Building a national solar PV manufacturing industry in Indonesia

Recommendations from the research project: "Towards a Just Energy Transition in Indonesia"

Drawing on lessons from a research project on just energy transitions in Indonesia, this brief provides recommendations to policy-makers and stakeholders in Indonesia and other emerging economies on developing a national solar PV manufacturing industry

Key Messages

To reap the industrial development benefits of the green transition, the Government of Indonesia should:

- Ensure a stable, predictable and increasing market for solar PV to effectively support the development of a national solar PV manufacturing industry
- Ensure the solid and continuous coordination of long-term energy and industrial policy
- Create supportive frameworks for the solar PV manufacturing industry by focusing on serving both the export market and domestic demand
- Maintain the use of local content requirements (LCR) as a key industrial policy instrument and ensure that the requirements are precise, predictable and realistic
- Combine minimum LCRs with a premium on electricity tariffs for higher local content shares
- Enhancing the LCRs to all investors independently of ownership
- Increasing the control and effective enforcement of LCR regulation
- Continue supporting state-owned companies to establishing joint ventures with foreign companies in order to obtain access to capital, technology and links to sub-components and end-markets

The green transition

Worldwide, the transition away from fossil fuel-based energy systems to renewable energy (RE) is playing a major role in reducing carbon emissions and mitigating climate change. Countries are at different stages of the transition to RE, with European countries having made the most progress in terms of installed capacities, while several emerging economies, including Indonesia, are at an earlier stage.

Indonesia is in a favourable position to benefit from the previous experience of early movers in Europe and other emerging economies, such as South Africa, India and Brazil, thus enabling it to avoid repeating past mistakes through the adoption of proven best practices [4]. Indonesia can capture such "latecomer advantages" by designing and implementing RE policies, which have shown to be effective in ensuring a just energy transition by promoting investment, job creation, local ownership, industrial progress and other social development objectives [5].

However, recent research in Indonesia and other emerging economies indicates that, on the contrary, the transition to RE may have a number of undesirable and negative implications, while the transition to RE in latecomer countries may contribute to reproducing or even exacerbating ongoing processes of social injustice and economic inequality [6], [7]. These studies highlight the difficulties involved in imparting global “best practices” and the possible existence of so far unresolved "latecomer disadvantages" for emerging economies.

In order improve our understanding of this development challenge, the research project has investigated how local industries respond to and benefit from the implementation of green industry policy measures in Indonesia, and what the implications are in terms of local industry development.

Green Industrial Policy

The concept of "green industrial policies" (hereafter "GIPs") has gained increasing attention as a new way of thinking about industrial policies in the 21st century's green transformation [8]. The basic idea is that governments should target industrial policies toward green technology sectors in order to capture the growing investments and market opportunities as a basis for developing their domestic manufacturing industries. The recently adopted Inflation Reduction Act in the United States and the EU Green Deal Industrial Plan adopted in the European Union are prominent examples of such policies.

According to Altenburg and Rodrik [9], governments in several developing economies have particularly embraced the idea and have adopted specific GIPs aimed at promoting industrial development in the renewable energy sector. To this end, measures such as tax benefits, import duty reductions and export subsidies have been adopted to attract foreign technology suppliers to produce components in their countries[10], [11]. Furthermore, policies such as local content requirements (LCRs) have frequently been used to encourage the development of domestic suppliers of components and services [12]. Renewable energy policies, such as feed-in tariffs and auction schemes, have also been put in place in order to create a domestic market (see e.g. [13]).

GIPs focus on two main interrelated dimensions: (i) the transition to green technologies, such as renewable energy; and (ii) development of the domestic manufacturing of such technologies [8]. As part of this research project, we developed a conceptual framework in order to determine how industrial policies and energy policies interacted with and influenced the development of a domestic solar PV module manufacturing industry in 2008-2023, see Figure 1.

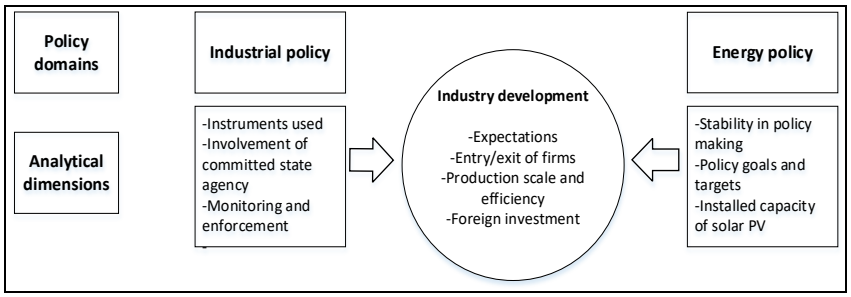
The research project entitled "Towards a Just Energy Transition in Indonesia" was carried out through close cooperation between the Technical University of Denmark, the University of Indonesia, Universitas Prasetiya Mulya, the Dala Institute and the University of Cape Town. The project was undertaken from 2022 to 2024 and was funded by the Ministry of Foreign of Affairs of Denmark.

The project involved research on procurement modalities, community involvement and industrial development. The present policy brief focuses on industrial development, and more specifically on how industrial policies and energy policies have interacted and influenced the development of a domestic solar PV module manufacturing industry in 2008-2023.

The study is based on eighteen in-depth interviews, nine of them with PV module manufacturers, and five with representatives of relevant government agencies, project developers and industry informants in Indonesia. We have also conducted online interviews with an international solar PV industry expert and three of the leading Chinese and European solar PV module and cell manufacturers, some of whom had previously considered establishing production in Indonesia.

The scientific output from the project include nine journal papers to be published in high ranking international journals. Three of these papers are specifically related to the theme of this policy brief [1]–[3]

Figure 1. Conceptual framework to study GIPs in the renewable energy sector



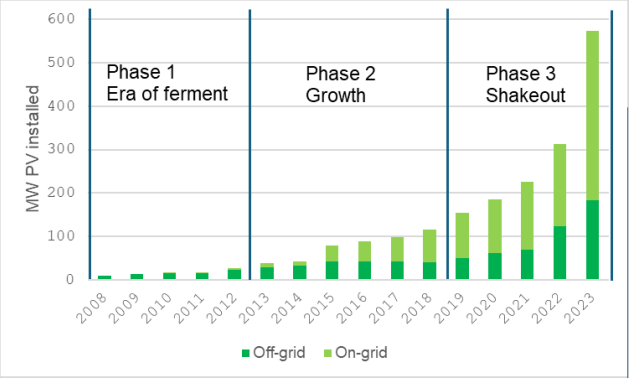
Source: authors' own elaboration

Development of the solar PV manufacturing industry in Indonesia

Prior to 2008, the installation of solar PV systems in Indonesia mainly involved projects focusing on the electrification of off-grid, rural communities in remote areas via small (10-100 W) installations [14]. Such projects were typically funded by various donor agencies (see e.g. [15]) or through rural electrification programs run by the Ministry of Energy and Mineral Resources (MEMR) and the national energy utility company, Perusahaan Listrik Negaraat (PLN). However, encouraged by the rapid and substantial decrease in the price of solar PV panels on the world market, from 2008 onwards a general enthusiasm emerged around solar PV, leading to significant growth in the total installed capacity of solar PV globally, which also influenced the policy in Indonesia.

Based on the empirical data that were collected and analyzed in the project, we identified three main phases in 2008-2023 with distinguishable features characterizing the development of the Indonesian solar PV module manufacturing industry: Phase I, "Era of ferment" (2008-2012); Phase II, "Growth" (2013-2018); and Phase III, "Shakeout" (2019-2023) (see Figure 2) [1]. We will present our main findings across these three phases in what follows.

Figure 2. Installed capacity of solar PV in Indonesia 2008-2022 (MWp)



Source: authors' own elaboration based on IRENA 2024 data

Era of ferment (2008-2012)

In the first phase plans for using solar PV gradually moved from rural electrification, to roof top and larger grid connected installations, and in 2010 and 2011, the government and PLN sat ambitious targets for the future market for solar PV in Indonesia. These expectations led to initial investments in the majority of the up to twenty domestic solar PV module manufacturing plants established over time. Encouraged by the Ministry of Industry, which was placed in charge of supporting the development of the industry, subsidiaries of two state-owned companies were created by the government as a further effort to spearhead the industry's development. Yet, the overall market size remained very limited, and by 2012 only 26 MW had installed, a significant share of which was imported.

Growth (2013-2018)

In the second phase, the government target for the installation of solar PV to be reached in 2030 was increased to 6.5 GW. In 2013, a net-metering scheme for "roof-top" solar (i.e. solar PV panels installed on top of buildings) and a generous feed-in tariff for larger solar PV projects were introduced. The same year, the first auction of 140 MW solar PV to be installed by Independent Power Producers (IPPs) was announced. These strong incentives, however, quickly eroded during the coming years. The 140 MW auction was cancelled due to a court case regarding the interpretation of local content requirements filed by the Indonesian solar PV industry association APAMSI in 2014. Moreover, in 2014, the value of the electricity delivered to the grid in the net-metering scheme was reduced to 65% of the retail price. The feed-in tariff was significantly reduced in 2015 and was capped at a maximum of 85% of the cost of electricity production from coal-fired power plants in 2017.

With respect to industrial policy, a general LCR regulation for solar PV projects, including specific requirements for the local content of modules, was adopted in 2012 while a premium for electricity produced by modules with high local content was introduced in 2013. In 2015, an ambitious road map

for the development of the solar PV manufacturing industry stipulated a gradually increasing minimum LCR of 40% of modules by 2017, 50% by 2018, 60% by 2019, 76% by 2020 and 90% by 2025. A regulation setting a target for local content for modules following the requirements in the road map was adopted in 2017, but the requirement of more than 40% local content was never implemented due to resistance from the industry, which was not able to meet the requirement for localizing cell production (which would have fulfilled the 60% local content requirement).

The high expectations of the domestic solar PV manufacturers regarding the size of the market at the beginning of this phase led to the expansion of total annual production capacity by at least 100 MW in 2014, 60 MW in 2016, 75 MW in 2017 and 560 MW by 2018. The market demand slightly increased during the second phase, including modules for rural electrification, roof-top and a few utility-scale IPP solar PV projects, but it remained below expectations at 10-30 MW increase annually. In 2018, the total installed PV capacity was only 115 MW. In spite of the continuous export of mainly niche solar PV products, the level of demand, which was below 5% of production capacity, did not allow domestic manufacturers to reach economies of scale.

Shake out (2019-2023)

In the third phase, government expectations of the future solar PV market continued to be high, and larger IPP projects were commissioned as the outcome of auctions and negotiated contracts with PLN. Similarly, the market for roof-top installations, especially for industrial purposes, was growing, but private investments in roof-top projects were not subject to local content requirements, from which most solar PV IPP projects were exempt. One prominent example is the 300 MW Cirata floating solar plant, which was inaugurated in 2023. This project was established as a joint venture between a subsidiary of PLN and Masdar, ultimately being equipped with imported modules from a Chinese company.

The early Indonesian solar PV manufacturers found themselves increasingly unable to compete on price with imported modules, mainly because of low production volumes and obsolete technology. Since the domestic solar PV manufacturers were not shielded by LCR, most of the remaining domestic solar PV module manufacturers left the industry, and those that were still in operation ventured into service activities or became importers of solar PV modules.

Interestingly, however, during the third phase a number of new modern, large (GW)-scale integrated solar PV module and cell production facilities were established in the industrial zone on Batam Island through joint ventures between domestic and foreign companies. While these manufacturers focused on the export market, they were also able to fulfil the dual requirement of being “first-tier” suppliers and fulfilling the LCR of 60% set by the government to be met in 2025. Unlike the first generation of domestic solar PV module manufacturers, they should therefore be able to deliver modules to utility-scale projects in Indonesia requiring modules from first-tier suppliers.

This new generation of solar PV cell and module manufactures on Batam Island may be the foundation for the next growth stage of the Indonesian solar PV manufacturing industry [16], [17]. That said, the government of Indonesia failed to exploit a window of opportunity to develop a domestic solar PV module-manufacturing industry in the early phases [18]. Given the requirements regarding the level of production capacity to be economically feasible on a global scale, the current window of opportunity seems to be progressively shrinking.

The importance of energy and industrial policy

The industrial policies that have been adopted over time have supported the development of the domestic solar PV manufacturing industry in Indonesia by a number of traditional industry measures.

This includes: (i) the role of the state in spearheading the industry's development through state-owned enterprises and in continuously increasing production facilities; (ii) introducing LCRs in 2012 and establishing a premium for local content in 2013; (iii) making the solar PV industry a government priority in 2015; and (iv) establishing a long-term vision for localizing the full solar PV supply chain through the road map in 2015, which was followed up by regulation in 2017 for increasing local content targets in accordance with the road map. More actively, on several occasions the Ministry of Industry and other government agencies were engaged in negotiations with foreign investors and technology providers to establish joint ventures for cell and module production with the objective of finally establishing a full supply chain.

Interestingly, the industrial policy was adapted to the new circumstances in 2018 by loosening the LCRs at a time when domestic manufacturers were unable to live up to the requirements. Moreover, the Ministry adjusted the industrial policy focusing on import substitution to include an export-oriented policy by supporting the establishment of export-oriented module and cell factories in the industrial zone on Batam Island.

Energy policies, on the other hand, have been characterized by very high expectations regarding the domestic market for solar PV set out in the national energy plans (RUEN) and in PLN's development plans (RUPTL) throughout the examined period. However, insufficient and continuously changing measures aimed at supporting market development in combination with frequent changes in regulatory frameworks has led to opaque approval procedures with increasing risks for project investors [19]. Furthermore, the national utility company, PLN, has implemented several regulations by effectively discouraging the development of solar PV projects.

The results in terms of a total annual market demand for solar PV of around 10-30 MW in 2012-2020 have been devastating for the development of the solar PV manufacturing industry in Indonesia, which during this period had a production capacity of up to 580 MW.

Indonesia's energy policies have thus failed to fulfil the aim of creating a stable and sizeable market demand. In particular, the lack of consistency across the energy policies adopted over time has contributed significantly to deterring project investments. We argue that this lack of alignment between energy and industrial policies has been the main reason why in the first ten years of this development Indonesia was unable to attract joint ventures for PV cell and module manufacturing producing for both the domestic and an export market. Indeed, comparing Indonesia with other Southeast Asian countries, such as Malaysia, Thailand and Vietnam, Indonesia stands out by not having been able to attract foreign technology suppliers to localize their activities [20].

Policy recommendations

This brief attempts to draw some policy lessons from the research project, which we hope will provide inspiration for policy-makers and industrial actors in Indonesia and beyond. We have organized these lessons into overall recommendations and separate recommendations for the two intertwined policy areas in GIP, namely energy policy and industrial policy.

General

The two most important recommendations are:

1. Whether governments are in favour of mainly export-led or import substitution-led industrialization, a stable, predictable and increasing domestic market is a key parameter for effectively supporting the development of a national solar PV manufacturing industry.

2. In a context with an industrial policy focused on import substitution, a strong and continuous coordination of energy and industrial policy is fundamental and a precondition for the rapid and efficient development of national industries.

Energy policy

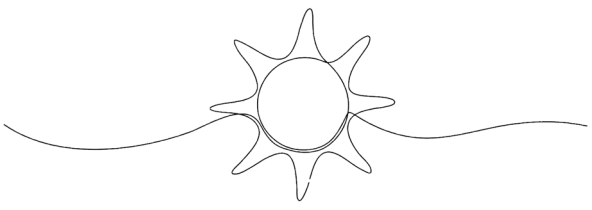
- Energy policies must be long term and create a predictable demand to reduce the risks to investors.

Industrial policy

1. An overall policy recommendation is to support solar PV industries serving both the domestic and the export market in order to gain the necessary economies of scale.
2. LCRs can be an important industrial policy instrument for protecting domestic industries, but the requirements must be communicated for a longer period of time and gradually strengthened in line with realistic prospects for the localization of the next item in the value chain, such as solar PV cells or wafer production.
3. LCRs could be made more efficient by:
   - Combining minimum requirements with a premium on tariffs for electricity sold to PLN and produced by modules with higher local content.
   - Introducing the LCR requirements for all projects regardless of public and private ownership, including utility-scale, roof-top installations and rural electrification.
   - Effective monitoring and enforcement of the LCR rules is required.
4. A continuation of the policy to support the Government of Indonesia in investing in value-chain upgrading by establishing joint ventures with foreign companies in order to obtain access to capital, technology and the necessary upstream and downstream linkages to service both domestic and export markets.
5. Introducing new export-oriented industrial policy measures to support solar PV manufacturing outside the industrial zones, which could include tax breaks, export subsidies, export guarantees and bilaterally negotiated agreements to access foreign markets.
6. Government support devoted to training, capacity development and industry-university collaboration.

Coordination of energy and industrial policy.

- The coordination of demand and supply policies is especially important in developing domestic industries in the solar PV sector compared to, for example, the automotive and electronic sectors [2]. This is because demand in the PV sector is mainly driven by energy policy regulation and public procurement, while demand in the automotive and electronic sectors is driven by private consumers in an increasing market.



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