Green Technology
Startups Landscape Study in Indonesia

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Startups Landscape
Study in Indonesia

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DEUTSCHE ZUSAMMENARBEIT

Implemented by

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Bappenas

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Executive Summary

Study Background

Southeast Asia, including Indonesia, has been considered a promising market for tech industry in the past decade, with significant amount of investment, the growth of innovative solutions and digital products. According to the 2019 World Economic Forum report, Indonesia tops the list of countries when it comes to the number of people who aspire to become entrepreneurs. Despite having more than 6,000 startups and receiving US$250 million in funding, there are still relatively few startups in the green technology sector, especially who offer digital technology in their product and services.

> The focus of most venture capital firms and other type of funders in 2023 is on financial technology, healthcare, and logistic. However, there is growing interest from venture capital organisations to invest in the green technology sector.

In parallel, mitigating and adapting to climate change are impeccable for Indonesia. As a country vulnerable to climate crises, Indonesia needs to ramp up its efforts to be more climate resilience through green technology. Industry actors in the green technology ecosystem have various ways to define and describe green technology, such as on the definition, scope of work, the intersection with other sectors, as well as varying networks and investment portfolios to support startups in this sector. Therefore, this study was conducted to discern the landscape of green technology startups ecosystem in Indonesia.

This research was conducted as part of Digital Transformation Center (DTC) and Make-IT Indonesia project, a cooperation project of Republic of Indonesia and Federal Republic of Germany. The pro-

ject is implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the Kementerian PPN/Bappenas (Ministry of National Development Planning).

About the Study

The study attempts to map out the landscape of the green technology ecosystem in Indonesia, particularly in the topic of startup or small businesses development, which includes several key findings as follow:

1. Mapping the landscape of green technology ecosystems in Indonesia, both for digital and nondigital startups. **(Chapter 1)** ⊙

2. Categorisation of green technology-related efforts/businesses within the areas of clean energy transition, circular economy, as well as natural resource management. In addition, a practical definition of green technology in Indonesia agreed upon by various actors is explained, as well as further classification of green technology within the sector. **(Chapter 1)** ⊙

3. A closer look at the statistics of startups partnership with the Indonesian government and/or private sector. **(Chapter 2)** ⊙

4. Compile information about existing and potential partnership of government entities with green technology startups in Indonesia. **(Chapter 2)** ⊙

5. Measuring realisation of impact investment for green technology startups in Indonesia up to the first quarter of 2023. **(Chapter 3)** ⊙

6. Suggestions and recommendations to mainstream green technology and support the ecosystem in Indonesia. **(Chapter 4)** ⊙

To obtain the findings mentioned above, the research team collected data of industry actors involved in the green technology ecosystem development in Indonesia, comprises of startups, enablers/startup support organisation, as well as capital providers who had invested to green technology sector in Indonesia. The startups in the database are those who have business in the areas of clean energy transition, circular economy, and natural resource management, and was founded in Indonesia. The enablers compiled in this study consist of not only those who were founded and have office in Indonesia, but also those who have Indonesian startups in their portfolio.

Based on the database, questionnaires were sent to all registered respondents and made interview requests to the selected industry actors. The interview method aims to have deeper understanding and diversity of perspectives from the industry actors, as well as mitigating research limitations that will be outlined below.

Study Limitations

The study was performed under defined scope of research and limitations. Firstly, this database does not cover all actors in the industrial green technology sector in Indonesia. The information collected through existing networks, desk study from published data, networking events, and inputs from GIZ and Kementerian PPN/Bappenas. The total number of entries in the database has reached to 237 actors.

Secondly, not all actors contacted by the research team were willing to become respondents due to various reasons. Some of the reasons were because potential respondents had other priorities, the complexity of the questionnaire that required submission of data, doubts that their institution is suitable responding to the questionnaire, as well as a reluctance to be involved in government research projects. In addition, the research team noticed inaccuracy of the startups categorising their own companies to which subsector of green technology they are belong to. Hence, it affects composition of the respondents, given that the data cleaning process that was conducted after all the answers from the respondents were collected.

Besides those limitations, this study managed to collect 38 startups respondents from the areas of clean energy transition (6 respondents), circular economy (16 respondents), and natural resource management (16 respondents). The disparity in the number of respondents is due to different number of industry actors in each of these sectors that the research team could identify, as well as the limited openness of industry actors to be involved in this study.

The research team has also interviewed 15 resource persons from different entities, with a composition

38
Questionnaire Respondents Startups Category

6
16
16

- ● Clean Energy Transition
- ● Circular Economy
- ● Natural Resource Management

15
Interviewee

3
3
3
5
3
1

- ● Circular Economy Startup
- ● Clean Energy Transition Startup
- ● Capital Provider
- ● Natural Resource Management Startup
- ● Accelerator and/or Incubator
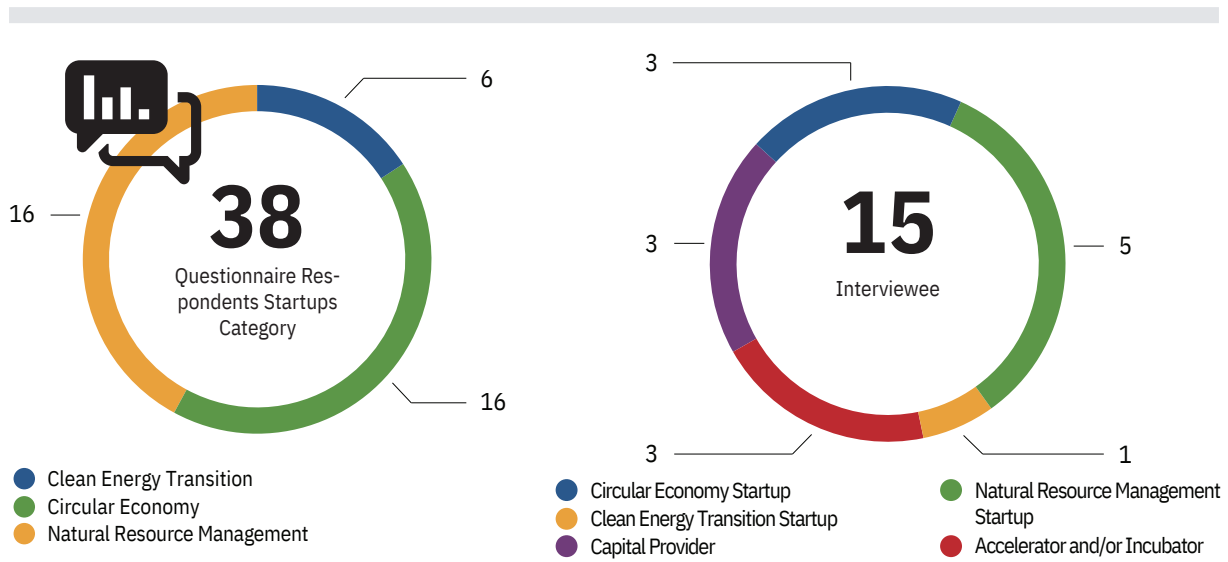
of 3 circular economy startups, 5 natural resource management startups, 1 clean energy transition startup, 3 accelerators and/or incubators, and 3 capital providers.

Study Highlight

DEFINITION AND CLASSIFICATION OF GREEN TECHNOLOGY

- According to green technology industry actors, definition of 'green technology' in Indonesia is the use of technology as a solution aiming to support environmentally friendly businesses to reduce negative impacts on the environment, including optimizing utilization of natural resources. The technology is not only limited to software, but also the hardware used to achieve the purpose of using green technology.

- The digital aspect of green technology industry actors is still heavy on the downstream side, for example the use of technology for mass/customer communication or marketing channels such as the use of social media and marketplaces.

- The classification of green technology startups by sector in this study is categorized to clean energy transition, circular economy, and natural resource management. Most clean energy transition startups in Indonesia are in the power generation subsector. Startups in the circular economy sector mostly focus on resource recovery business models. In the natural resource management sector, agricultural subsector is the majority focus area of the startups.

GREEN TECHNOLOGY BUSINESS ACTORS

- Green technology business actors in Indonesia are divided into several entities, namely startups, enablers, and capital providers. If we add up all the startups and supporting institutions such as enablers and capital providers, high emergence of industry actors was happened in 2016-2020. The surge is more than doubled compared to the previous period of 2011-2015 with 42 industry actors.

- Gender equality was measured by percentage of female employees in the position of decision making. The figures from the study reflect positive gender equality in the green technology actors. Relative to the total number of employees, there is variation among the respondents regarding ratio of female employees. The composition of each entity with female employee ratio above 40% are 91.6% of enablers, followed by 50% of capital providers, and 47.3% from startups.

- A total of 68.4% of startups have measured their impact, which 84.6% of them have their impact measurement documented. Despite having their impact documented, there are only 15.4% of them have made the impact documents publicly accessible. Most startups associate impact measurement with environmental aspect and followed by social and corporate governance aspects. As for enablers, mostly have the social aspect measured in their impact measurement.

FUNDING

- Most of the green technology startup are using their own savings (mentioned 25 times), for their initial capital, followed by donors or grants (mentioned 15 times), financiers/investors (mentioned 13 times), family/friends (mentioned 7 times), prizes from competitions (mentioned 2 times), and the remaining 2 were not willing to provide information. During the first three years, startups respondents began to generate revenues and profits hence can reduce their reliance on external sources of funds.

- Most clean energy transition startup respondents were able to acquire their first customer in 4-6 months, whereas the circular economy and natural resource management startups need less than 3 months to acquire customers.

- Respondents from capital providers defined impact investing as investments that have a measurable positive impact on the environment and social aspects.

- In the study, capital providers in Indonesia are grouped into venture capital firm, venture builder, P2P lenders, investment platforms and/or banks, grant providers, loan providers, and intermediary institutions.

Initial Capital Source:

| Personal Savings | : | **25** times | Investor | : | **13** times | Family/ Friends | : | **7** times |

Source: Questionnaire Results by GIZ and Kementerian PPN/Bappenas

Maximum Funding Amount per Sector:

| Natural Resource Management | : | **6,6** Trillion Rupiah | Clean Energy Transition | : | **1,5** Trillion Rupiah | Circular Economy Sector | : | **303** Billion Rupiah |

Source: Questionnaire Results by GIZ and Kementerian PPN/Bappenas

- The natural resource management (NRM) was the first sector that had received funding in 2016 before the circular economy and clean energy transition. The NRM sector had continued to receive funding until the first quarter of 2023. Clean energy transition sector is the latest sector to receive funding, which began to receive funding in 2020.

- Funding for the green technology sector had reached IDR 8.4 trillion within the period of 2016 up to the first quarter of 2023. The funding mostly contributed by series A funding. The other types of funding were seed funding (6 times), prizes from competitions (6 times), grants (5 times), pre-series A (4 times), pre-seed (3 times), funds from the enabler programme (3 times), funds from the government (2 times), series B (1 time), series C (1 time), and series D (1 time).

- Grouped by sectoral focus, natural resource management sector has received the highest number of funding around IDR 6.6 trillion, clean energy transition sector which received IDR 1.5 trillion, and circular economy sector with IDR 303 billion funding received.

- Looking at the annual funding, year of 2022 had the highest incoming funding since 2016, amounting to IDR 4 trillion, note that the figure in 2023 only record funding in the first quarter of 2023. The year of 2022 contributed almost half of the total amount of funding that had been channelled to startups in the green technology sector in Indonesia, with total of IDR 8.4 trillion.

- Of the 41 funding rounds from various categories, the largest number of funders came from Indonesia with 72 institutions, followed by Singaporean institutions (37 institutions) and the United States (19 institutions). These institutions were combination of public and private organisations.

INTERACTIONS WITHIN THE GREEN TECHNOLOGY ECOSYSTEM

- The actors in the green technology sector in Indonesia have been working in collaborative manner. Most of the green tech startups have communities as their important stakeholders, which then followed by direct users, local governments, suppliers, investors, and other businesses. Nonetheless, some startups mention that competition has already increased. This might indicate that existing regulations might need to adapt with this current situation and initiate fair playing field within sector.

- The collaboration of startup respondents with the government is still heavily concentrated in Java, as well as the collaboration of enablers with the government. Various form of collaboration has reached other areas in Indonesia although the number is quite unequal between one area to another.

- Most startup respondents have already collaborated with national government and local (sub-national) government institutions. Similarly, enablers' collaborations with the government institutions are dominated by the central government and non-ministerial government agencies.

- Collaboration has been the common strategy for most green tech ecosystem players. All respondents in the startup category had collaborated with the private and public institutions, either one or both. As many as 65.7% of the respondents have collaborated with both public and private institutions.

- Not all startup respondents had interacted with both investors and capital providers. If there are respondents who have only ever interacted with one of them, they rather choose to collaborate with capital providers, not enablers.

- When interacting with capital providers, only 36.8% of the startup respondents have reached the deal stage for funding. However, the low number of deals was not caused by ineligibility of startups to receive funding from capital providers. In several cases, it was also due to mismatch of values and visions from both organisations (the startups and the capital providers). Several startup respondents have rigorous selection process in receiving funding and they are often the ones who refuse potential funding when both parties could not reach common ground, especially regarding their values and vision for the cooperation.
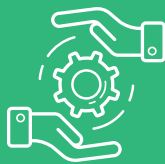
DUKUNGAN DAN TANTANGAN

- There were three criteria that most enablers put attention to support startups, namely company growth stage, impact reach, and business plan.

- The top three government supports that had been received by green tech startup were the provision of funds or grants, connections to local communities, and being invited to be involved in other activities relevant to the topic.

- Most green tech startups in Indonesia faced challenges on obtaining funding or financing for their business, navigating regulation in their sector, and to create or enlarge market demand in the sector.

This study categorises green technology startups by sector into clean energy transition, circular economy, and natural resource management.

The clean energy transition sector is divided into several subsectors, namely 1) exploration & extraction; 2) power generation; 3) energy transmission and distribution; 4) multipurpose projects; and 5) efficiency projects.

The circular economy sector is divided into five business models, namely 1) circular inputs; 2) sharing model; 3) services as products; 4) product life extension; and 5) resource recovery.

Natural resource management is divided into six subsectors, namely 1) aquaculture; 2) agriculture; 3) forestry; 4) water management; 5) air quality management; 6) carbon-based enterprises.

Carbon-based enterprises are categorized under

the umbrella of the natural resource management sector referring to the background of Presidential Regulation (PERPRES) Number 98 of 2021 about the Implementation of Carbon Economic Value for Achieving Nationally Determined Contribution Targets and Controlling Greenhouse Gas Emissions in National Development part c:

"that carbon as a universal indicator in measuring the performance of climate change control efforts reflected in nationally determined contributions, in addition to having an important economic value and having an international dimension, mainly in the form of economic benefits for the community, as well as a reflection of the principle of sustainable resource management in accordance with the mandate of Article 33 paragraph (4) of the 1945 Constitution of the Republic of Indonesia"

CLASSIFICATION OF GREEN TECHNOLOGY STARTUP COMPANIES BASED ON SECTORS IN THIS STUDY

CLEAN ENERGY TRANSITION

Exploration & Extraction	Power Plant	Transmition & Energy Distribution	Multipurpose Project	Efficiency Project

CIRCULAR ECONOMY

Circular Input	Shared Model	Service as a Product	Product Lifecycle Extension	Resource Recovery

NATURAL RESOURCE MANAGEMENT

Aquaculture	Agriculture	Forestry	Water Management	Air Quality Management	Carbon-Based Enterprise

Chapter 1
Understanding
Green Technology

1. Getting to Know Green Technology

1.1. Green Technology Definition

Green technology is a term that is increasingly used in our modern discourse especially in the context of innovative solutions for sustainable development.

Despite its widespread use and growing importance, the definition of 'green technology' has yet to be collectively agreed upon. In addition to green technology, there are several other terms circulating with definitions based on the same principles as green technology, such as climate technology or clean technology, as well as some other technology terminologies that are relatively less used, such as environmentally sound technologies (ESTs). Various institutions have provided definitions of these terms which are outlined in the following table.

Intergovernmental Panel on Climate Change (IPCC)[1]	Oxford English Dictionary	PwC (State of Climate Tech 2021 Report)[2]
Green technologies are "technologies that mitigate or adapt technologies that contribute to reducing greenhouse gases while realising specific development goals, such as economic development, poverty reduction, food and water supply, infrastructure, energy, and health".	Green technologies are "technologies which are used to mitigate or reverse the effects of human activities on the environment".	Climate technologies are "technologies that explicitly focus on reducing greenhouse gas emissions or addressing the impacts of climate change.
Ron Pernick (Clean Tech Revolution[3])	*United Nation Conference on Environment and Development di Rio de Janeiro, Brazil, 1992[4]*	**UNFCCC (*The Role of The Patent System in Stimulating Innovation and Technology Transfer for Climate Change*)[5]**
Clean technologies are "products, services, or processes that deliver specific value using little or no non-renewable materials and/or producing significantly less waste compared to conventional practices".	Environmentally sound technologies are "technologies that protect or are less polluting to the environment, use all resources in a more sustainable way, recycle waste and products, and handle residual waste in a more acceptable way	Two types of technologies are seen when dealing with climate change: adaptation and mitigation. Adaptation is defined as "the adjustment of a natural or human system in response

1. https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Chapter16.pdf, accessed in May 2023

2. https://www.pwc.com/gx/en/services/sustainability/publications/state-of-climate-tech.html accessed in May 2023

3. Ron Pernick. (2007). *Clean Tech Revolution: The Next Big Growth and Investment Opportunity.* Harper Collins Publisher.

4. U.N. Conference on Environment and Development, Rio de Janeiro, Braz., June 3-14, 1992, Agenda 21, Chapter 34, U.N. Doc. A/CONF.151/26/Rev. 1 (Vol.I), Annex II (1993)

5. Kim, Hee-Eun. *The Role of the Patent System in Stimulating Innovation and Technology Transfer for Climate Change.* NOMOS, 2011. MIPLC Studies Volume 13. https://www.nomos-elibrary.de/10.5771/9783845234472.pdf?download_full_pdf=1. Accessed in May 2023.

| | than the technologies they replace, as well as technologies that produce low or no waste, for pollution prevention. Environmentally sound technologies also include end-of-pipe technologies as specialised treatment of pollution after it has been generated". | to a real/expected stimulus or its effects, so as to moderate harm or exploit beneficial opportunities" or in other words, making the necessary adjustments to either reduce negative impacts or increase positive impacts. Technologies that fall under this type of adaptation can be seen in 'soft' forms, such as crop rotation patterns and traditional knowledge, as well as in 'hard' forms, such as designed irrigation systems, drought-resistant seeds, and a combination of both 'soft' and 'hard' form as demonstrated in early-warning systems.

Mitigation is defined as the activity of finding and implementing solutions to reduce greenhouse gas emissions, through human intervention from renewable energy options, carbon capture and storage, hybrid vehicles, animal defecation waste management, clean coal technology, and green buildings.[6] |

Table 1. Definition Related to Green Technology According to Several References

According to PwC in the State of Climate Tech 2021 Report,[7] "climate technology applications can be categorised into three sector agnostic groups; namely (i) those that directly mitigate or remove emissions; (ii) those that help humans adapt to the impacts of climate change; and (iii) those that deepen human understanding of climate change". On the other hand, based on their implementation, clean technologies can be categorised into several key sectors; namely (i) power generation including wind, water, wave, geothermal, solar, and fuel cells; (ii) alternative fuels such as biogas, biomass, and synthetic fuel; (iii) technologies to capture and store carbon; (iv) environmental technologies including water purification and treatment, waste recycling, treatment and desalination; (v) transport including batteries and hybrid electric vehicles; and (vi) information technology and other systems to make energy storage and distribution more efficient, reduce unnecessary use and facilitate emissions trading.[8]

Through a questionnaire we distributed to startups in the green technology sector in Indonesia, there were several keywords that emerged from the 38 respondents when they were asked to define green technology. The word 'environment' had the highest frequency at 25 times, as well as 'technology' at 25 times, 'impact' 9 times, 'reduce' 8 times, and 'negative' 5 times. This mapping was obtained by excluding linking words, as well as repetition of the questions, e.g. the phrase 'green technology is...'

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6. U.N. Conference on Environment and Development, Rio de Janeiro, Braz., June 3-14, 1992, Agenda 21, Chapter 34, U.N. Doc. A/CONF.151/26/Rev. 1 (Vol.I), Annex II (1993)

7. https://www.pwc.com/gx/en/services/sustainability/publications/state-of-climate-tech.html

8. James Nurton. *Get Ready for the Clean Tech IP Boom,* 182 Managing INtell. Prop. 40, 40-47 (2008)

The word 'environment' had the **highest frequency** at **25** times

The word 'technology' had the **highest frequency** at **25** times

The word 'impact' had the frequency **9** times

The word 'reduce' had the frequency **8** times

the word 'negative' had the frequency **5** times
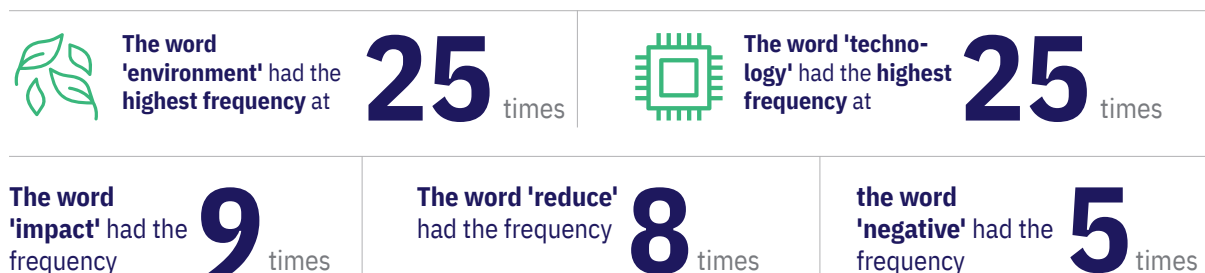
Figure 1. Frequency of keyword occurences regarding green technology (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

Figure 2. Definition of Green Technology by Startups in Indonesia (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

Figure 3. Definition of Green Technology by Enablers in Indonesia (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

Fourteen enabler respondents including accelerators, incubators, and consultants in Indonesia had similar opinions to the startup respondents previously. The most common keyword was 'technology' and 'environment' which are 12 times each, then followed by 'friendly' 5 times, 'impact' 4 times, and some words that appeared 3 times were 'support', 'use', 'company', 'solution', and 'reduce'.

Not much different from respondents in the startup category and enabler, the 6 capital providers who completed our questionnaire also mentioned the word 'environment' 7 times, 'technology' 6 times, 'impact' 3 times, 'device' 3 times, and 'use' 3 times.

The definition of green technology by startups is sufficiently illustrated by the mapping of these keywords, namely technologies that reduce negative impacts on the environment. However, given the diversity of keywords that appear in the categories of enablers and capital providers, it is needed to look at the phrases attached to these keywords as outlined in the following table. This is done to formulate one overall definition that can represent respondents' opinions on green technology.

Figure 4. Definition of Green Technology by Capital Providers (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

Respondents	Popular Keywords	Frequency of Mention	Phrases Attached to Keywords
Enablers (accelerators and/or incubators)	Friendly	5 times	Environmentally **friendly (5 times)**
	Impact	4 times	1. Strategies implemented by the company to reduce negative **impacts** 2. Reduce adverse **impacts** caused by human activities on the environment 3. Considering lower environmental **impact** 4. Make an **impact** on society without degrading environmental quality
	Support	3 times	1. **Support** environmentally friendly practices 2. **Supporting** sustainable businesses development 3. **Supporting** sustainability
	Usage	3 times	1. Relating to the **use** and development of technology 2. Can include multifaceted solutions across sectors (energy, materials, land **use**, industry) 3. Reducing the **use** of non-renewable natural resources
	Solution	3 times	1. Covers a wide range of **solutions** from different facets of the sector 2. Utilization and development of technology as a **solution** to environmental problems 3. Modern **solutions** that can help the world achieve a low-carbon economy

Respondents	Popular Keywords	Frequency of Mention	Phrases Attached to Keywords
Capital Providers	Reduce	3 kali	1. Aims to **reduce** adverse impacts caused by human activities 2. Strategies implemented by the companies to **reduce** negative impact 3. **Reducing** the use of non-renewable natural resources
	Impact	4 times	1. Produce measurable environmental **impacts** 2. Contribute to positive environmental **impact** 3. **Impact** on profits, people, and the planet 4. Reduce negative human **impact** on the environment
	Device	3 times	Can take the form of (**device**) hardware or (**device**) software, e.g. monitoring (**device**) software, carbon calculator
	Usage	3 times	1. **Use** of more sustainable technologies 2. **Use** of more environmentally friendly materials 3. **Use** of renewable resources

Table 2. Respondents' Searches for Popular Phrases and Keywords in Green Technology Definitions

Given that the word 'technology' was one of the most frequently mentioned keywords when respondents were asked to define green technology, a follow up question that arose was the definition of technology. The IPCC defines technology as a tool, technique, practical knowledge, or ability to perform a particular activity[9]. Technology is divided into three different elements, namely: 1) hardware, which includes tangible aspects, such as products or equipment; 2) software, which covers the process associated with the production and use of the hardware, involving specific methods and skills, experience, or practices; and 3) orgware which is the institutions or organisations involved in the adoption and dissemination of a new technology.

While the majority of respondents did not elaborate on what they meant when they mentioned technology, some specifically defined technology as not only hardware such as gadgets or software such as apps, but also innovations in systems and processes. As such, the scope of green technology should not be limited to business entities enabled by a piece of hardware or software, but also institutional tools that offer something new to reduce negative impacts on the environment.

From the results of the questionnaire previously outlined, it can be concluded that **the popular term 'green technology' used by practitioners in Indonesia encompasses the use of technology as a solution aiming to support environmentally friendly efforts to reduce negative impacts on the environment, including optimizing utilization of natural resources.** The technology itself is not only limited to software, but also hardware in various forms, as well as innovations in systems and processes used to achieve green technology goals.

9. *Technology to Understand and Manage Climate Risks*. Background Paper for the UNFCCC Seminar on the Development and Transfer of Environmentally Sound Technologies for Adaptation to Climate Change, Tobago, 14-16 June 2005.

1.2. Classification of Green Technology Industry Actors

1.2.1. Classification by Digital Aspect

Referring to the definition of 'technology' in the green technology term as defined by respondents, technology can include hardware or software which can utilise digital aspects. For this reason, this study attempts to map out the digital aspects in green technology startups in Indonesia as compiled in the database of this study.
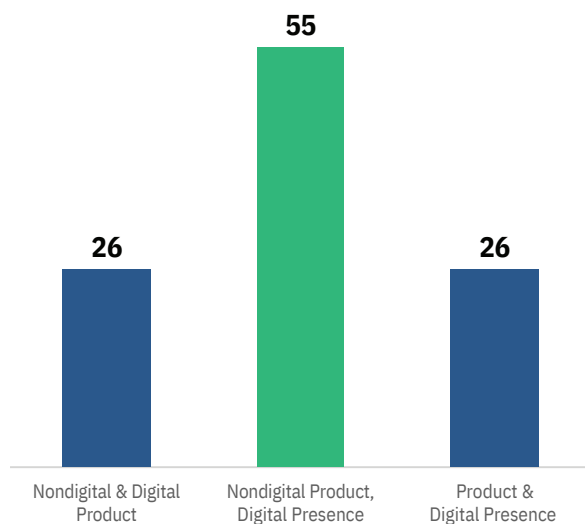
Figure 5. Mapping of Digital Aspect in Indonesia Green Technology Startups (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

From Figure 5, it can be seen that the majority of startups, 55 out of 107 startups (51.4%), utilise digital aspects only in downstream, namely in the marketing aspect (digital presence). Various platforms are utilised, with some startups using web channels, social media, or both. However, the products and/or services of these companies are not digital products.

Only 26 startups (24.3%) utilise digital aspects from end to end (digital product & digital presence).

In this group, both the sold products and/or services and the marketing function have utilised digital aspects. On the left side of the chart, the remaining 26 startups (24.3%) sell both digital and non-digital products and/or services. Besides, this category not only utilises the digital aspect to market products directly but is also digitally present to affirm corporate identity to create credibility. Given that the database was collected based on the desktop research, industry actors in the green technology sector that have no digital aspects at all are difficult to identify.

1.2.2. Classification by Sector

The sectors that fall under the scope of green technology are quite diverse, ranging from energy, chemistry, engineering, information technology, food, manufacturing, business, economics, supply chain, logistics, building, and nanotechnology. However, this study categorises the scope of research into 3 sectors, namely clean energy transition, circular economy, and natural resource management.

1.2.2.1. Clean Energy Transition

In the International Journal of Energy Research titled A Review on Clean Energy Solutions for Better Sustainability[10], clean energy is a system that has the potential to (i) reduce emissions by utilising cleaner and renewable sources; (ii) require lower energy inputs; (iii) improve system efficiency by expanding useful outputs, e.g. multigeneration; and (iv) reduce emissions and waste by recovering energy.

To make the context of the first point mentioned above clearer, renewable energy is defined by the International Energy Agency (IEA)[11] as "energy derived from natural processes, such as sunlight and wind, that can be replenished at a higher rate than when it is used." The United States Energy Information Administration (EIA)[12] has a similar definition of renewable energy, namely "renewable energy so-

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10. Int. J. Energy Res. (2015) Published online in Wiley Online Library (wileyonlinelibrary.com).

11. https://www.seforall.org/sites/default/files/l/2013/09/9-gtf_ch4.pdf, accessed May 2023

12. https://www.eia.gov/energyexplained/renewable-sources/#:~:text=Renewable%20energy%20is%20energy%20from,available%20per%20unit%20of%20time., accessed May 2023

Clean energy is a system that has the potential to

1 ✂️ **Reducing emissions** by utilizing cleaner and renewable sources

2 ↘️ Requires **lower energy input**

3 📊⏳ **Improving system efficiency** by expanding useful outputs

4 ☁️↓↓↓ **Reducing emissions and waste** by recovering energy

urces are capable of self-regeneration and can be used indefinitely, unlike fossil fuels which can be depleted." So, an energy source can be said to be renewable if it can be replenished even after being used many times.

The transition to the use of renewable energy is important considering that the energy sector is one of the largest contributors to greenhouse gas (GHG) emissions in the world, contributing approximately 40% of total global emissions in 2021[13]. In the context of Indonesia, the energy sector also always occupies the top three positions as a carbon emitter since 2019 to the past ten years[14].

A few years back, it has been seen an increase in the amount of installed renewable energy power in the world with the majority use of solar photovoltaic (PV), wind, and hydropower. Renewable energy accounted for nearly two-thirds of newly installed generators worldwide in 2016.[15] In 2017, the total accumulated global investment in the renewable energy sector reached USD 2.9 trillion since 2004, equivalent to IDR 44.4 quadrillion, and has surpassed the amount of investment in fossil fuels.[16]

The energy sector includes not only business activities engaged in the extraction of energy sources themselves, but also business activities in other fields. Therefore, Boston University's Global Development Policy Centre (GDPC) divides the energy sector into five subsectors, namely exploration and extraction, power generation, energy transmission and distribution, multipurpose projects, and energy efficiency projects.

Inventarisasi Gas Emisi Rumah Kaca per Sektor
(dalam ribu ton CO2e)
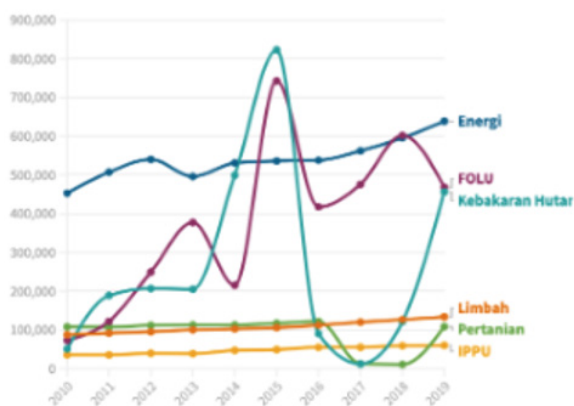
Sumber: Laporan Inventarisasi Gas Rumah Kaca dan MPV 2020, Kementerian Lingkungan Hidup dan Kehutanan Republik Indonesia

Figure 6. Greenhouse Gas Emissions Inventory by Sector

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13. Global Energy Review: CO2 Emissions in 2021

14. *Laporan Inventarisasi Gas Rumah Kaca dan MPV 2020,* Ministry of Environment and Forestry Republic of Indonesia

15. *REN21 Renewables 2017 Global Status Report and Advancing the Global Renewable Energy Transition*

16. Frankfurt School-UNEP Centre/BNEF (2018), *Global Trends in Renewable Energy Investment 2018,* www.fs-unep-centre.org

3 startup   **4** startup

Clean Energy Transition **28** startup

10 startup

13 startup

● Energy Efficiency Project **(35,7%)**
● Energy Transmission and Distribution **(2,6%)**
● Exploration & Extraction **(0 startup)**
● Power Plant **(46,4%)**
● Multipurpose Project **(14,3%)**
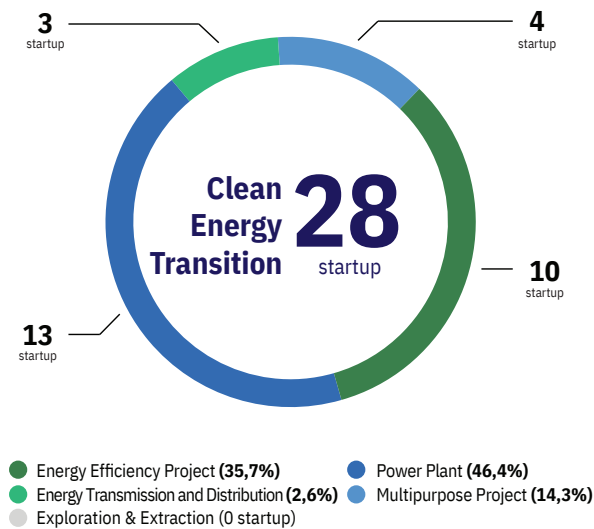
Figure 7. Number of Clean Energy Transition Startups in Indonesia

Based on the GIZ and Kementerian PPN/Bappenas database of industry actors in the green technology sector in Indonesia, there are 28 startups in the clean energy transition sector out of a total of 117 startups. The number is quite small, at 23.9%, compared to the other two sectors, which are circular economy and natural resource management.

Startups in the power generation subsector (13 startups) dominate the others, followed by the energy efficiency subsector (10 startups). Only a small number of startups are engaged in multipurpose projects (4 startups), and 1 startup is in the energy transmission and distribution subsector. No green technology startups have been identified in the exploration and extraction subsector.

1.2.2.2. Circular Economy

The circular economy model has been circulating for more than 30 years as a replacement for the linear economy model, in which products are designed to be made, used, and then discarded.[17] Many entities have attempted to define the circular economy model, including the United Nations Environment Pro-

gramme (UNEP). UNEP refers the circular economy as "an alternative economic model for exchange and production that separates economic growth from material dependence".[18]

The Ellen MacArthur Foundation, an international organisation to accelerate the economy transition from a linear to a circular one, calls the circular economy "a framework that generates systemic solutions to global challenges such as climate change, biodiversity loss, waste and pollution" by centred on design to eliminate waste and pollution, rotate products and materials at their highest value and regenerate nature.[19]

In the Indonesia context, Minister of National Development Planning/Head of Bappenas Suharso Monoarfa in The Economic, Social, and Environmental Benefits of a Circular Economy in Indonesia (2021) stated that a **circular economy is a closed circular economic system approach, which maximises the value and usefulness of raw materials, components, and products so as to reduce the amount of waste materials that are not reused and disposed of in landfills.** This economic model is also cited as one of the tools to drive Indonesia's economic transformation by supporting the green economy.

These definitions of circular economy are then translated into 10 principles summarised in the 9R framework.[20] This framework is divided into 3 sections grouped by the type of initiatives undertaken, namely (1) making and using products in a smarter way; (2) extending product life; and (3) benefiting from materials. The smaller the R number, the greater the circularity value, which means the less natural resources needed and the less burden that needs to be borne by the environment from the production of an activity or business. The larger the R number, the closer it is to linear economic practices. Thus, to make an economic activity more circular, practices with small R numbers need to be favoured. The 9R framework can be seen from the following illustration.

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17. Bappenas, *The Future is Circular: Langkah Nyata Inisiatif Ekonomi Sirkular di Indonesia.* 2022

18. https://www.unep.org/news-and-stories/blogpost/circular-economy-indicators-what-do-they-measure

19. https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

20. Bappenas, *The Future is Circular: Langkah Nyata Inisiatif Ekonomi Sirkular di Indonesia.* 2022
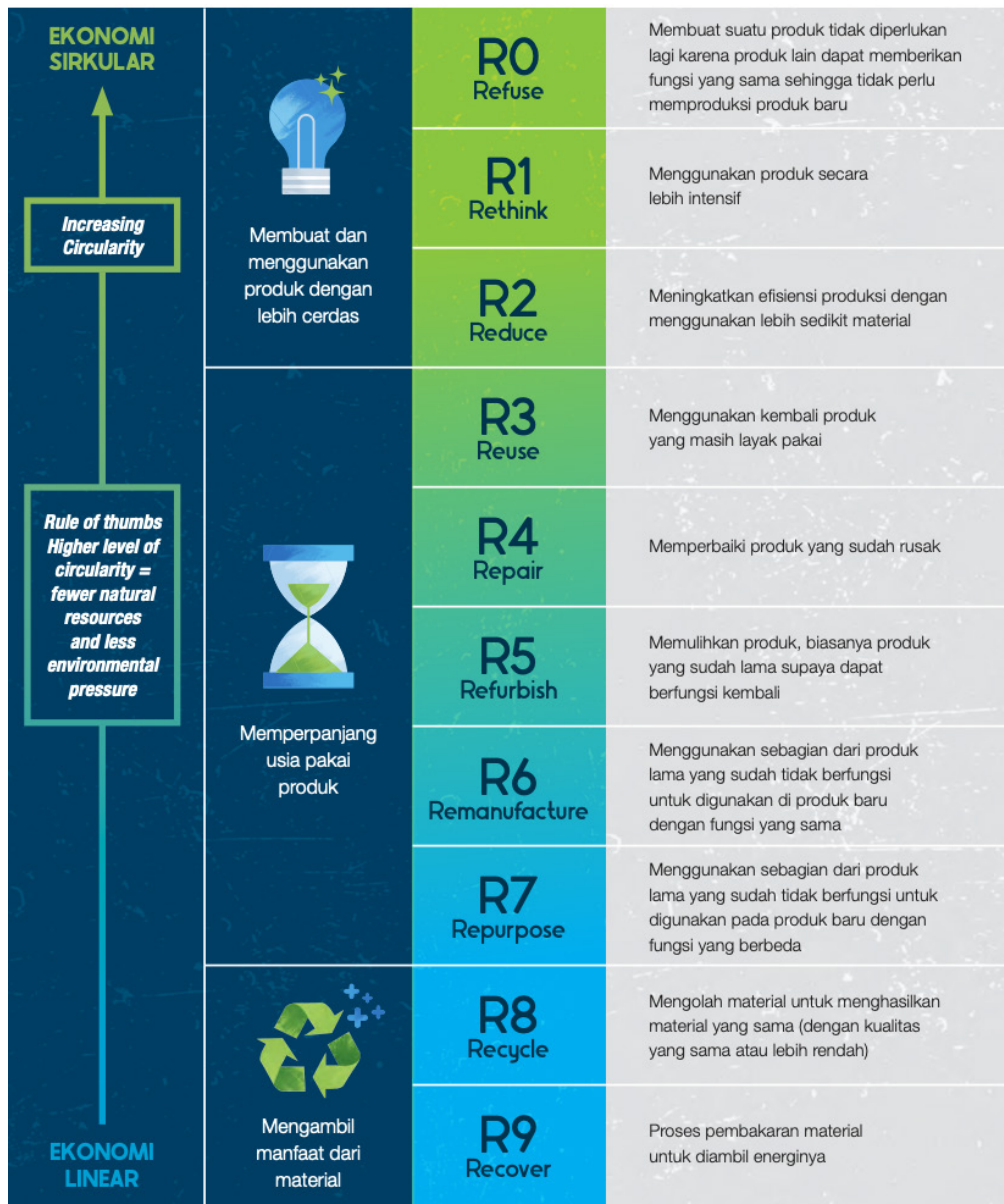
Source: The Future is Circular: Langkah Nyata Inisiatif Ekonomi Sirkular di Indonesia[21]

Figure 8. The 9R Framework in the Circular Economy

In terms of business models, there are five current circular business models with the aim to make the most of resources from all parts of the supply chain. In its application, these business models can be combined to generate greater impact. The five circular economy business models are; (1) material inputs that are circular by using renewable energy, biobased materials, or recyclable materials, (2) sharing models that seek to increase product usage through collaborative usage models, (3) services as products that offer long term maintenance services of a product apart from the sale of the product itself, (4) product life extension or efforts to repair, reprocess, improve quality, and resell, and (5) resources recovery or reprocessing waste or by-products into secondary raw materials.

The concept of circular carbon economy has also been incorporated into several Indonesian legal substances since 2017, namely in Presidential Re-

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21. Bappenas, The Future Is Circular: Langkah Nyata Inisiatif Ekonomi Sirkular di Indonesia. 2022

gulation No. 97/2017 on National Policy and Strategy (JAKSTRANAS) and Government Regulation No. 46/2017 on Environmental Economic Instruments. This practice, which is included in the concept of low carbon development, has also been incorporated in the National Medium-Term Development Plan (RPJMN 2020-2024) which underlines the Indonesia government's intention to jointly promote business activities that prioritise the principle of circularity.

Slightly more than the number of clean energy transition startups, a total of 38 circular economy startups has been compiled within the database of GIZ and Kementerian PPN/Bappenas. Of these 38 startups, more than half startups (52.6%) have resource recovery business models that focus on reprocessing waste (by-products) into secondary raw materials. The second largest startups composition is from the service as a product business model, with 9 startups (23.6%). The remaining 8 startups (21%) have circular input business models and 2 startups (5.2%) have product life extension business models.

8
startup

9
startup

Circular Economy **38** startup

20
startup

2
startup

- Circular Input **(21%)**
- Resource recovery **(52,6%)**
- Product life extension **(5,2%)**
- Service as product **(23,6%)**
- Share model (0 perusahaan)
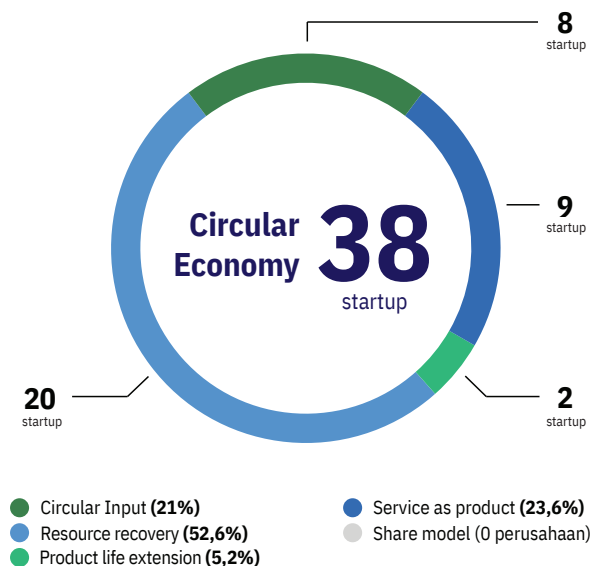
Figure 9. Jumlah Perusahaan Rintisan Sektor Ekonomi Sirkular di Indonesia (Sumber: Basis Data GIZ dan Kementerian PPN/ Bappenas)

The circularity aspect of circular economy practices in Indonesia still focuses on waste management or other by-products in the downstream of the production chain. There are already companies that have sustainability aspects from the upstream, but the number is still not large yet, as well as those that try to extend the life of products or increase the efficiency of product use in the sharing model.

1.2.2.3. Natural Resource Management

Natural resource management refers to the sustainable utilisation of natural resources, such as land, water, air, minerals, forests, fisheries, flora, and other wild fauna.[22] Some definitions limit the scope of natural resources as resources that can renew themselves, as well as resources that can naturally produce without human intervention. Referring to this definition, natural resources include forests and non-petroleum products (although petroleum also comes from nature, it is considered as a non-renewable natural resource). Similarly, soil quality and its mineral content are included in the scope of natural resources. Unlike the case with farming products (e.g. fruits, vegetables, etc.) which requires the intervention of farmers in cultivating the land to produce them, then referring to the previous definition, farming products are not considered as natural resources.[23]

Natural resources require a capable management system. In principle, natural resource management seeks a balance point between the demands of exploiting industries and the capacity of natural resources to regenerate.[24]

The natural resource management is the green technology sector with the highest number of startups, which reaches 50 startups. Half of the 50 startups are startups in the agriculture subsector. The remaining half is spread into 13 aquaculture startups (26%), 5 carbon-based business startups (10%), 4

22. *Natural Resource Management and Biodiversity Conservation*. Iyyanki V. Muralikrishna, Valli Manickam, in Environmental Management, 2017.

23. *Natural Resource Management and Biodiversity Conservation*. Iyyanki V. Muralikrishna, Valli Manickam, in Environmental Management, 2017.

24. *Natural Resource Management and Biodiversity Conservation.* Iyyanki V. Muralikrishna, Valli Manickam, in Environmental Management, 2017.

water management startups (8%), and 1 air quality management startup (2%).

4 startup
1 startup
5 startup
25 startup

Natural Resource Management
50 startup

13 startup
4 startup

- Agriculture **(50%)**
- Aquaculture **(26%)**
- Air Quality Management **(2%)**
- Water Management **(8%)**
- Carbon-base business **(10%)**
- Forestry **(8%)**
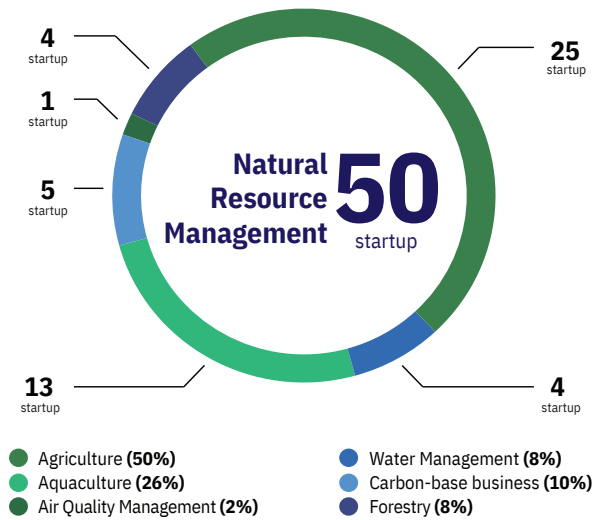
Figure 10. Number of Natural Resource Management Startups in Indonesia

In the Indonesia context, carbon-based businesses fall under the natural resource management sector. Quoting from the background of PERPRES No. 98 of 2021 section c:

"That carbon as a universal indicator in measuring the performance of climate change control efforts reflected in the national determined contribution, in addition to having an important economic value and having an international dimension, mainly in the form of economic benefits for the community, is also a reflection of the principle of sustainable resource management in accordance with the mandate of Article 33 paragraph (4) of the 1945 Constitution of the Republic of Indonesia."

1.3. Gender Perspectives in Startups

Studies have shown that gender equality in professional workplaces can lead to concrete financial benefits.[25] This has been recognised by companies, with the percentage of female decision-makers increasing from 17% to 21% over the past five years[26] in the US corporate world.

The link between gender equality and financial gains in companies lies in the organisational health. Research[27] shows that a diversity of perspectives, experiences, and leadership styles that differ between men and women consistently beat competitors with homogeneous team compositions.

61-80% **2**
≤ 20% **9**

Employee

41-60% **16**
21-40% **11**

61-80% **5**
≤ 20% **14**
81-100% **1**

Decision Makers

41-60% **13**
21-40% **5**
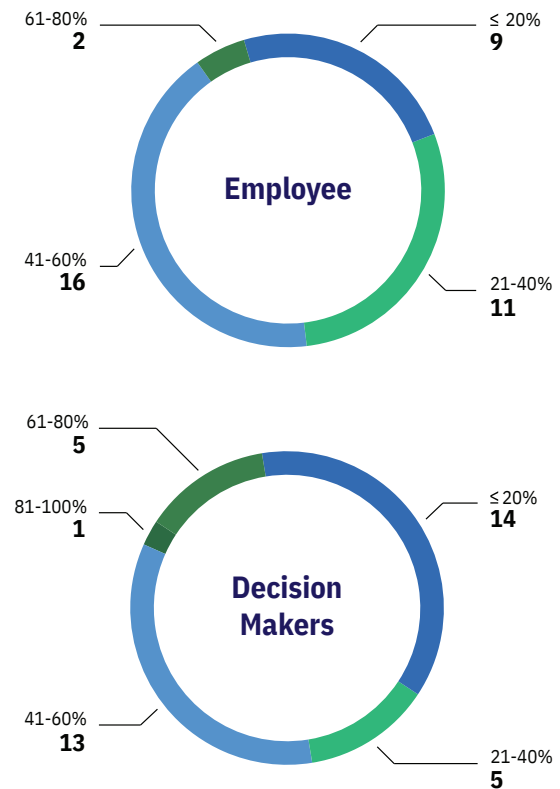
Figure 11. Percentage of Female Employees to Total Employees in Startups

From the startup respondents in the study, startups have sufficient gender equality shown by the number of female and male employees who are quite

25. https://professional.dce.harvard.edu/blog/why-gender-equity-in-the-workplace-is-good-for-business/, accessed June 2023

26. https://www.mckinsey.com/featured-insights/gender-equality/women-in-the-workplace-2019, accessed June 2023

27. https://www.mckinsey.com/featured-insights/gender-equality/women-in-the-workplace-2019, accessed June 2023

balanced, as seen in the graph. Out of a total of 38 startup respondents, there are 18 startups (about half of the total) whose composition of female employees is in the combined range of 41 - 60% and 61 - 80%.

When looking at the gender composition of decision-makers within these startups, there are still many startups (14 startups, or 36.8%) that have a small percentage of female decision-makers (less than or equal to 20% female decision-makers) as seen in the graph. However, other 19 startups have already had more than 41% female decision-makers. The two graphs show that there are quite a number of startups with a gender-neutral mix of employees and decision-makers.

1.4. Enablers
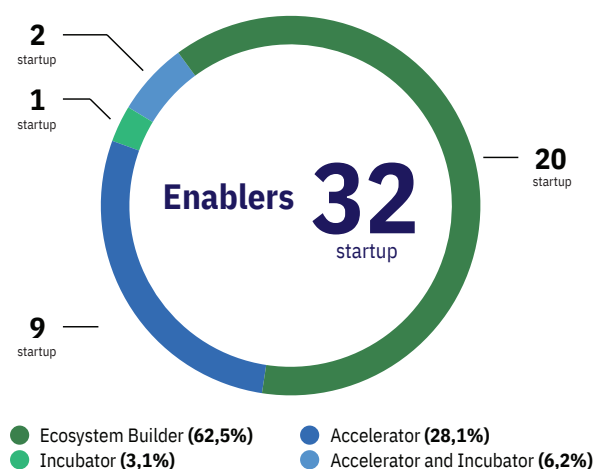
Figure 12. Classification of Enablers for the Green Technology Industry in Indonesia

Incubators have been around since the early 1950s in the United States. On the other hand, accelerators have only been around since the mid-2000s in

Silicon Valley. The difference between the two lies in the stage of the business being nurtured.

The UNFCCC in its Climate Technology Incubators and Accelerators report defines an incubator as a party that supports the establishment of new startups.[28] The assistance provided by incubators is generally in the form of physical location or premises, business models offered, marketing services, technical services, financial support (by connecting the startup to investors or other sources of funding), as well as diverse information and networking services. The duration of assistance provided by incubators is usually more than one year. In some cases, the duration of this assistance can even reach up to five years.

Meanwhile, the accelerator acts as a party that supports the acceleration of the established businesses.[29] Accelerators offer support in the form of mentoring, peer review, and skill transfer for approximately three to six months. Accelerators often select businesses that already have traction or are considered capable enough to compete in the industry.

Both incubators and accelerators aim to nurture startups and provide support in various forms. However, there is a fundamental difference between the two. Incubators help build the startup from scratch, while accelerators only provide additional support when the business is more developed. In addition, incubators are generally funded by the government, while accelerators receive funding from large corporations or venture capitalists.[30]

Ecosystem builders are defined as accelerators that are typically set up by corporations that aim to form an ecosystem of consumers and stakeholders associated with their company.[31] Often, the goal is to expand their stakeholder network. In addition, these

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28. https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/incubators_index/ee343309e8854ab783e0dcae3ec2cfa6/c172d2f388234bdbbe3dd9ae60e4d7e9.pdf

29. https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/incubators_index/ee343309e8854ab783e0dcae3ec2cfa6/c172d2f388234bdbbe3dd9ae60e4d7e9.pdf

30. https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/incubators_index/ee343309e8854ab783e0dcae3ec2cfa6/c172d2f388234bdbbe3dd9ae60e4d7e9.pdf

31. https://essay.utwente.nl/74353/1/Link_MA_BMS.pdf, accessed on 28 June 2023

ecosystem builders are also often used as a tool to bring together key consumers with trusted startups (matchmaking) in the hope of maintaining the development of the ecosystem between companies.

1.4.1. Gender Perspectives in Enablers (Accelerators and Incubators)

In line with the gender perspective seen in the startup respondents, the majority of the enabler respondents also have a fairly balanced and high composition of female employees. 6 enabler respondents have 41-60% female employees and 5 enabler respondents have 61-80% female employees compared to the overall employees, as shown in the graph.
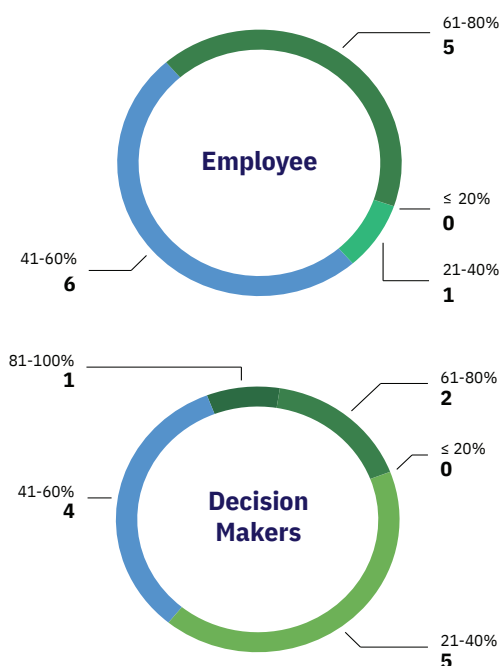
Figure 13. Persentase Jumlah Karyawan Perempuan terhadap Total Karyawan pada Entitas Pihak Pemungkin (Sumber: Hasil Kuesioner oleh GIZ dan Kementerian PPN/Bappenas)

At the decision-making level, 7 out of a total of 12 enablers have female decision-makers composition of more than 40%.

In Indonesia, carbon trading is part of the implementation of climate change mitigation actions. Carbon-based business activities fall into two broad categories, namely carbon projects and carbon trading. Carbon trading is a market-based mechanism to reduce GHG emissions through the buying and selling of Carbon Units.[32] When referring to the terminology in the international carbon market, carbon projects are generally divided into several types of projects. Firstly, there is carbon avoidance, which is an attempt to prevent activities that produce carbon emissions.[33] An example of carbon avoidance is projects to keep forests from being cut down. Secondly, there is carbon reduction, which emphasises energy or resource efficiency efforts to reduce carbon emissions. Third, there is carbon removal, which is an effort to eliminate carbon that is already in the atmosphere. Activities in these carbon projects are implemented with (i) nature-based approach by relying on organisms or natural phenomena, such as chemical mineralisation and others, and (ii) tech-based approach by relying on human-developed forms such as machines, chemicals, or others.

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32. Presidential Regulation No.98 of 2021 on the Implementation of Carbon Economic Value for Achieving Nationally Determined Contribution Targets and Controlling Greenhouse Gas Emissions in National Development, Article 1 point 17.

33. Abatable, The State of Carbon Developer Ecosystem 2021, accessed 7 June 2023

**CARBON-BASED
BUSINESS**

**CARBON
TRADING**

**CARBON
PROJECTS**

Carbon
Avoidance

Carbon
Reduction

Carbon
Removal

Tech-based

Nature-based
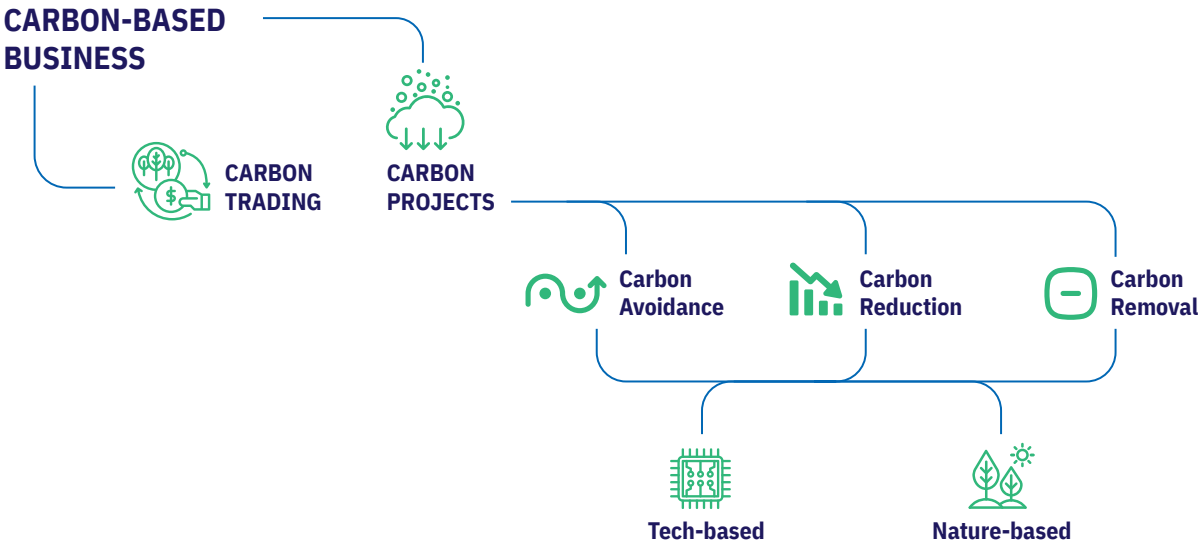
Chapter 2
The Subtleties of Startups in Navigating the Green Technology Industry in Indonesia

2. The Subtleties of Startups in Navigating the Green Technology Industry in Indonesia

2.1. Entry of Industry Actors into the Market

The Digital Transformation Center (DTC) and Make-IT Indonesia project together with the Kementerian PPN/Bappenas created a database containing green technology industry actors data, whether they are startups, enablers, or capital providers. Based on this database, both capital providers and startups entered the industry before 2000, as shown in Figure 14.

Comparison of the Emergence of Industry Actors in the Green Technology Sector in Indonesia
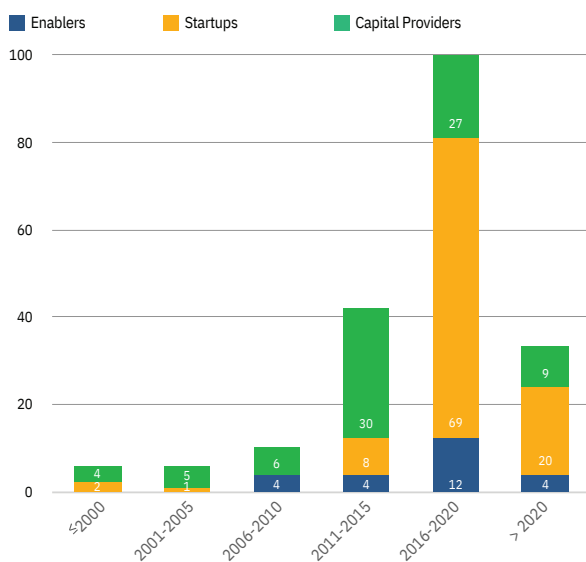
Figure 14. Comparison of Green Technology Industry Actors' Emergence in Indonesia

According to the database of the DTC – Make-IT Indonesia project and Kementerian PPN/Bappenas, capital provider institutions are consisted of venture capitals, venture builders, granting institutions, donors, and other financial institutions that provide funding in various forms to green technology star-

tups in Indonesia. Although some financial institutions do not exclusively provide funding to this industry actors, they are included in the database as long as they have provided funding to the green technology sector. Different with capital providers and startups, within the period of 2006-2010, enablers that encompasses several types of companies, namely accelerators, incubators, and consultancies, began to emerge.

The 2016-2020 is the period with high emergence of enablers and startups, with 12 enablers and 69 startups. Meanwhile, many capital providers that provide funding to the green technology sector in Indonesia began to emerge in the 2011-2015, with 30 institutions. However, given that data collection was only conducted until the beginning of 2023 and is not comparable to other periods covering five years, it is possible that the growth of industry actors in the green technology sector skyrocketed higher in 2021-2025.

When totalling up all industry actors and its supporting institutions such as enablers and capital providers, the 2016-2020 period is the period with the highest emergence of industry actors. The surge is more than double compared to the previous period, namely 2011-2015 with 42 industry actors. The rapid increase in the number of industry actors in the 2016-2020 period is thought to be due to the transition period towards a more sustainable development. The Paris Agreement and UN SDGs were established at the end of 2015 and Indonesia also ratified the Paris Agreement into law in 2016. In addition, 2015 was also a period of transition from the Millennium Development Goals to the Sustainable Development Goals (SDGs). In the Millennium Development Goals, poverty alleviation was prioritised. On the other

hand, important points to ensure environmental sustainability and prevent climate hazards caused by human activities are added in the SDGs.[1]

Looking back at the previous two periods, there was a surge in the number of capital providers from 6 institutions in 2006-2010 to 30 institutions in 2011-2015. In the following five years, 2016 – 2020, the number of capital providers remained relatively stagnant, but the number of enablers increased rapidly. It is not surprising that startups also increased rapidly by almost 9 times from 8 startups in 2011-2015 to 69 startups in 2016-2020, given that the supporting ecosystem is also quite developed.

To be recognised by the industry, startups should not only look at the year of their emergence, but also whether their products and/or services have been accepted by the public. To that end, Figure 15 attempts to illustrate the duration of green technology startups in acquiring their first customers.

Most clean energy transition startup respondents were able to acquire their first customer within 4-6 months. In contrast to the clean energy transition sector, almost half of the circular economy and natural resource management startup respondents were able to acquire their first customer in less than 3 months.
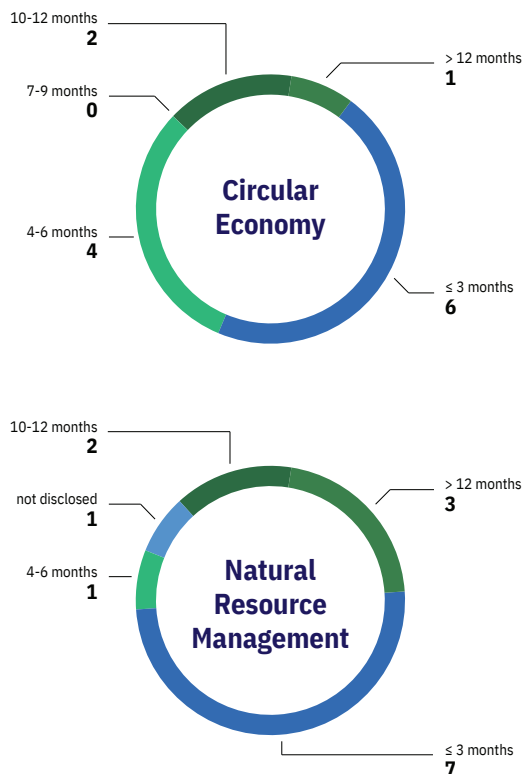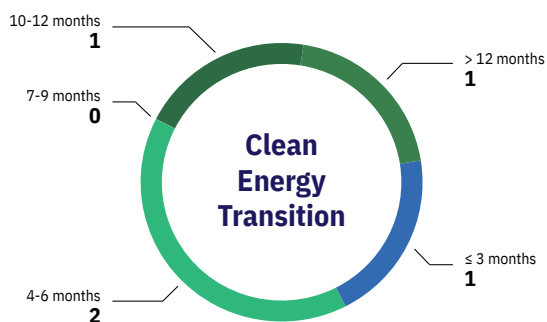
Figure 15. Startups' Duration to Acquiring First Customer (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

The longer duration of acquiring the first customer in the clean energy transition sector might be one of the reasons why there are few industry actors in the clean energy transition sector as recorded in the database of this study. The long duration may also reflect the complexity of the work in the clean energy transition sector, which requires more complex infrastructure and a high dependence on existing regulations.

Clean energy transition efforts are also often related to grassroot communities in non-urban areas. One of study respondents said the unorganised structure of communities requires a more time-consuming individual-level approach. As a result, much of the study respondents' work time was spent for meeting with communities, talking to them and building relationships with them, rather than engaging in trans-

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1. https://www.weforum.org/agenda/2015/03/why-the-sustainable-development-goals-matter/, accessed November 2023

actional activities. Not to mention the dependence of the clean energy transition sector on electricity infrastructure that has not been evenly distributed to the regions.

2.2. Relationship with Fellow Industry Actors

To see how interactions within the green technology sector landscape, one of the questions asked to respondents was who their stakeholders are. Interestingly, in the green technology landscape in Indonesia, the most mentioned stakeholders by the study respondents were communities, not direct users, suppliers, or other parties that intersect with company operations, as shown in Figure 16.
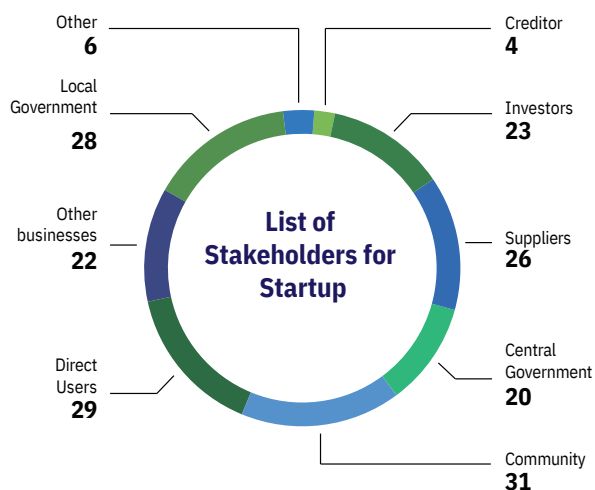
Note: Respondents are allowed to choose more than one answer.

Figure 16. List of Stakeholders for Startups (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

After communities, the order of most mentioned stakeholders by startup respondents was: 1) direct users, 2) local government, 3) suppliers, 4) investors, and 5) other businesses. The 'other' category in the figure includes resellers, academics and practitioners, funders, climate project organisations, joint ventures, and other collaborators such as NGOs.

An interesting trend that can be seen from the results of this questionnaire is that local governments

are considered to become more important stakeholders for startups than the central governments. This is interesting to note because in general, the strategic direction of activities and policies comes from the central governments. Thus, it will be important to synchronise the central governments and local governments who know the local context and knowledge of their respective regions.

Other businesses, which were also considered stakeholders, were ranked as the 6th most mentioned by respondents. Seeing that communities were the most mentioned stakeholders and other businesses were also identified as stakeholders, it can thus be indicated that the culture of the green technology landscape tends to be collaborative. Nonetheless, some startups mention that competition has already increased. This might indicate that existing regulations might need to adapt with this current situation and initiate fair playing field within sector.

This is in line with the answers of study respondents when asked about the cooperation that has been established with the public and private sectors. Only a handful of respondents (7.3%) had never collaborated with the private sector. As for cooperation with the public sector, although not as many as with the private sector, the majority of respondents stated that they had worked together, namely 73.2%.

Based on the location of collaboration between startups and the public sectors, Java Island is still the area with the highest number of collaborations, followed by Sumatra Island, although the difference is more than 50%. From Figure 17, in general, all areas in Indonesia have been grasped by respondents' collaboration with the public sectors. It is just that the amount of collaboration carried out in each area is still uneven.

Number of Collaborations between Startup and the Government

(Based on Collaboration Location)

Collaboration with Government   0 ▨▨▨ 35
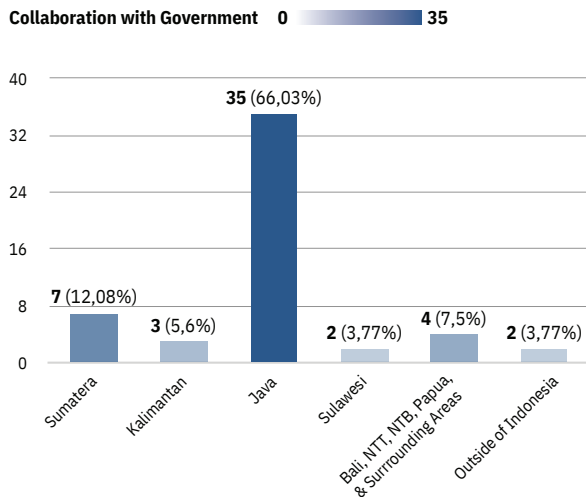
Note: Respondents are allowed to choose more than one answer.

Figure 17. Number of Startups Collaborations with Governments by Collaboration Location (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

Number of Collaborations between Enablers and the Government

(Based on Collaboration Location)

Collaboration with the Government   3 ▨▨▨ 13
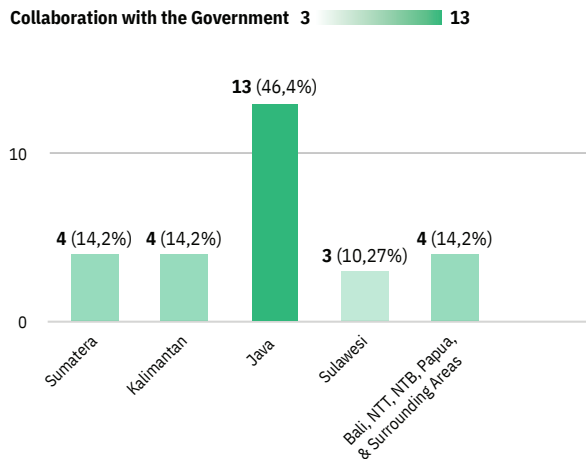
Note: Respondents are allowed to choose more than one answer.

Figure 18. Number of Enablers Collaborations with Governments by Collaboration Location (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

Similar to the collaboration between startups and governments, collaboration between enablers and governments is still also most prevalent in Java. From Figure 18, it can be seen that apart from the collaboration in Java, the rest number of collaboration is quite balanced in other areas. However, from the results of this questionnaire, there are no enabler respondents who have collaborated abroad like the startups as seen in Figure 17.

Public Sector that Have Collaborated with Green Technology Startups in Indonesia

Note: Respondents are allowed to choose more than one answer.

Figure 19. Public Sectors that Have Collaborated with Green Technology Startups in Indonesia (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

The institutions in the public sector with which startup respondents have collaborated the most were the central governments (mentioned 15 times) and local governments (14 times). The difference in mentions number between the central governments and local governments is only one number, so it can be concluded that the startup respondents are equally open to collaborating with the central governments and local governments.

Public Sectors that Have Collaborated with Green Technology Enablers in Indonesia

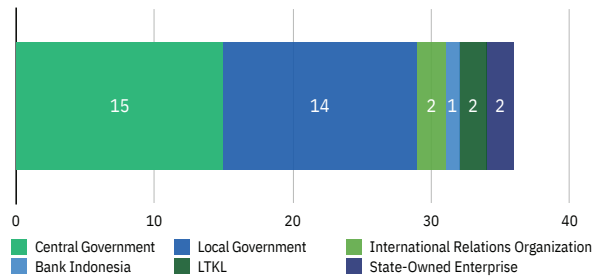Note: Respondents are allowed to choose more than one answer.
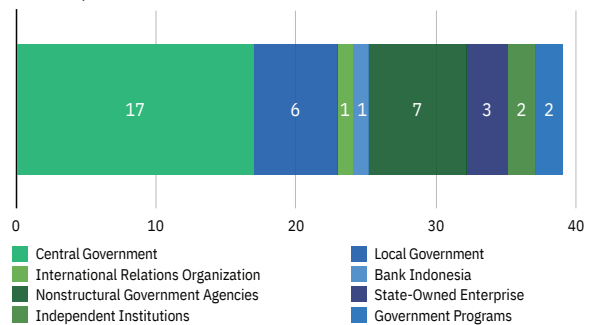
Figure 20. Public Sectors that Have Collaborated with Green Technology Enablers in Indonesia (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

Compared to startups, Figure 20 shows that enabler respondents have collaborated with more diverse public sector entities. In addition to the categories of central governments, local governments, international relations organisations, Bank Indonesia, and state-owned enterprises, there are also categories that do not appear in Figure 19, namely non-structural government agencies, independent institutions, and government programs.

The non-structural government agencies referred to those that are under the responsibility of the Government of Indonesia through a ministry but are not necessarily incorporated into a ministry. Some of the non-structural government agencies mentioned by respondents are the National Research and Innovation Agency (BRIN), the Public Housing Savings Management Agency (BP Tapera), and the Investment Coordinating Board (BKPM).

Interaction of Green Technology Startup in Indonesia with the Public and Private Sectors
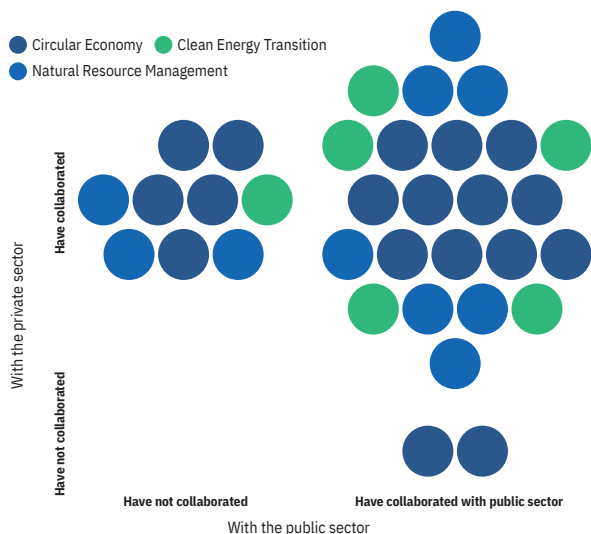
Figure 21. Interaction of Green Technology Startups in Indonesia with Public and Private Sectors (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

Having known that startups respondents have collaborated with the public sectors, Figure 21 examines whether there is a tendency for startups to collaborate with only one of the sectors (public or private). The horizontal axis in Figure 21 represents whether they have collaborated with the public sector and the vertical axis represents whether they have collaborated with the private sector.

The majority of startup respondents are in the upper right quadrant, which means they have collaborated with both sectors (public and private). The empty lower left quadrant indicates that all respondents have collaborated with either one of the sectors (private only or public only) or both. Thus, collaboration has been the common strategy for most green tech ecosystem players.

Startups respondents who have never collaborated with the public sector (upper left quadrant) mentioned several factors that hinder collaboration, such as: 1) public sectors' bureaucracy that tends to be slow and time consuming; 2) startups need to fulfil complex procedures to collaborate with public sectors; 3) difficulties in communicating with public sectors; 4) public sectors that are perceived to be less open to the green technology industry; 5) public sectors that are perceived want to implement and develop by themself independently without the startups involvement.

Interaction of Green Technology Startup in Indonesia with Funding Institutions and Accelerators/Incubators
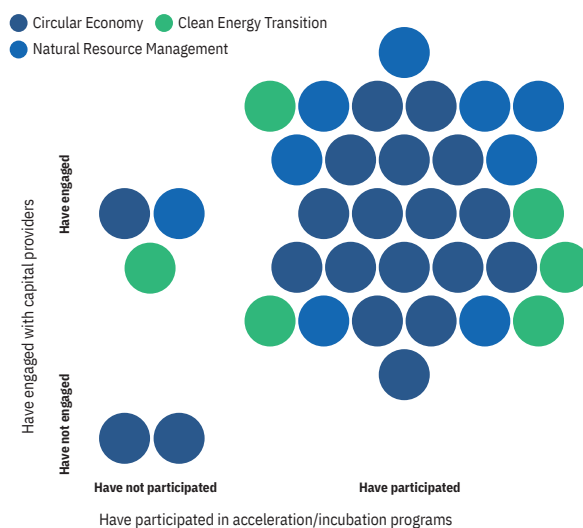
Figure 22. Interaction of Green Technology Startups in Indonesia with Capital Providers and Accelerators/Incubators (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

Figure 22 attempts to compare the interactions of startup respondents with capital providers and accelerators and/or incubators. The horizontal axis represents startups' engagement with acceleration and/or incubation programmes and the vertical axis represents startups' engagement with capital providers.

Similar to Figure 21, the majority of startup respondents are also in the upper right quadrant indicating that they have engaged or interacted with both accelerators and/or incubators and capital providers. The filled upper left quadrant indicates that there are some startups that have only engaged with capital providers.

In Figure 21, the void occurs in the lower left quadrant. However, in Figure 22 the void does not occur in this quadrant. This means that there are still startup respondents who have not interacted and/or engaged with either accelerators and/or incubators or capital providers. Startups that have never interacted with either of them consists of one respondent startup that is still in the early-stage phase and one respondent startup that already has quality projects. The early-stage startup respondent was considered to have a long way to go in developing their company to meet the criteria to join an incubator/accelerator programme or get funding from a capital provider. In contrast, one other startup respondent already had quality projects. This startup was able to fund its operations independently, so at the time of filling out the questionnaire, they had never interacted with a capital provider for the funding process.

Meanwhile, the three respondents in the upper left quadrant or those who have only interacted with capital providers and have never interacted with accelerators and/or incubators are: 1) companies that have been engaged by large corporate companies in Indonesia; 2) companies with non-physical products or services; 3) and companies that have received a lot of funding.

Representative respondents from the green technology sector in Indonesia showed that interaction with capital providers and/or accelerators and incubators is not an absolute determinant of success. Rather, market awareness and readiness, regulatory support, the commitment of the startups to grow, and the maturity of the business models offered by the startups are required to compete and success in the green technology industry.

2.3. Source of Initial Capital and Funding

To find out how significant the role of capital providers in advancing the green technology landscape in Indonesia, the questionnaire included questions on the sources of initial capital for startups. Startup respondents were allowed to answer more than one source of initial capital and funding, taking into account the possibility that the source of initial capital would not only come from the same type of source.

Initial Funding Sources for Startups
Green Technology Sector in Indonesia
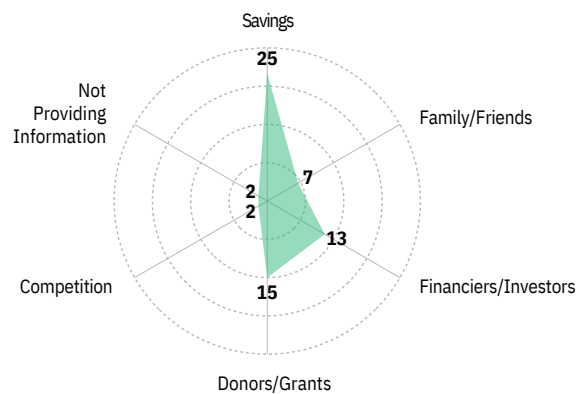
Note: Respondents are allowed to choose more than one answer.

Figure 23. Source of Initial Capital for Green Technology Startups in Indonesia (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

The majority of questionnaire respondents mentioned that most of the green technology startup are using their own savings (mentioned 25 times) for their initial capital. Furthermore, the second most mentioned source of startup capital was donors/grants (mentioned 15 times), followed by financiers/investors (mentioned 13 times), family/friends (mentioned 7 times), prizes from competitions (mentioned 2 times), and the remaining 2 were not willing to provide information.

If source of funds is categorized into two major groups, namely internal companies (savings and family/friends) and external companies (financiers/investors, donors/grants, competition), then internal sources of funds are mentioned 32 times and external sources of funds are mentioned 30 times.

The difference between the two is not much, with only two mention times. This indicates that the Indonesia green technology startups are well-connected to parties outside of their own company, so they have been able to secure initial capital from external sources. On the other hand, it can be indicated that capital providers are also quite open to fund Indonesian green technology startups, as indicated by the high number of initial capital sources from donors/grants and financiers/investors.

Funding for Operational Activities of Startup

During the First Three Years
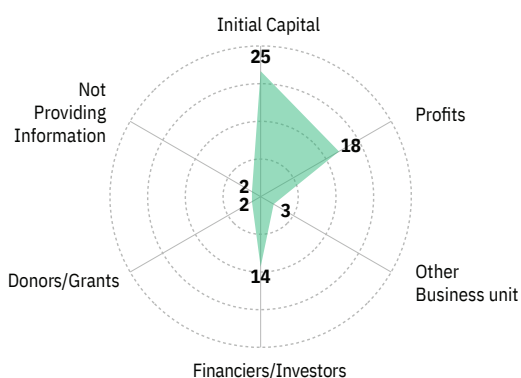
Note: Respondents are allowed to choose more than one answer.

Figure 24. Funding of Startups' Operational Activities during the First Three Years (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

Nonetheless, it is undeniable that startups are still at risk of failure. As of March 2021, 80% of startups in the United States made it through their first year and have been operating ever since. Through this study, 18 startups respondents in the green technology sector mentioned that they have earned profits that are then used to fund their operations. Inside the questionnaire, startups respondents could answer more than one source of funding for operating costs. This was done by considering the possibility that the profits earned by the startups were not yet large enough to actually fund their operations.

Figure 24 shows that during the first three years of a startups' entry into the industry, their funds for operational activities are mostly sourced from external

parties, namely financiers or investors (14 times) and donors/grants (2 times), totalling 16 mentions. Internal sources of funds are mentioned far more, totalling 46 times, including initial capital (25 times), profits (18 times), and other business units of the same company (3 times).

Composition of Funding for Green Technology Startups in Indonesia
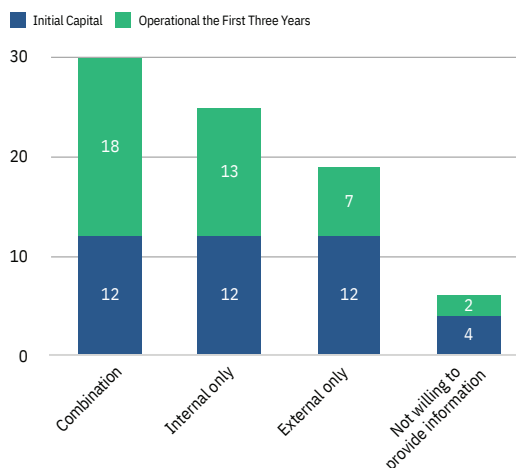
Figure 25. Funding Composition of Green Technology Startups in Indonesia (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

As can be seen from Figure 25, the initial capital of green technology startups in Indonesia is equally divided into three, namely internal funding sources only (12 mentions), external funding sources only (12 mentions), and a combination of both internal and external sources (12 mentions). As the first three years progressed, the number of respondents whose operational funding sources relied on external sources only started to decrease (to 7 mentions). This may indicate that startup respondents began to generate revenues and profits hence can reduce their reliance on external source of funds.

Still referring to Figure 25, although the composition of startups relying on initial capital funding from external sources only is the same to those relying on internal sources only and a combination of external-internal sources, some respondents of the study are very selective in receiving initial capital funding. Besides looking for funders with whom they share a common vision and values, these startup respondents avoid ac-

cepting funds that are intended to turn the startup's operational process. In other words, these startup respondents aim to be self-sufficient and self-reliant first and will only receive funding from capital providers if they feel the need. This is done to avoid high dependency on uncertain external sources of funds.
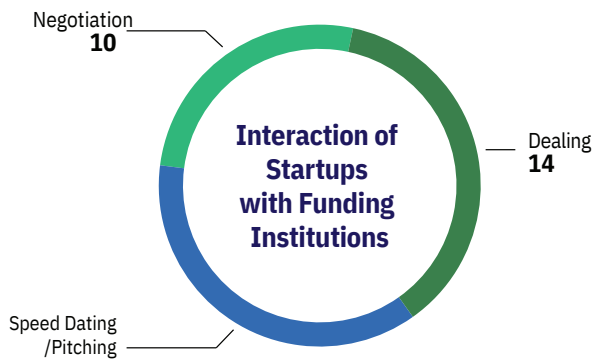
Figure 26. Startups Interaction with Capital Providers (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

Furthermore, as can be seen in Figure 26, only 14 out of 38 respondents (36.8%) have reached the deal stage when it comes to their interactions with the capital providers. An interview with one of the startup respondents to the questionnaire results illustrates that it is not only the capital providers that have a vested interest in determining funding disbursements, but also the startups themselves. The low number of deals was not caused by ineligibility of startups to receive funding from capital providers. In several cases, it was also due to mismatch of values and visions from both organisations (the startups and the capital providers).

2.4. Impact Measurement

Measuring the startups' environmental, social, and governance (ESG) impacts has its own benefits in the long run for startups, whether they are in the early stages of development or advanced. The startups' image and reputation can be well established, thereby increasing customer trust and attracting qualified talents to join the startups .

In addition, ESG impact measurement will also help

startups with risk management. When startups have incorporated ESG impact measurement into their agenda, they will be more aware of the risks that can occur from an environmental, social, and governance perspective. Thus, startups can put themselves in a better position to mitigate the risks that may arise. Furthermore, measuring ESG impacts can also increase the chances of receiving funding.

A total of 26 out of 40 startup respondents (65%) answered that most of them have measured the impact of their startups' activities. Impact measurement can include one of the environmental, social, or governance aspects only, a combination of two aspects, or all three. Majority of startups document these measurements, although not all of them. As shown in Figure 27, only 22 out of 26 startups documented such measurements.

Startup Impact Measurement
Green Technology Sector in Indonesia
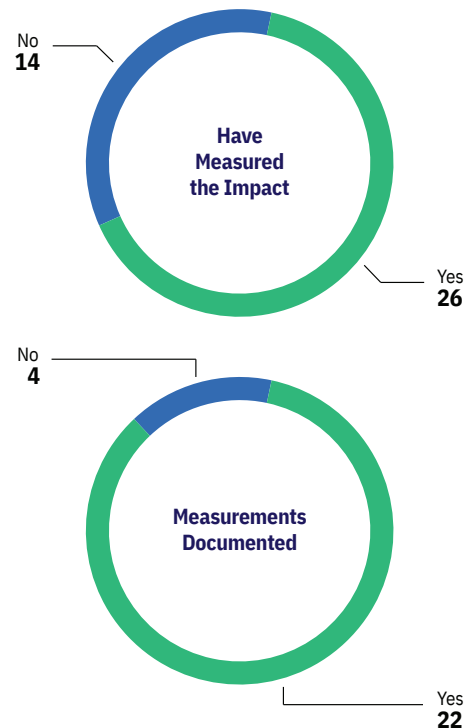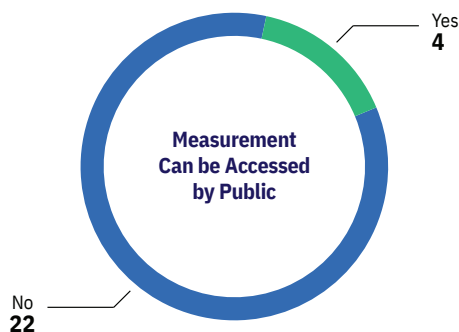
Figure 27. Startups and Impact Measurement (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

The impact measurement process generally does not only consist of measuring and documenting, but also includes reporting/publishing the documentation to the public. This documentation publication can take the form of sustainability reports, infographics, or other forms. Good and transparent impact reporting can build trust with investors/donors. In addition, impact reporting can be an instrument for startups to submit funding proposals with concrete evidence. In a broader context, the ability to articulate the impact that a startup has made can help the startup to inform the public about the issues that concern the startup and the performance that has been successfully achieved.

Despite many benefits that startups can derive from measuring, documenting, and reporting on ESG impacts, Figure 27 shows that 22 out of 26 startups have not publicised these impacts. The reason why one of the respondents did not make the documentation public is because of the additional cost of having the measurement validated by a third party.
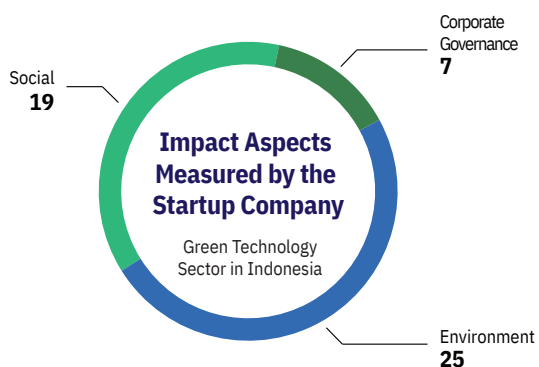
Note: Respondents are allowed to choose more than one answer.

Figure 28. Aspects of Impact that Startups Have Measured (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

According to the representatives of the green technology startup respondents in this study, impact measurement is closely related to measuring the impact on the environment. As Figure 28 illustrates, environmental aspect measurement was the most frequently selected by the startups (25 times), followed by social aspect measurement (19 times) and corporate governance aspect measurement (7 times). Startups respondents were allowed to select more than one aspect when answering questions about types of impact measurements they have conducted.

Impact measurement is generally not an activity that startups undertake right from the start of the establishment year. Based on the results of the questionnaire, impact measurement was only started by the startup respondents in 2019 and was only conducted by 3 startups. Since that year, the number of startups that have conducted impact measurement has never decreased and has even continued to increase. The year 2019 marks the starting point of impact measurement by startup respondents.

The Starting Point for Green Technology Startup to Begin Measuring Impact
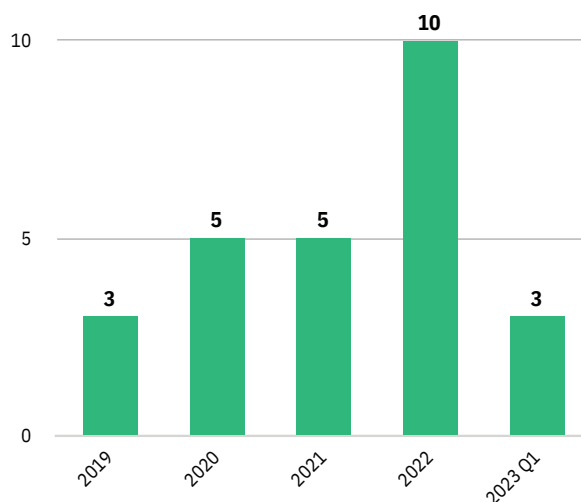
Figure 29. Starting Point Green Technology Startups to Measuring Impacts (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

In the first quarter of 2023, 3 startups are measu-

ring their impact. If this number is projected to remain constant from the following quarters in 2023, number of impact measurement by green technology startups in Indonesia is indicated to be increasing compared to previous years. The increasing trend of impact measurement from year to year may indicate that startups are increasingly realising the importance of impact measurement. On the other hand, it also indicates that there is a stimulus from the ecosystem as well as capital providers that have a focus on providing impact funding.

Impact Measurement Accelerator/Incubator
Green Technology Sector in Indonesia
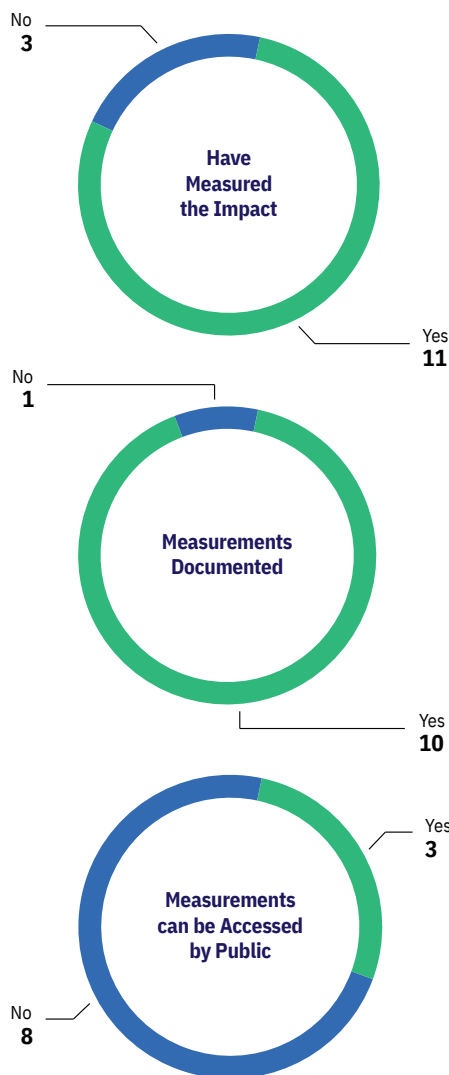
Figure 30. Impact Measurement by Accelerators and/or Incubators (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

The impact measurement conducted by accelerator and/or incubator respondents is not much different from that conducted by startups. 11 out of 14 enabler respondents (78.5%) have measured the impact of their activities. Furthermore, the majority of respondents have documented these measurements (10 out of 11 respondents or 90.9%), but very few accelerators and/or incubators have made these impact measurements publicize (only 3 out of 11 respondents or 27.3%).

What is interesting when talking about the impact measurement done by accelerators and/or incubators is the type of aspects measured. Accelerators and/or incubators mostly measure the impact of their social aspects, in contrast to startups respondents who have mostly measured the impact of their environmental aspects. In the accelerators and/or incubators, impact measurement of the environmental aspect comes second, followed by the measurement of corporate governance aspect.

2.5. Enablers Support for Startups

To get a picture of the programs designed by the enablers for green technology startups in Indonesia, the questionnaire asked a question on the criteria of prioritized startups to be nurtured by the enablers. Enabler respondents were allowed to select more than one criterion. As shown in Figure 31, the most common criteria were the stage of development of the startups (12 times), impact reach (11 times), business plan and model (4 times), background of founders and team (3 times), and others (5 times). The 'others' category includes the amount of capital, gross revenue, as well as the number of partners.

What is meant by the development stage of startups according to one of the respondents is the extent to which the products and/or services offered by the startups can be a solution and fit to problems in society. In addition to the solution offered, the uniqueness of the solution also needs to be considered, just like other sectors that need to think about the

unique selling points that can be presented through their products, services, or companies.
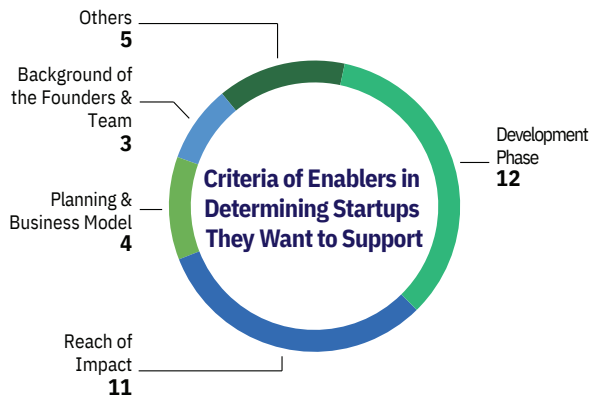
Note: Respondents are allowed to choose more than one answer.

Figure 31. Startups Criteria to be Supported by Enablers (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

The finding that enablers are more concerned with the future success of the startups than with the current state of their business plan and model is expected, given the role of enablers who are tasked with developing the capacity of startups. One enabler respondent mentioned that the level of team cohesiveness is also an important factor because startups that operate with just one or two people are more at risk.[2]

Support Programs Offered by Enablers
For Green Technology Sector in Indonesia
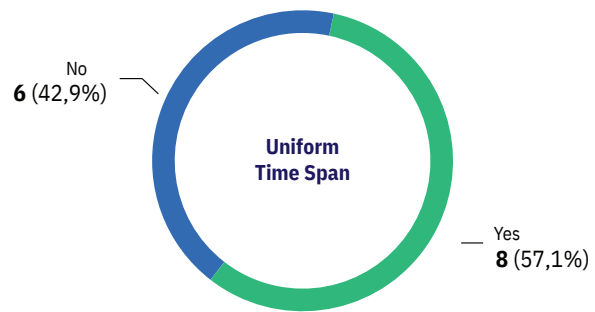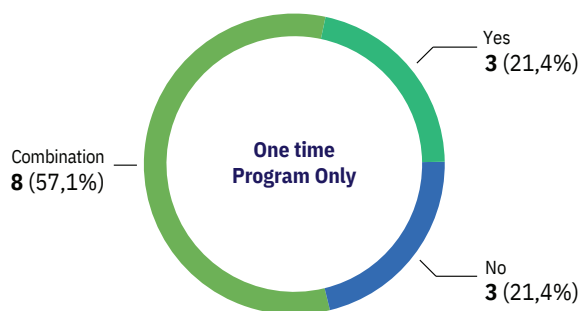
Figure 32. Duration Variety of Supporting Programmes by Enablers for Green Technology Startups in Indonesia

In relation to supporting programs for startups, the duration and continuation of the enablers' programs also need to be considered besides the content of the supporting program itself. This needs to be taken into account because it can be adjusted to the needs of green technology startups in Indonesia. More than half of the enabler respondents, or 57.1% to be precise, had programs that varied between one-off and continuous programmes. The remaining 21.4% had one-off programs with no follow-up programs and the remaining 21.4% had programs that took place more than once.

The repetition of support programs offered by enablers does vary. As can be seen from Figure 32, most enabler respondents (57.1%) have support programs with a uniform time span, conducted repeatedly, and using a predefined method, such as per-3 months and/or per-6 months. On the other hand, 42.9% of the enabler respondents conduct support programmes with a more varied time duration to suit the needs or requests of their partners.

2.6. Governments Supports for Startups

Governments programs which aim at supporting the performance or activities of industry actors in the green technology sector in Indonesia have been compiled in Table 3. The data was obtained from the literature study as well as some answers from the study questionnaire respondents.

___

2. Interview with a representative of enablers, Maret 30, 2023

No.	Supporting Party	Program	Program Description
1.	Ministry of National Development Planning (Kementerian PPN/Bappenas)	Green Growth Program	The main program that promotes green economic growth in Indonesia through three priority sectors, namely sustainable energy, sustainable landscape, and sustainable infrastructure in the context of Special Economic Zones or KEK (Kawasan Ekonomi Khusus).
2.	Ministry of Communications and Informatics	1000 Startup Digital	The 1000 Startup Digital program supports to develop digital startup ideas in 18 provinces in Indonesia. The program is being rolled out in stages, with the green technology sector as one of the targets. The program aims to help startups reach the product-market fit stage. The solutions and ideas born from the startups in this program are expected to help solve problems in each region.
		Startup Studio Indonesia	The program aims to facilitate digital startups that have reached the product-market fit stage of their development and support them to scale up. The form of offered facilitation is acceleration for startups by providing resources and networks to scale their businesses.
		HUB.id	Enabling startups in various sectors (healthcare, fisheries and agriculture, ESG-related, logistics, small and medium enterprise enablers, as well as fintech) to increase their capacity and chance to network with capital providers in a business matchmaking or networking platform.
3.	Ministry of Tourism and Creative Economy	BEKUP 2023	A capacity building program for digital startups in the Tourism and Creative Economy sector. The program is run in four cities, namely Jakarta, Bandung, Semarang, and Surabaya. Ministry of Tourism and Creative Economy equips startups with necessary collaboration networks, market access, learning curriculum, qualified mentors, and access to funding.
4.	Coordinating Ministry for Maritime and Investment Affairs together with Ministry of Marine Affairs and Fisheries	Indonesia as part of the Archipelagic and Island States (AIS) Forum	An open forum of 51 archipelagic and island countries to promote sustainable ocean growth. The forum provides a space for startups whose offer sustainable ocean solutions to network with investors and other supporters.

No.	Supporting Party	Program	Program Description
5.	Ministry of Co-operatives and SMEs	SMESCO Indonesia	An official organisation that provides access to marketing and distribution for MSMEs in Indonesia. To enhance the creativity of new potential entrepreneurs, SMESCO also conducts incubation programmes. SMESCO East Hub was recently launched in Bali at the momentum of G20 Indonesia 2022.
6.	Ministry of Industry	Hannover Messe (Kolaborasi dengan Pemerintah Jerman)	The largest industrial technology exhibition held in Hannover, Germany in 2022. Indonesia prioritises downstream (value-added) industries to create jobs and maintain sustainability, energy transition, and the archipelago's IKN (Ibu Kota Nusantara) development project.
		Startup4Industry	Startup4Industry aims to establish an ecosystem of technology solutions for industry bridged with society. The objectives of this program are to accelerate startups as technology providers for industry and society, facilitate the implementation of technology in industry, especially small and medium industries, and socialise the use of Indonesian-made technology. Startup4Industry has a platform that contains list of startups' information, competition information and networking opportunities, mentoring, business matchmaking, and events related to startup development.
7.	Ministry of State-Owned Enterprises	BUMN Startup Day	A hub between digital startups and those in the State-Owned Enterprises ecosystem. Opportunities offered include business matching, rapid mentoring, pitching with investors, startup exhibitions, and conferences.
8.	Provincial Government of DKI Jakarta	Jakarta Smart City	Jakarta Smart City is digital government services for ecosystem innovation owned by DKI Jakarta government. This service collaborates with technology startups to realise Jakarta as a smart city. Competitions and startups development have been commenced several times, such as at Hackathon Jakarta: Jakarta Open Data Challenge and accelerator programme, MRTJ Accel, in collaboration with PT MRT Jakarta.

No.	Supporting Party	Program	Program Description
9.	West Java City Government	Jabar Digital Service	Jabar Digital Service (JDS) is a task unit under the Communication and Informatics Office of West Java Province. This institution has aspirations to narrow the digital divide, assist efficiency and accuracy in data and technology-based policy making, and revolutionise the use of technology in the lives of the people and government of West Java. Some of its programs include the Sapawarga application for West Java residents to access a variety of public services and actively convey their aspirations; Ekosistem Data Jabar as a portal for data management and easy access; and Desa Digital which aims to realise the welfare of village communities through digitalisation, community capacity building, and maximisation of village potential.
10.	Solo City Government	Solo Technopark	An integrated area as a centre for vocational and technological innovation, technological research, applied technology research centre under the auspices of the Solo City Government. There is also a facility to empower MSMEs through an incubation program, namely the Solo Techno Incubator.
11.	Siak District Government	Siak Smart City	The smart city development program is a collaboration between the Siak District Government and Lintasarta, which targets at tourism, digitalisation, events, forest and land fire anticipation, and river waste monitoring. Although there is no specific information about empowering startups, the collaboration of all parties, especially Siak residents, is needed so that local residents can participate in developing innovations that support these initiatives.
12.	Medan City Government	Startup Big Day 2022	An opportunity for startups in Medan city to grow their businesses. This event was held to celebrate the 432nd anniversary of Medan City.

No.	Supporting Party	Program	Program Description
13.	Banyuwangi District Government	Festival Kampung Digital, Act for Sustainable Aquaculture	The Banyuwangi District Government has launched a green technology sector to be developed in the region. Through the Festival Kampung Digital, each village has the opportunity to showcase their digital technology innovations. Local technology based MSMEs are also given the same opportunity. The Act for Sustainable Aquaculture is an environmentally friendly action carried out by the district government together with private institutions and the public. The application of the technology used is biofloc (a method of fish farming which use liquid containing microbiology to break down the waste produced by the fish so that the use of water can be more efficient).

Table 3. Governments Support Programmes for Digital Industry and Green Technology in Indonesia

In addition to the issue of government programmes' sustainability to support the green technology sector in Indonesia, the socialisation and accessibility aspects of these programmes also need to be taken into account. A total of 21 out of 38 startups respondents answered that they were aware of government support in various forms that were geared towards helping their businesses survive. When asked whether the startup respondents had utilised government support, 21 respondents answered 'yes', the same number as the previous question on whether respondents were aware for government supports as illustrated in Figure 33.

Perspective of Green Technology Startup on Government Support in Indonesia
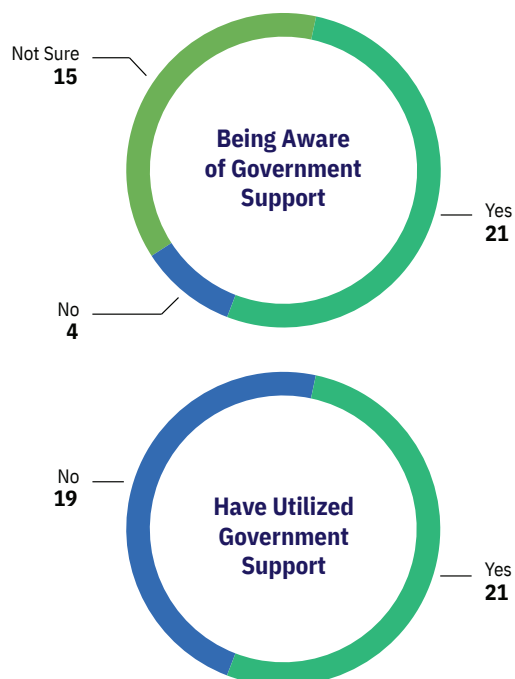
Figure 33. Green Technology Startups' Perspectives on Government Supports in Indonesia (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

Although having the same amount, when traced individually, not all startup respondents who are aware of government support have necessarily utilised that support. The possibilities are: 1) respondents who are aware about the governments' programmes for the green technology sector have not had the opportunity to take advantage of the support, or alternatively, 2) those who have taken advantage of the support from the government might be discontented with the support, thus responding that the received government support is not optimal.

Government Support Received by Startups

Green Technology Sector in Indonesia
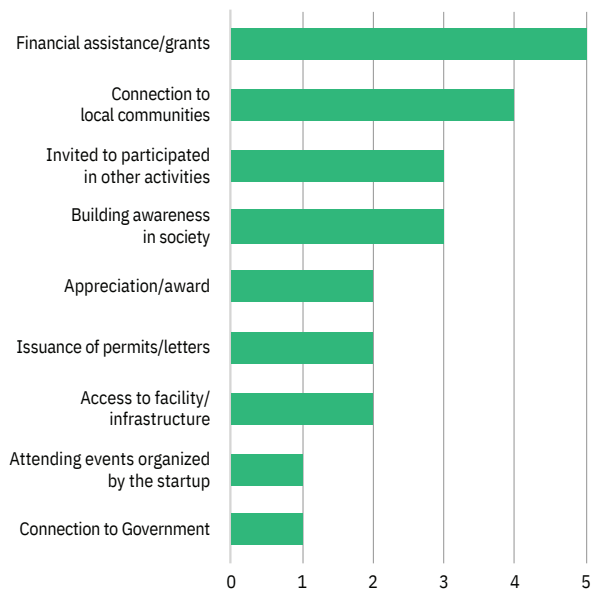
Note: Respondents are allowed to choose more than one answer.

Figure 34. Governments Supports that Have Been Received by Green Technology Startups in Indonesia (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

Figure 34 maps the forms of support that have been received by green technology startup respondents in Indonesia. The forms of support are quite diverse, but the four most common forms of support are financial assistance or grants (mentioned 5 times), connections to local communities (mentioned 4 times), invitations to attend or engage in other activities relevant to the topic (mentioned 3 times), and government assistance in dialogue and building awareness in the community (mentioned 3 times).

2.7. Challenges for Green Technology Startups

In the previous section, we looked at the forms of government supports that have been received by green technology startups in Indonesia. To find out whether the forms of support provided by the government are in line with the needs of startups, Figure 35 shows the questionnaire result regarding the challenges faced by startups. From the graph, it can be seen that the biggest challenge faced by startups is obtaining funding or financing for their business.
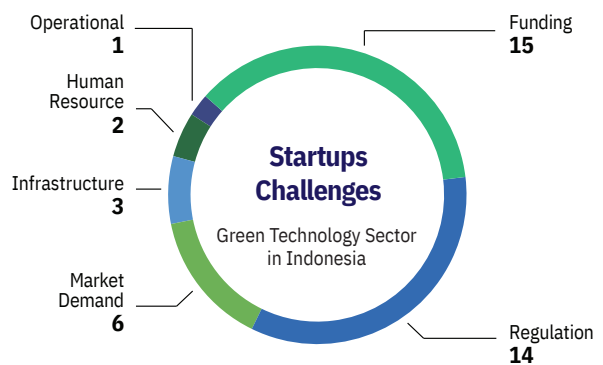
Note: Respondents are allowed to choose more than one answer.

Figure 35. Challenges for Green Technology Startups in Indonesia (Source: Questionnaire results by GIZ and Kementerian PPN/Bappenas)

Thus, the funding assistance provided by the government to startups is in line with the funding issue, which is the most challenging aspect for startups (mentioned 15 times). However, only 5 startups have received funding from the government (Figure 34), indicating that the distribution and provision of government funding needs to be further improved. The second most common challenge cited by startup respondents was navigating regulation in their sector. Startup respondents felt that regulatory support is still lacking.

Create or enlarge market demand in the sector was cited as the third most common challenge by startup respondents. Referring to Figure 34, we can see the government's assistance in educating the market, such as connecting startups with local communities and building dialogue to increase

41

public awareness. The presence of awareness in the communities may not always end in demand, for example, people have realised the importance of environmentally friendly products but do not yet have the desire to buy and use them. Considering these conditions, education and counselling with local communities and the public needs to be carried out continuously until the awareness can turn into market demand.

Although there is uniformity of opinion on the challenges faced by startups, there is a probability that the challenges faced by each startup are different. In addition, the dynamics in dealing with the public sector and the private sector are certainly different, resulting in different forms of challenges. Based on the questionnaire's results, the challenges faced by startups in dealing with the private and public sectors are summarised in Table 4 below.

Sector	Aspect	Explanation	Frequency of Mention
Public	1) Bureaucracy	Long bureaucracy in both implementation and coordination, including the licensing process	15
	2) Regulation	Regulations are changing, unclear, and not well socialised, making it difficult to understand	12
	3) Differences in interests	Public sector tends to be influenced by political considerations and the public sector's tendency to implement alone without collaborating with startups	6
	4) Openness to innovation	Lack of responsiveness to innovations and changing trends, and a tendency to work on one-off project-based items rather than development and scale up	5
	5) Communication	Little room for interaction and dialogue to find a middle ground	3
	6) Lack of Support	Still feel the lack of assistance from the government to build community awareness	2
	7) Infrastructure	Poorly developed infrastructure leads to high operational costs, such as electricity that has not yet reached all regions in Indonesia	1

Private	1)	Differences in Interests	Determination of indicators that are not in line because they are only orientated to profit	10
	2)	Lack of education	Limited understanding about the urgency to adopt green technology products	7
	3)	Competition	Competition with private entities offering the same products or services	4
	4)	Standard Difference	There is no standard for product eligibility, so to fulfil market demand, large capital is needed to adjust to the different standards of each entity	4
	5)	Openness to innovation	Willingness to adopt new and unfamiliar systems	4
	6)	Network limitations	Not finding partners or funders who share the same vision	4
	7)	Other	Business development, data security, collaboration sustainability, risk mitigation	4

Table 4. Description of Challenges Experienced by Startups (Source: Results of the Startups Questionnaire)

From the table, it can be seen there are many aspects of challenges for green technology startups when dealing with the private sector and the public sector. In addition, challenges when dealing with the public sector also have implications for dealing with challenges from the private sector. For example, the challenge of limited or no standardised regulations means that there is no uniformity of standards adopted by entities in the private sector.

In terms of regulations, the problem is not only the absence of such regulations, but also sometimes the misalignment of national and international regulations. The assumption that the green technology sector is the same as other sectors that are only profit-orientated can also be behind this absence of regulation. Not only do we need regulations to set standards on what can and cannot be done, regulations in governing the provision of incentives are also expected by startup respondents. It is the expectation of startups respondents that these incentives will attract all business units in various sectors to start considering the impact of their work on the environment and not only be profit-orientated. Another startup respondent also argued that so far, the government's programme to educate the market to create demand for the green technology sector in Indonesia

has been more encouraging. An alternative incentive scheme that is more attractive rather than encouraging could be a new form of regulatory assistance.

Chapter 3
All About ESG and Impact Investing

3. All About ESG and Impact Investing

3.1. Definition of ESG & Impact Investing

Impact investing is defined by The Global Impact Investing Network (GIIN) as "investments made with the intent to generate measurable social and environmental positive impact alongside financial returns". Impact investing has become increasingly popular in the world since the COVID-19 pandemic[1].

According to the report Investing for Impact: The Global Impact Investing Market 2020 issued by the International Finance Corporation (IFC)[2], impact investing has been gaining traction since the pandemic due to a deeper awareness of social challenges, such as unequal access to healthcare, racial and gender inequality, and the impact of the climate crisis.

The amount of assets allocated to impact investing was identified by GIIN to reach USD1.2 trillion or equivalent to IDR19,472 trillion by the end of 2021, an increase of 63% since 2019. IFC estimates that this figure is equivalent to approximately 2% of global assets under management (AUM). Although the percentage is still relatively small, this allocation is the highest in history, demonstrating the growing interest in the impact investing sector.

Referring to the definition of impact investing by GIIN, there are several terms with similar meanings circulating in the investment world, such as Environmental, Social, Governance (ESG) investing and socially responsible investing (SRI). The practice of ESG investing began to emerge in 2004, as a collective effort between the United Nations, the IFC, and the Swiss Government.

The difference between ESG investing and impact investing lies in the approach used to assess the startups to be funded. According to Capital 4 Development (C4D Partner) CEO and Co-Founder Arvind Agarwal, ESG investing refers to the process of providing funds to companies and/or institutions that already have a good track record. Slightly different from ESG investing, impact investing focuses on strategies to generate positive impact from the funds that will be invested for various social and environmental causes.[3] ESG investing takes a backward-looking approach (based on track record), while impact investing is seen as something that refers to the future (what will potentially be generated). The procedures involved in providing funding to companies are also different between ESG investing and impact investing. ESG investing only looks at existing business practices and their conformity with ESG standards, while impact investing requires the availability of data and a further checking process regarding the impact of the products and/or services that a business will produce.

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1. https://www.ifc.org/wps/wcm/connect/publications_ext_content/ifc_external_publication_site/publications_listing_page/impact-investing-market-2020, accessed June 2023

2. https://www.ifc.org/wps/wcm/connect/publications_ext_content/ifc_external_publication_site/publications_listing_page/impact-investing-market-2020, accessed June 2023

3. https://www.vccircle.com/howimpact-investing-differs-from-esg-and-why-investors-must-know-the-distinction, accessed June 2023

Practical Definition of Impact Investing
according to respondents from capital providers

Figure 36. Practical Definition of Impact Investing by Capital Provider Respondents (Source: Questionnaire Results by GIZ and Kementerian PPN/Bappenas)

Capital provider respondents of the study with funding portfolios in Indonesia have their own definition of impact investing. Some of the keywords with high frequency of mention were 'social' (mentioned 7 times), 'environmental' (mentioned 6 times), 'impact' (mentioned 5 times), 'investment' (mentioned 5 times), 'measurable' (mentioned 4 times), and 'positive' (mentioned 4 times). The method used is the same as the method of finding practical definitions of green technology in Chapter 1 earlier (word cloud graph). The word cloud graph in Figure 36 is obtained by excluding filler words such as 'and', 'or', 'with', as well as repetition of questions such as 'impact investing is'.

From this mapping, it can be concluded that the capital provider respondents define impact investing as investments that have a measurable positive environmental and social impact. Despite having the same principle, one of the capital provider respondents[4] admitted that she/he avoids the organisation represented by her/him being associated with the

term impact investor due to the misconceptions attached to the term. According to this respondent, the misconception attached to impact investors is their tendency to generate minimum returns on investment.

3.2. Classification of Capital Providers

Capital providers that invest in green technology startups are not only from Indonesia. Capital providers from overseas can still be included in this classification process as long as they have a portfolio of funding in the green technology sector in Indonesia. This criterion is still applicable even if the capital provider does not fund the green technology sector exclusively.
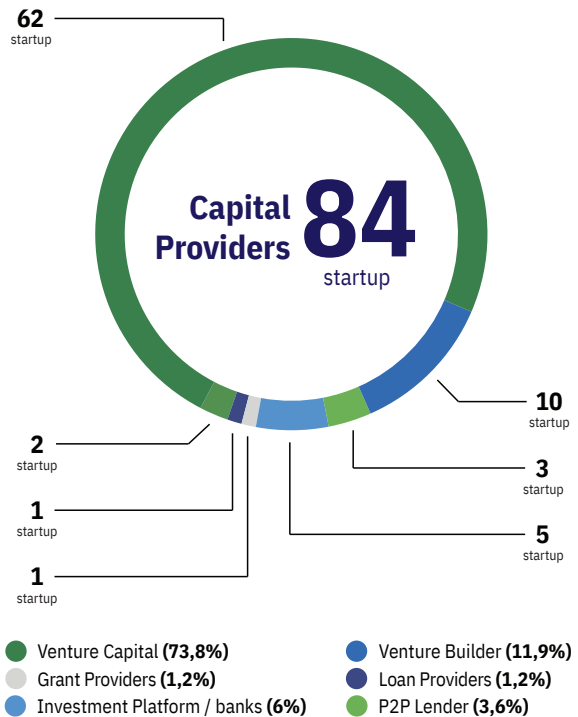

Figure 37. Classification of Capital Providers (Source: Questionnaire Results by GIZ and Kementerian PPN/Bappenas)

Based on the GIZ and Kementerian PPN/Bappenas database, the classification of capital providers that

4. Interview with a representative of capital providers, 15 May 2023

invest in the green technology sector in Indonesia is mostly in the venture capital firms classification (73.8%), followed by venture builders (11.9%), investment platforms or banks (6%), P2P lenders (3.6%), grant providers (1.2%), loan providers (1.2%), as well as intermediaries (2.3%).

In line with this composition, the capital providers that have provided the most funding to startups in the green technology sector in Indonesia are also venture capital firms, namely AC Ventures and East Ventures.

The definition of venture capital itself is a form of private capital or type of funding provided by investors to startups and small businesses, which are believed to have the potential for long-term growth. Venture capital can be provided at various stages of a startup's evolution, but generally involves seed funding.[5] On the other hand, venture builders, which are mostly run by the private sector, are a mix of interdisciplinary practitioners with a mission to develop new business concepts, release the companies and/or products and help them succeed.[6] The reason venture builders are categorised as capital providers is because of the consideration that connections, legal, and expertise can also be counted as intellectual capital utilized by startups to run their businesses, even if it is not in the form of cash.

P2P lender, according to OJK (Financial Services Authority), is defined as an information tech-based money lending and borrowing services in Indonesia rupiah currency between creditors (lenders) and debtors (loan recipients).[7]

3.3. Capital Providers Business Model

Venture capital firm, the most prevalent classification of capital providers in Indonesia's green technology landscape, is an institution that injects venture capital funds into early-stage startups, which are in many cases not yet profitable.[8] If referring to the regulatory definition, Venture Capital Business is a financing business through equity participation and/or financing for a certain period of time in order to develop the business of the partners or debtors' business.[9]

Venture capital firm can be analogous to a funnel[10] that gathers investors who want to invest, then channelling the investors' funds to companies that are deemed to have the potential to achieve profits many times over. Investment by venture capital firm is divided into several stages[11] that depend on the development of the startups at that time. In general, the investment stages are 1) pre-seed, which is for startups that are just starting their initial activities; 2) seed, which is to fund the initial steps in the startups' operations such as market research and product development; 3) series A, which is for a long-term profit strategy; 4) series B, which is to expand market reach; and 5) series C, which is to grow profits to many times over. Usually, after series C funding, the startups will start to list on the stock exchange as IPO (initial public offering), but it is not seldom either for startups to also need further funding, namely series D.

The amount of funding will generally depend on the type of funding. Advanced funding will require a larger amount compared to early funding, such as pre-seed or seed. A further explanation of the stages of startup funding is summarised in Table 5.

5. https://www.investopedia.com/terms/v/venturecapital.asp, accessed 28 June 2023

6. https://www.bcg.com/publications/2022/the-venture-builders-strategy-for-principal-investors, accessed 28 June 2023

7. *OJK Regulation No.77/POJK.01/2016*

8. https://www.bvca.co.uk/Our-Industry/Venture-Capital, accessed June 2023

9. *OJK Regulation No.35/POJK.05/2015 on Business Operation of Venture Capital Companies, Article 1 point 1.*

10. Interview with a representative of capital providers, 15 Mei 2023

11. https://www.investopedia.com/articles/personal-finance/102015/series-b-c-funding-what-it-all-means-and-how-it-works.asp, accessed June 2023

	Funding Stages				
	Pre-Seed	**Seed**	**Seri A**	**Seri B**	**Seri C+**
Criteria/stage of startups receiving funding	Business concept testing	The product already has sufficient traction, already has a foundation for products, operations, and personnel	The business has been running and it has been proven that the business idea is promising	Already profitable, has a high number of active users, financial statements have been audited by a public auditor	Have a solid track record of growth
Utilisation of fund allocation	Develop concept into minimum viable product, recruitment of critical personnel	Develop ideas, increase company valuation	Business optimisation	Increase market share, scale up business, acquire other businesses	Differentiate from competitors, accelerate user growth, increase geographic reach
Investment size	Varies	USD 10 thousand - 1 million	USD 10 - 15 million	USD 20 - 50 million	Varies
Funders	The business owner himself and/or someone close to the business owner Venture capital firm specialist pre-seed Incubator and/or Accelerator	Angel investor, Incubator and/or Accelerator	Angel investor Venture capital firm Private capital investors	Venture capital firm Private capital investors Crowdfunding	Venture capital firm Corporate investors

Table 5. Stages of Startups Funding (Source: Investopedia[12], Wallstreetmojo[13], Visible VC[14], Harper James[15])

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12.   https://www.investopedia.com/articles/personal-finance/102015/series-b-c-funding-what-it-all-means-and-how-it-works.asp, accessed 14 Juli 2023

13.   https://www.wallstreetmojo.com/funding-rounds/#:~:text=Funding%20rounds%20are%20the%20number%20of%20times%20a%20 startup%20opts,funds%20it%20needs%20for%20operations, accessed 14 Juli 2023

14.   https://visible.vc/blog/startup-funding-stages/, accessed 14 Juli 2023

15.   https://harperjames.co.uk/article/funding-stages-a-guide/, accessed 14 Juli 2023

Venture builders, also known as venture studios, have a business model that combines startup establishment with venture funding.[16] In principle, a venture builder's role is to match business ideas with those who can execute on them. These executors will act as the Founder/Co-Founder of the company, even if the original and initial idea are not coming from them. By being managed by experienced parties, the startups will be easier to grow rapidly. It is noted[17] that startups released by venture builders experience a 30% higher success rate than those that develop organically.

The P2P lender business model works by connecting borrowers who need help with lenders who want to get a return on their investment.[18] On the other hand, grant organisations are a form of non-profit funders that will disburse fund if the recipient has reached a certain point[19].

3.4. Funding for Green Technology Startups in Indonesia

In Indonesia, funding for green technology startups began in 2016, although it was still relatively small. In 2017, the amount of funding declined slightly, but later then has increased sharply (see Figure 38 and Table 6). This data is derived from tracking funding which has been achieved by green technology startups within the GIZ and Kementerian PPN/Bappenas databases but does not include funding that is not publicly disclosed. Given that not all details of funding are fully disclosed by the media or the communication channels of the funded companies, the actual amount of funding that has gone to green technology startups in Indonesia is likely to exceed the figures provided in this study. Some funding was also sourced from capital providers outside of Indonesia, so the funding figures have been adjusted to the exchange rates at the time of this research, which was IDR 14,876.95 per 1 USD and IDR 11,013.05 per 1 SGD.

Funding for Startups
Green Technology Sector in Indonesia (in billion IDR)

Figure 38. Graph of Funding for Green Technology Startups in Indonesia (Source: Questionnaire Results by GIZ and Kementerian PPN/Bappenas)

In 2016, the natural resource management sector was the first to receive funding compared to the circular economy and clean energy transition sectors. The clean energy transition sector was the last to receive funding compared to other sectors, which was in 2020.

Grouped by sectoral focus, natural resource management sector has received the highest number of funding around IDR 6.6 trillion, followed by the clean energy transition sector which received IDR 1.5 trillion, and circular economy sector with IDR 303 billion funding received.

16. https://nextbigthing.ag/blog/venture-studio-business-model-explained, accessed June 2023

17. https://nextbigthing.ag/blog/venture-studio-business-model-explained, accessed June 2023

18. https://p2pmarketdata.com/articles/p2p-lending-explained/#:~:text=Peer%2Dto%2Dpeer%20(P2P)%20lending%20works%20by%20connecting,exchange%20for%20an%20interest%20rate., accessed June 2023

19. Interview with a representative of capital providers, 30 Maret 2023

Year	Total Funding (in Billion IDR)			Total Funding per Year (in Billion IDR)
	Natural Resource Management Sector	Circular Economy Sector	Clean Energy Sector	
2016	0,298	0	0	0,298
2017	0,244	0	0	0,244
2018	0,331	0,662	0	0,993
2019	8,175	0	0	8,175
2020	3,2	45,005	50,125	98,33
2021	1.475,221	0	372	1.847,221
2022	2.973,17	258,07	811	4.042,24
2023 Q1	2.176	0	279	2.455
Total Funding per Sector	6.636,341	303,737	1.512,125	8.452,501

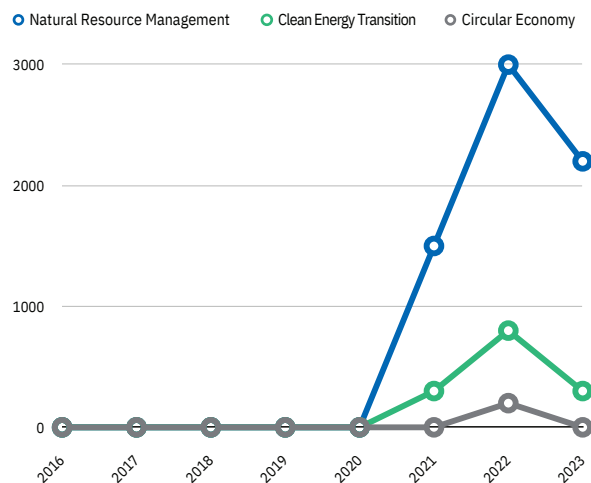*Table 6. Funding Nominal Details for Green Technology Startups in Indonesia (Source: Questionnaire Results by GIZ and Kementerian PPN/Bappenas)*

Based on the proportion of startups recorded in the database of GIZ and Kementerian PPN/Bappenas, the number of startups in the natural resource management, circular economy, and clean energy transition sectors are 50, 38, and 28, respectively. It is not surprising that the natural resource management is the sector with the highest amount of funding. This is because in terms of the number of startups, the natural resource management sector has the highest number of startups compared to the other two sectors. In addition, the amount of funding in the natural resource management sector is also higher due to the very large funding nominal of companies in this sector that have entered the scale-up stage. The clean energy transition and circular economy sectors are also interesting in terms of funding. Although the clean energy transition sector has fewer startups than the circular economy sector, the startups in clean energy transition sector has more funding than the startups in circular economy sector. This may indicate that the value of funding per investment made in clean energy transition startups on average were greater compared to the circular economy sector.

Looking at the amount of funding per year, 2022 is the year with the most achieved funding from 2016 to the first quarter of 2023, amounting to IDR 4 trillion. As can also be seen in Table 6, 2022 also contributed to almost half of the total amount of funding that has been given to green technology startups in Indonesia, totalling IDR 8.4 trillion.

Furthermore, the investor paradigm has changed after the COVID-19 pandemic to become more conservative, focusing on profitability and sustainability.[20] The natural resource management sector in general

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20. https://databoks.katadata.co.id/datapublish/2022/11/28/ini-startup-indonesia-dengan-pendanaan-terbesar-sampai-kuartal-iii-2022, accessed October 2023.

is a conservative and more crisis-resistant business. In addition, the business model in natural resource management sector tends to be easier to be understood, making it less difficult to introduce the business concept to the market. Therefore, the natural resource management sector has become a green technology sector that is favoured by investors, as can be seen from the amount of funding done in this sector (table 6), especially since the shifting of investor paradigm.

Forms of Funding for Startup Companies
Green Technology Sector in Indonesia
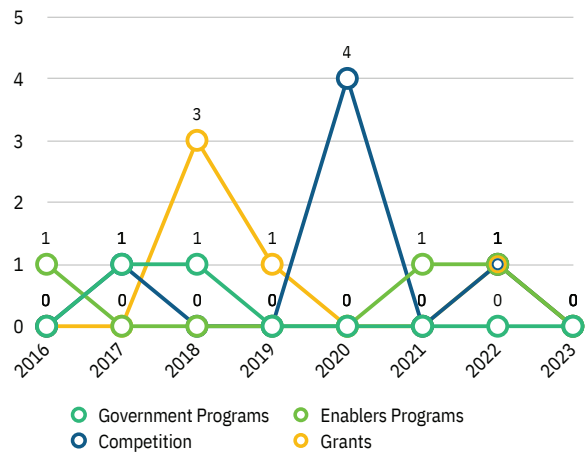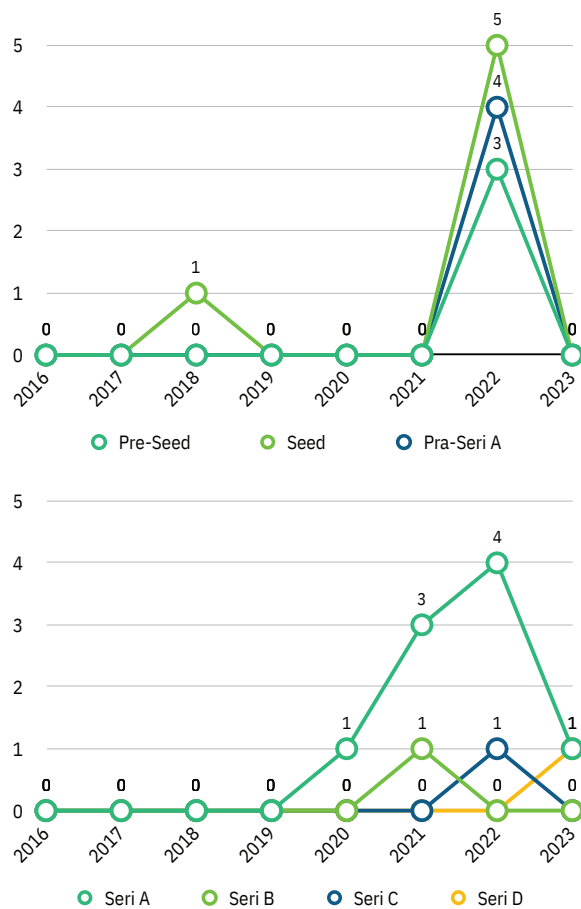
Figure 39. Funding for Green Technology Startups in Indonesia by Year (Source: Questionnaire Results by GIZ and Kementerian PPN/Bappenas)

Funding for the green technology sector had reached IDR 8.4 trillion within the period of 2016 up to the first quarter of 2023. The funding mostly contributed by series A funding (9 times). The rest are seed funding (6 times), prizes from competitions (6 times), grants (5 times), pre-series A (4 times), pre-seed (3 times), funds from enabler programs (3 times), funds from government programs (2 times), series B (1 time), series C (1 time), and series D (1 time).

Speaking of seed funding as one of the most common types of funding for green technology startups in Indonesia, there was a significant spike in 2022 for this type. In the same year, there was also a spike in funding from the pre-seed and series A categories. However, series A funding started to occur in 2020 as can be seen in Figure 39. Based on this information, 2020 can be indicated as a year where there are already green technology startups that have shown their readiness and maturity, as reflected by the series A funding awarded in that year by capital providers.

Country of Origin of the Funder
for green technology startups in Indonesia

Institutional Investment

Personal Investment

Figure 40. Funders' Country of Origin for Green Technology Startups in Indonesia (Source: Questionnaire Results by GIZ and Kementerian PPN/Bappenas)

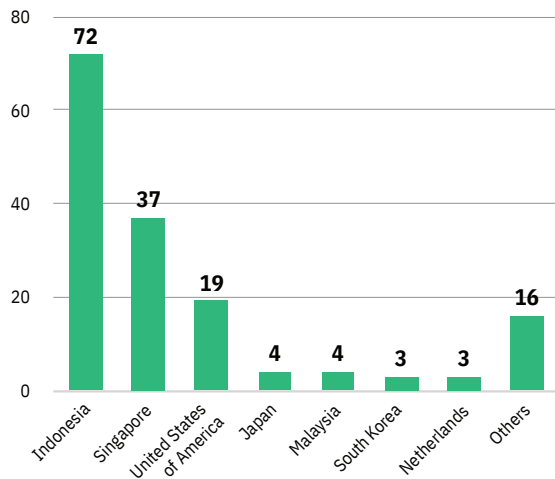Out of a total of 41 funding streams across the various categories, the largest number of funders came from Indonesia (72), followed by Singaporean organisations (37), and the United States (19). The remaining, as shown in Figure 40, 'Other' category (16) includes countries with a total funding of less than 3 times, namely the United Kingdom (2 times), France (2 times), Taiwan (2 times), India (2 times), Brazil (1 time), United Arab Emirates (1 time), Hong Kong (1 time), South Africa (1 time), Australia (1 time), Cyprus (1 time), China (1 time), and Thailand (1 time). These institutions were combination of public and private organisations

3.5. Gender Perspective in Capital Providers

A total of 33.3% of the capital provider responden-

ts (2 respondents) said that around 81% - 100% of their employees are female. The other 33.3% of capital provider respondents have a female employee's percentage around 21% - 40%. However, given the small number of capital provider respondents, there is a probability that the questionnaire results on this matter do not fully represent the gender composition of capital providers in the green technology sector in Indonesia.
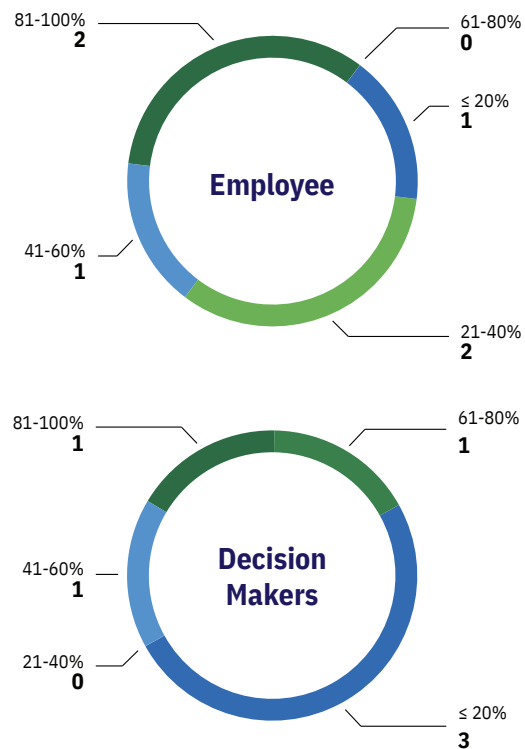
Gambar 41. Persentase Jumlah Karyawan Perempuan terhadap Total Karyawan pada Lembaga Penyedia Modal (Sumber: Hasil Kuesioner oleh GIZ dan Kementerian PPN/Bappenas)

In terms of decision makers, the number of capital provider respondents with female decision makers' percentage is less than or equal to 20% (3) is equal to the total number of respondents with female decision makers' percentages above 41% (3).

The trend is consistent across different categories of respondents, ranging from startups, enablers, and capital providers. Thus, it can be concluded that industry actors in the green technology sector in Indonesia have quite sufficient attention to gender equality in their organisations.

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Chapter 4
Conclusion and Recommendations

4. Conclusion and Recommendations

4.1. Conclusion

Green Technology

The term 'green technology' in Indonesia encompasses the use of technology as a solution in the context of sustainable development, aiming to support environmentally friendly efforts and reduce negative impacts on the environment, including optimizing utilization of natural resources. The technology is not limited to software alone but also includes hardware in various forms, innovations in systems, and processes that are used to achieve green technology goals.

Green technology is applied both upstream and downstream in business process activities. In the upstream business process, green technology is used to acquire, process, or manage resources, such as the processes of energy generation, soil processing for the cultivation of high-quality crops, or the conversion of waste into reusable products. Meanwhile, in the downstream business process, digital technology connects producers with buyers, either through product advertising, platform pages, or the utilization of databases. The ultimate goal remains the same, which is to reduce the negative impact of business activities on the environment.

From this study, three sectors of green technology have been identified, which are consist of clean energy transition, circular economy, and natural resource management.

Collaborative Efforts to Support the Development of Green Technology

The development of the green technology ecosystem in Indonesia demonstrates a collaborative culture. The government appears to be one of the most frequently engaged parties in collaboration, although regionally, collaboration with governments anywhere but Java is still relatively limited.

Collaborative efforts from various stakeholders are crucial to strengthen the green technology ecosystem in Indonesia. The study results indicate that collaboration outside the Java Island region needs to be continually improved, considering the immense potential for the development of its green technology. The potentials beyond the Java Island region include forests, coastal/mangrove areas, and peatlands, which have significant potential emission absorption. Moreover, the environmental quality of these areas is relatively better compared to Java, which is more densely populated. Therefore, the presence of green technology can help maintain or enhance the existing environmental quality in these regions.

Government Support

In the ecosystem of green technology startups in Indonesia, the government has been actively involved and has shown its support. However, there are still many other forms of support that are expected to be enhanced, such as:

• Establishing regulations that can encourage the development of the green technology ecosystem.

Furthermore, improving bureaucracy to facilitate communication and collaboration between the government and relevant stakeholders in the green technology ecosystem.

- Providing increased capacity access for local governments to collaborate more with local startup businesses.

- Offering incentives in the form of market creation and becoming buyers (consumers) for products and services from the green technology industry sector.

The contribution of local governments is crucial, especially considering that local governments are the second most abundant collaborating entities after the central government. The low level of collaboration outside the Java Island region indicates at least two things: 1) startups have limited exposure to information and access to local governments, or 2) the local governments is not yet ready to collaborate with startups.

The governments have the opportunity to strengthen their role as collaborators outside the Java region. Startups and existing facilitators can serve as references or sources of information for the development of programs and capacity-building activities.

Funding

This study indicates that funding or financing support for green tech startups is still highly anticipated. The opportunities for this kind of support should be considered due to the promising development prospects of green technology startups (which is within three years, they begin generating profits that can support operational costs). It should be emphasized that this funding support needs to be grounded in strong regulations. These regulations include the aspects of funding flow, taxation, and selective criteria for funding recipients that can encourage the sustainable growth of startups and enablers.

Impact Measurement

This study shows that the majority of respondents from green technology startups have conducted impact measurements on social, environmental, and corporate governance aspects. These operational impact measurements are already good and need to be supported as a form of corporate accountability. In the current era of collaborative governance, the involvement of non-governmental parties is crucial so that startups impact measurements can serve as input for further monitoring and evaluation. A persuasive approach (communication between the government and startups) and a regulatory approach (through regulations and incentives) are needed to stimulate the improvement of startups impact measurements and their publication. In addition to strengthening the regulatory framework, the audit aspect is essential as a form of verification for the impact measurements already conducted by startups. Moreover, this audit aspect can also become a support and facilitation process by the government, given that the verification process of these impacts generally requires additional costs.

4.2.   Recommendation

This study is not without its limitations; thus, several recommendations are provided to be further explored in the future. Additionally, the aspirations of industry actors can be incorporated into policies, both in the National Long-Term Development Plan (RPJPN / Rencana Pembangunan Jangka Panjang Nasional) and in the National Medium-Term Development Plan (RPJMN / Rencana Pembangunan Jangka Menengah Nasional).

4.2.1. Recommendations for Further Studies

In addition to identifying startups within the ecosystem, further studies could involve the identification of Civil Society Organizations (CSOs) to enrich the study's perspective. Although CSOs operate differently from startups, they also play a crucial role

in promoting messages or activities that can contribute to advancing the green technology sector.

Considering that many study respondents mentioned their interactions with the governments, the next study could also include the governments as study respondents. This is expected to map out elements related to government, such as the government's perspective and evaluations by the government. The government's evaluation can also respond to the opinions of study respondents who mentioned the lack of existing regulations to support work in the green technology sector. By participating as study respondents, the governments can address aspects related to the formation of regulations and communication processes with stakeholders in this green technology ecosystem.

In the database document, which is one of the outcomes of the mapping in this study, it would be very helpful if industry actors were also identified based on the types of consumers they serve. This is because business models for individual consumers (Business-to-Customer / B2C) and business models for other businesses (Business-to-Business / B2B) have very different characteristics and dynamics.

Furthermore, based on the practical definition of green technology arising from this study, green technology is briefly referred to as the use of technology to reduce negative impacts on the environment. Generally, there are two approaches as efforts to help reduce negative impacts on the environment: preventive efforts and adaptive efforts. In addition to identifying industry actors based on the types of consumers they serve; it would be even better if current green technology industry actors could also be identified based on the efforts they make to reduce negative impacts on the environment. With this identification, the efforts of green technology industry actors can be further analysed.

4.2.2. Recommendations for Long-Term and Medium-Term Policy Development

The main recommendations from this study that can be adapted into policies for the long term (RPJPN

/ Rencana Pembangunan Jangka Panjang Nasional) are as follow:

1. Strengthening the government's role as an enabler/facilitator for the creation of an ecosystem to continuously drive green technology growth, Including::

   a. Strengthening the government's role as a connector/facilitator between startups, enablers, and communities in various forms, such as digital platforms, communication forums, or others. This can be done centrally and locally while remaining nationally connected. This role is also intended to widen the dialogue space between the government and stakeholders in the green technology ecosystem.

   b. Strengthening the facilitator role between green technology industry actors and the private sectors to connect both sides. This facilitation is also to help addressing various issues related to the private sector, such as competition between startups and private enterprises, as well as the collaboration between the government and the private sectors, which still needs continuous improvement.

   c. The government's role in promoting the growth of green technology outside Java, including conducting further mapping. This mapping is conducted as an effort to develop green technology startups that align with regional potentials and can address development issues and challenges. This can be achieved through increased quantity and quality of collaborations with other local entities.

   d. Improving the quality of government facilitations with a stronger focus on development and scale-up.

2. Enhancement of the government's role in directly supporting the strategic development of green technology:

   a. Strengthening the regulatory framework. Regulations are expected to be more easily

understood and accommodate the rapid development of green technology. One of regulatory strengthening needs mentioned by respondents is regulation related to carbon businesses and standardization related to businesses in the green technology sector.

b. Government funding support already exists but needs improvement. With limited government funding resources, funding support can be considered to focus on strategic, incentive-based, and/or reward-oriented initiatives. Funding allocation needs to consider project cash flow and refer to project finance policies to ensure the project's cash flow remains positive. One replicable example is the Bali Regional Civil Service Agency (Badan Kepegawaian Daerah Bali), which collects funds from investors to be distributed to local startups.

c. Public and local communities' outreach need to be conducted sustainably, along with strengthening grassroots movements and communities' support. One replicable example is the establishment of the Forum Bisnis dan Investasi Inovasi Berbasis Alam (Business and Investment Forum for Nature-Based Innovation) conducted by Lingkar Temu Kabupaten Lestari together with Sigi District.

d. Capacity training for individuals can be carried out simultaneously with existing programs such as Vocational Training Centers, with curriculum adjustments to align with industry needs. Industrial stakeholders can also be invited as facilitators in these programs to build direct relationships with the communities. Furthermore, through this training, the communities can also receive positive impacts from industry actors as a form of mutual benefit for social life.

3. Improvement of governments' governance:

a. Expanding the governments' facilitation reach,

b. Enhancing the quality of bureaucracy to be more responsive, open, and adaptive to highly dynamic trend changes, and

c. Simplifying green technology development's bureaucracy.

As a more detailed follow-up, recommendations that can be implemented in the medium-term plan (RPJMN / Rencana Pembangunan Jangka Menengah Nasional) are as follow.

1. Mapping existing regulations and those that are needed to support the development of startups and enablers. Additionally, two-way communication and socialization of these regulations should be taken into account, considering the possibility to collaborate with local communities. For example, collaboration on the creation of the Pedoman Investasi Lestari (Sustainable Investment Guidelines), which has been previously issued and socialized, can serve as a basis and standardization for the development of the green technology industry sector.

2. Developing a government role scheme as a facilitator in connecting startups, enablers, and communities. The facilitation scheme can focus on developing sectors of startups that are emerging, such as clean energy, recycling, agriculture, and aquaculture. This facilitation scheme can also prioritize its focus on several potential regions. At the local government level, the development of the government's role scheme as a facilitator needs to involve:

a. Regional Secretariat (Sekretariat Daerah) to obtain general guidance and administrative arrangements as well as local government's governance,

b. Regional Development Planning Agency (Bappeda/Bappelitbangda) to obtain guidance on regional development priorities and priority sectors that need support,

c. Information and Communication Agency (Dinas Kominfo) to support in communication and information technology, as well as support for socialization,

d. Tourism and Creative Economy Agency (Dinas Pariwisata dan Ekonomi Kreatif) to support in the development of the creative economy sector,

e. Environmental Agency (Dinas Lingkungan Hidup) to support measuring the environmental impact of the built green technology,

f. Other sectoral agencies such as the Marine and Fisheries Agency (Dinas Kelautan dan Perikanan) or the Agriculture Agency (Dinas Pertanian) related to the business classification of the built green technology.

3. Development of a more focused and strategic funding support scheme, especially for potential green technology sectors, with a segmented orientation: initiation and scale-up. Preferably, funded startups should be in the early stage of establishment rather than the intermediate stage. This is to assist early-stage startups that face greater challenges in accessing funding from private investors.

4. Development of a monitoring system for funding provided by funders to startups in Indonesia and education for all stakeholders to ensure that these funds are not misused for undue financial circulation.

5. Preparation of assistance and support forms other than financial funding, such as access to laboratories/development facilities and mentors with expertise and networks in the green technology sector.

6. Creation of collaboration between the government sector and other stakeholders, such as industry actors, research institutions, the banking sector, and grassroots movements, to share knowledge, resources, and experiences in developing green technology.

7. Strengthening the role of regional cooperatives or other business units such as Village-Owned Enterprises (BUMDes) that can act as partners

for green technology startups in the region, as well as to expand their reach to the communities.

8. Provision of digital literacy training for the public and government employees as well as emphasizing the urgency of public sector support for efforts and works in the green technology sector.

9. Establishment of special portals or dedicated sections on existing portals in each region to showcase locally made products, especially those related to green technology products. For broader public access, each local government can deploy special task forces to create and manage social media accounts and/or local markets to showcase and sell locally crafted products, particularly those that meet green technology standards.

10. Guidance for government employees, especially at the local government level, to set an example for the public in supporting work in the green technology sector. Public sector workers need to understand the urgency of sustainability in the green technology industry and serve as role models for the public in adopting products and/or services provided by the green technology industry.

11. Creation of markets and demands for products and services from the green technology industry. Furthermore, the government can incorporate green technology requirements and standards as part of the procurement process for goods and services within the scope of the government.

Glossary

Glossary

—

Agriculture
One of classifications under the natural resource management sector. According to the KBBI definition (Big Dictionary of the Indonesian Language), agriculture refers to the practice of tillage, production of crops, and/or raising livestock.

Accelerator
Parties that support the acceleration of existing businesses, with support in the form of mentoring, peer review, and skill transfer for approximately three to six months, according to the United Nations Framework Convention on Climate Change in the Climate Technology Incubators and Accelerators report (2018).

Aquaculture
One of classifications under the natural resource management sector. According to the definition in KBBI (Big Dictionary of the Indonesian Language), aquaculture refers to the practice of water cultivation/marine exploitation to bring in products such as fishes, shellfishes, or seaweeds.

Angel Investor
Individual investors that could be family, friends of startup founders, or those who have no personal relationship at all with the startups they want to invest in.

Carbon Avoidance
One of the three carbon-based business subsectors that includes activities to avoid the release of carbon emissions into the atmosphere.

Carbon Reduction
One of the three carbon-based business subsec-tors that includes activities to reduce the output of carbon emissions into the atmosphere.

Carbon Removal
One of three carbon-based business subsectors that includes activities to eliminate carbon emissions that already exist in the atmosphere.

Ecosystem Builder
The type of enabler that is usually created by corporations that want to form an ecosystem of consumers and stakeholders associated with their company. Often the purpose of their formation is to expand their stakeholder network, and it is also often used as a tool to match key consumers with trusted startups in hopes of maintaining ecosystem development among companies.

Circular Economy
An alternative economic model for exchange and production activities, which separates economic growth from material dependence, according to the United Nations Environment Program.

A framework that produces systemic solutions to global challenges, such as climate change, biodiversity loss, waste problems, and pollution problems which centered into a design on eliminating waste and pollution, turning products and materials to their highest value and regenerating nature, according to The Ellen Macarthur Foundation.

A closed circular economy system approach, by maximizing the value and usefulness of raw materials, components, and products so as to reduce the amount of waste materials that are not reused and disposed of in landfills, according to Minister

of Kementerian PPN / Head of Bappenas Suharso Monoarfa in The Economic, Social, and Environmental Benefits of a Circular Economy in Indonesia (2021).

Enabler
Startup support entities that influence the startups' growth and sustainability. Enablers includes accelerators, incubators, and ecosystem builders.

Clean Energy
Systems that have the potential to reduce emissions by utilizing cleaner and renewable energy sources, require lower energy inputs, increase system efficiency by expanding useful outputs, and reduce emissions and waste by recovering energy, according to an article in the International Journal of Energy Research titled A Review on Clean Energy Solutions for Better Sustainability.

Energy sourced from natural processes, such as sunlight and wind, can be replenished at a higher rate than the rate at which it is used, according to the International Energy Agency.

Energy sourced from renewable energy that are capable of regenerating and can be used indefinitely. It is different with fossil fuels that can run out, according to the Energy Information Administration.

ESG Investing
ESG investing stands for Environmental, Social, and Governance investing which is often used as an alternative to impact investing. The difference between the two lies in their approach. ESG investing uses a backwards approach or pays attention to business practices that have been carried out and whether they are in accordance with ESG standards. On the other hand, impact investing uses a forward approach that focuses on strategies that can generate a positive impact for social and environmental along with financial benefits from the invested funds.

Grant
The provision of funds that do not need to be paid back, but usually requires a form of reciprocal liability, such as a report or something else.

Impact Investing
The definition of impact investing according to this study is an investment that has a measurable positive impact on the environment and social. Furthermore, The Global Impact Investing Network quotes impact investing as an investment made with the intention to generate positive and measurable social and environmental impacts along with financial benefits.

Incubator
Enablers who support the establishment of new startups by providing assistance in the form of co-working spaces, business models coaching, marketing services, technical services, financial support (by connecting the startup to potential investors or other sources of investment), information services, and diverse networks, according to the United Nations Framework Convention on Climate Change in the report Climate Technology Incubators and Accelerators (2018).

Circular Input
One of the five business models of the circular economy sector that refers to the use of renewable energy, biological-based materials, or recyclable materials.

Services as Product
One of the five business models of the circular economy sector, which refers to the extension of product life or efforts to improve, reprocess, improve quality, and resell products.

Sharing Model
One of the five business models of the circular economy sector that seeks to increase product use through a collaborative/joint product usage model.

P2P Lender
Lending and borrowing services in certain currency directly between creditors (lenders) and debtors (borrowers) based on information technology.

Resource Recovery

One of the five business models of the circular economy sector, which refers to business activities that reprocess waste or by-products into secondary raw materials.

Natural Resource Management

Sustainable management and utilization of natural resources, such as soil, water, air, minerals, forests, fisheries, and other wild flora and fauna, according to a journal Natural Resource Management and Biodiversity Conservation (2017)

Capital Providers

Institutions that provide capital for startups, both initial and follow-on capital. The capital is not always in the form of money but can also include intellectual capital and connections.

Startups

Startups are not only referred to companies that have just been pioneered or built, but also companies that offer products and/or services in the field of technology or at least utilize technology.

Pre-Seed Funding

The earliest stage of startups funding aimed at testing business concepts. The funds provided are allocated to develop the concept into a minimum viable product (MVP) and recruitment of important personnel. Funds are generally sourced from the business owner himself and/or the owner's closest person, venture capital firms specialist pre-seed, and enablers.

Seed Funding

Funding stages for startups that already have sufficient traction, already have a foundation for products, operations, and startups personnel. Funding allocation is generally used to develop ideas and increase startup valuations. Funds are generally sourced from angel investors and enablers.

Series A Funding

Funding stages for startups that have been running for some time and have proven promising. The allocation of funds is for optimization and usually sourced from angel investors, venture capital firms, and private capital investors.

Series B Funding

Funding stages for startups that have earned profits, have a high number of active users, and have financial statements that have been audited by public auditors. The allocation of funds can be used to increase market share and business scale or acquire other businesses. Sources of funds come from venture capital firms, angel investors, and crowdfunding.

Series C Funding

Funding stages for startups with a very mature track record of growth. Funds that generally come from venture capital firms and corporate investors are allocated to differentiate the startups from competitors, accelerate user growth, and increase geographic reach.

Clean Technology

Products, services, or processes that convey a certain value, use little or no non-renewable materials, and/or produce far less waste than conventional practices, according to Ron Pernick in his book Clean Tech Revolution.

Environmentally Sound Technologies

Technologies that protect the environment or less-pollute the environment, use all resources more sustainably, recycle waste and products, and deal with the waste in a way that is more appropriate than the technology they substitute for, and also as end-of-pipe technologies, as proposed at the United Nations Conference on Environment and Development in Rio de Janeiro, Brazil in 1992.

Green Technology

The practical definition of green technology terminology according to industry actors in Indonesia is the use of technology as a solution in the context of sustainable development (sustainability), which aims to support environmental friendly businesses and reduce negative impacts on the environment, including natural resource management. Further, some institutions have made their definition of

green technology. The Intergovernmental Panel on Climate Change (IPCC) defines it as "technologies that mitigate or adapt technologies that contribute to reducing greenhouse gases along with realizing specific development goals, such as economic development, poverty reduction, food and beverage provision, infrastructure, energy, and health" while the Oxford English Dictionary defines it as "technologies that are used to mitigate or restoring the effects of human activity on the environment."

Climate Technology

Technologies that explicitly have a focus on reducing greenhouse gas emissions or addressing the impacts of climate change, according to PwC in State of Climate Tech 2021.

Carbon-Based Business

Business models that offer services to avoid, reduce, or remove carbon emissions in the atmosphere.

Venture Capital

Type of finance company through capital and/or financing participation for a certain period of time in the context of developing partners' business or debtors.

Venture Builder

Type of capital company that combines startup es-

tablishment with corporate funding. In principle, venture builders also play a role in matching business ideas with parties who can execute the idea.

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