
• Basic Design - FEED	Component	Weigh	• Foundation	• Testing and Commissioning
Detailed Engineering Design	Steam Turbine	8.65%	• Structure and Building	• Training
	Boiler	17.30%	• Erection/Installation	
	Generator	4.94%		
	Electrical	8.03%		
	Instrument & Control	3.09%		
	Balance Of Plant	10.51%		
	Civil & Steel Structure	9.27%		
	Total	61.80%		
Total				100.00%

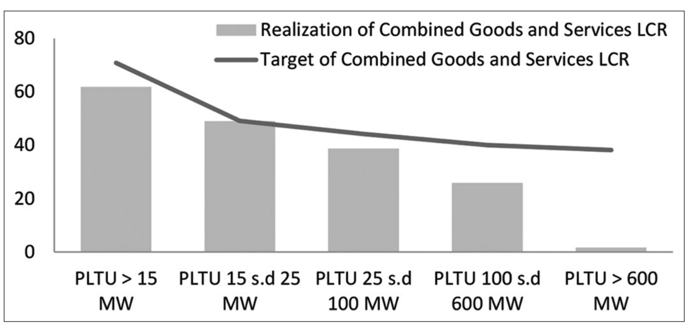
Source: B2TE, 2015

Table 5: Realization of the average use of LCR

	≤2017 (%)	2018 (%)	2019 (%)	2020 (%)
Power Plants	22.21	30.00	31.66	29.33
Transmission	20.76	64.00	64.36	75.37
Substation	31.14	80.00	80.79	58.46
Distribution	24.70	80.00	80.97	61.19
Total	-	36.00	34.66	40.13

Source: Yahmadi, 2021

Figure 5: Target and realization comparison of CFPP combine LCR (MW, up to 2015)



*Data is processed from various sources

4.3.3. Uncertain market

Products cannot be mass-produced, one of which is because domestic demand is not guaranteed for continuity and stability.

4.3.4. Distrust of quality

The insecurity of the domestic market is also due to the general perception that is quite entrenched, doubting the quality of domestic products.

4.3.5. Lack of expertise/lack of human resources supports

Constraints in the ability of producing qualified products as the result of lack of qualified human resources.

4.3.6. Lack of financial support

Inadequate ability is caused by the ability of human resources and financial availability for conducting research to ensure the products fits in the needs of the domestic market as well as for export purposes. Limited domestic funding is also limited to being able to finance electricity investment, while foreign funding (loans) tends not to be pro LCR.

In terms of realizing the idealism of fully implementing LCR in power plants, efforts to build small-scale power plants that utilize local products have been carried out but the cost of building power plants has become uncompetitive. The average price per MW generated is around USD 4.4 million (PT PLN, 2015).

4.4. Potential Measures to Overcome the Hurdles of LCR Implementation

The problem of uncompetitive prices and constraints on the quality of the products produced are distributed along the upstream and downstream production lines, starting from the supply of raw materials, R&D, production capabilities to market level acceptance (Sitompul, 2019). To overcome this, an upstream and downstream policy is needed to implement LCR effectively so that it can contribute positively to the national economy. The right formula is needed to implement LCR sustainably and effectively in various aspects, such as technical and non-technical aspects which varied from financial, policy, human resources, economic, to technological aspects by the lingering problems in these aspects.

An active exchange of information between PLN and the providers of goods or services is crucial, for example regarding plans and roadmap to develop LCR capabilities in goods and services providers. Updating supplier data in the list of providers of goods/services is also important in order to find the latest capabilities of suppliers as a reference for the procurement of goods/services that will be used by PLN.

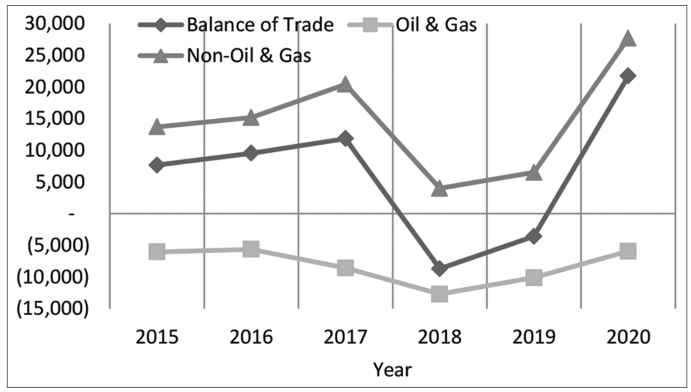
In addition, a link and match between PLN's needs and electricity development research are needed, so that the resulting research products have the potential to be absorbed by the market and quantified as a contributor to LCR. PLN also proposes that national industries cooperate with companies/manufacturers/consultants, especially those that have become major players in PLN and globally. One of the strategies to implement LCR is through providing compensation to business units that choose to utilize domestic products over imported products, even though the price of domestic products is more expensive. This is a form in which the state participates in developing domestic industry. In terms of funding as well as bridging the WTO issue, a win-win solution approach can be in the form of developing strategic component manufacturing owned by foreign manufacturers in Indonesia through a cooperation system. This strategy is in line with one form of the LCR formula that takes into account the location of the industry (Figure 4). This model is a model of a combination of foreign investment with maximum domestic capabilities. The strategy can be coordinated with the Indonesia Investment Coordinating Board, to be supported as a priority investment opportunity. This is also intended to overcome if there are financing constraints from lenders who do not support LCR rules, which is a common practice at the global level. If there are local industrialists who can grow into a reliable industry, the support provided can be in the form of market guarantees. The development of potential components can be realized through research collaboration between educational/research institutions and BPPT, to propose priority products that are by market needs.

4.5. Potential Contribution of LCR to Economic Development

To support the concentration of domestic capital in terms of increasing the multiplier effect of the development of the electricity sector (Listrik Indonesia, 2015), Indonesia's dependence on imported components has increasingly pushed the narrative of the importance of LCR. Increasing export capability in the form of positive net exports is an important indicator of economic growth. This is by the theory put forward by Keynesians which states that the growth of national income is determined by the amount of aggregate expenditure of household consumption, government spending, investment, and net exports. This theory is the basic theory of GDP formation that incorporates net exports (exports-imports) into the economic growth equation and if it is positive it will be an additional factor in the equation (Mankiw, 2009). In general, Indonesia's exports and imports in the trade balance fluctuated between surplus and deficit. Currently, the main component of the deficit balance is still in the import of the oil and gas sector. The graph of Indonesia's trade balance in the 2015–2020 period which shows the proportion of oil and gas imports and non-oil and gas is shown in Figure 6.

In the non-oil and gas sector, the largest component of state spending revolves around boilers and electrical equipment. The average portion of the import expenditure component in 2020 was 32%, while the average imports of boilers and electrical equipment (excluding spending on metal equipment for power generation) to the total imports of both oil and gas and non-oil and gas was 27%. Table 6 shows the composition of the two components' import spending during 2015–2020. One study, concludes that although the contribution of the net export variable to GDP growth is not significant, export-import activities are an injection variable in a country's economy, which can improve the economy because of the multiplier effect process. Control over the volume of imports can prevent

Figure 6: Balance of Trade of Indonesia 2015–2020



Source: Portal Statistik Perdagangan Kemendag (PDSI Kementerian Perdagangan, 2021)

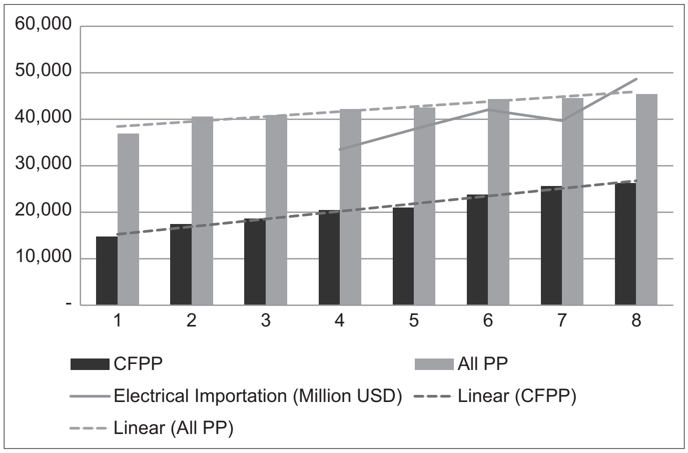
Table 6: Electrical components importation and Indonesia balance trade (2017–2020)

Component	2017	2018	2019	2020
Oil & Gas	24,316	29,869	21,885	14,257
Non-Oil & Gas	132,669	158,843	149,390	127,312
Nuclear reactors, boilers, machinery, and mechanical appliances	21,768	27,197	26,817	21,809
Electrical machinery and equipment and parts thereof	17,932	21,448	20,061	19,028
Total electrical components	39,700	48,645	46,878	40,837
% of imports of electrical goods to non-oil and gas	30%	31%	31%	32%
Total Import (oil and gas and non-oil and gas)	156,986	188,711	171,276	141,569
% of imports of electrical goods to all imports	25%	26%	27%	29%

Table 7: CFPP and all PP installed capacity 2011-2018 and electrical importation 2014–2018

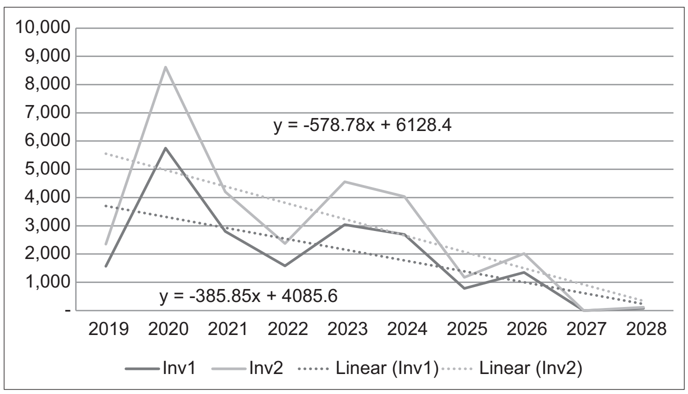
Year	CFPP	All PP	Electrical importation
2011	14,804	36,932	
2012	17,468	40,564	
2013	18,637	40,968	
2014	20,512	42,249	33,473
2015	21,047	42,565	37,894
2016	23,807	44,365	42,05
2017	25,644	44,613	39,670
2018	26,321	45,397	48,645

Figure 7: Correlation of electrical component imports with CFPP growth



Source: Data sources are processed from various sources

Figure 8: The trend of investment of CFPP within 2019–2028



Source: Author's own calculation

Table 8: CFPP Development Plant 2019-2028

Development Plan	PLN (MW)	IPP (MW)
2019	1,055	514
2020	256	5491
2021	251	2550
2022	356	1224
2023	625	1115
2024	665	1725
2025	74	710
2026	1,345	600
2027	0	1000
2028	78	0
Total Cap	4,704	14,929

a flood of imported products that will harm domestic products (Asbiantari et al., 2016). This has implications for conditions where the intended export capability is not only the status of products that are ready to be exported, but also includes the ability to substitute components that were originally imported.

An increase in domestic capacity which results in a decline in exports can encourage aspects of economic growth. In the input structure of the electricity sector, the results of the I-O analysis of BPS data for 2014, show that the supporting sector of electricity, namely generating machinery, accounts for approximately one-third of the intermediate input originating from imports of the domestic intermediate value, and in the output structure, it is used entirely for final demand. The interaction between inputs and outputs has the lowest effect on income and GDP added value compared to the other 4 sub-sectors. By increasing domestic intermediate inputs and reducing intermediate import inputs, it is likely to have a positive effect on income and value-added of GDP. In the perspective of the trend of the development of the import value of electrical commodities and machinery, which is compared with the growth in the number of CFPP and all types of power plants (Table 7), it is seen that there is a very strong correlation between the three variables, with a value of 0.852, as shown in Figure 7.

4.6. The Estimation of the Opportunity Cost of Implementing LCR Based on CFPP Cost Construction

To review the potential for avoiding the cost of importing turbine and generator components, the simplest approach can be taken, namely by calculating the proportion of turbine and generator components in the CFPP, according to Figure 4 and Table 4. The basis for the calculation is taken from the CFPP development plan based on the 2019–2028 RUPTL, assuming all costs related to turbines and generators have not been spent. The following Table 8 is a list of CFPP development plans from 2019 to 2028, with a focus on power plants built by PLN and IPP based on RUPTL 2019–2028. CFPP with a total capacity of 19,634 MW will be built until 2028.

Table 9 shows the result of the total calculation during the period 2019-2028 (investment value based on net present value).

As previously mentioned, regarding the policy of reducing CFPP development in the future, the trend of investment value for turbines and generators also follows the trend in the number of CFPP developments, for the next 10 years, as shown in Figure 8.

Table 9: Range of projected investment during 2019–2038 (in USD)*

Range of Investment	Developer	CFPP Full Investment	Steam Turbine & Generator Cost V1	Steam Turbine & Generator Cost V2
Inv1**	PLN	4,705,000,000	1,176,250,000	639,409,500
	IPP	14,929,000,000	3,732,250,000	1,291,358,500
Total		19,634,000,000	4,908,500,000	1,930,768,000
Inv2***	PLN	7,057,500,000	1,764,375,000	959,114,250
	IPP	22,393,500,000	5,598,375,000	1,937,037,750
Total		29,451,000,000	7,362,750,000	2,896,152,000

Remarks: Data sources are processed from various sources. *Assumption: Power plant in 2019–2020 are still on the construction process. **Inv1 equals to 1 million USD per MW. ***Inv2 equals to 1.5 million USD per MW

The downward trend is part of fluctuations in overall electricity planning as well as the declining use of CFPP from year to year, related to the policy of reducing the construction of coal-based power plants to fulfill GOI's commitment to increase renewable energy mix in the electricity system. According to Hartono et al. (2020), the advantages of coal-fired power plants over renewable power plants require less investment and provide a better economic impact.

5. CONCLUSION

The challenge in implementing LCR in the electricity sector is to ensure the demand for tested and reliable electricity, the domestic electricity component industry can also grow simultaneously through the provision of qualified electrical components in Indonesia. LCR policy also helps in line with the narrative, especially in the context of the Covid-19 pandemic issues, where every country is struggling to stabilize its economy, including Indonesia. The step of reducing import spending is one of the most important financial policies and increasingly encourages the importance of prioritizing the use of domestic products. The disruption to the global supply chain due to the pandemic has become a wake-up call to seek domestic supply strength in the interest of the sustainability of national security. The Covid-19 pandemic condition, further strengthens the need to increase the ability to supply raw materials and finished materials from within the country, to anticipate and independently address the possibility of economic turbulence or natural disasters affecting the global supply chain. In general, is due to the obstacles experienced around the electricity industry, which revolve around two main issues, namely the quality of domestic products that are not yet qualified or the absence of domestically available generating components especially with a capacity above 25 MW, and the uncompetitive final price of products of local components compared to imported products. The two factors are the determining factors in the selection of components for spending on power plant development needs. There is no local turbine and generators industry capable to produce for CFPP locally. Hence, several approaches through policy and strategy are needed to develop the LCR, including cooperation in the form of foreign investment in the construction of industrial facilities for priority components of electricity in Indonesia, which allows the adoption of LCR while at the same time balancing issues with the WTO.

The development of absorption of local content in the electricity sector is still around 29.33% in 2020. The opportunity cost for turbines and generators range between USD 2,896,152,000–7,362,750,000 throughout 2019–2028. Further in-depth study, for instance in the form of Cost and Benefit analysis, need to be carried out to portray the essence of LCR in supporting the government to capture the industrial multiplier effect of turbine and generator industries for CFPP, which discusses the use of LCR to prove its benefits in a long term economic development. In particular, for the development of turbines and generators, sufficient investment support and industrial development strategies are required. In addition, LCR does not need to be a scourge for foreign investors to invest in government projects for the construction of power plants, considering that some components that cannot be produced domestically and require special specifications can still be imported from abroad.

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