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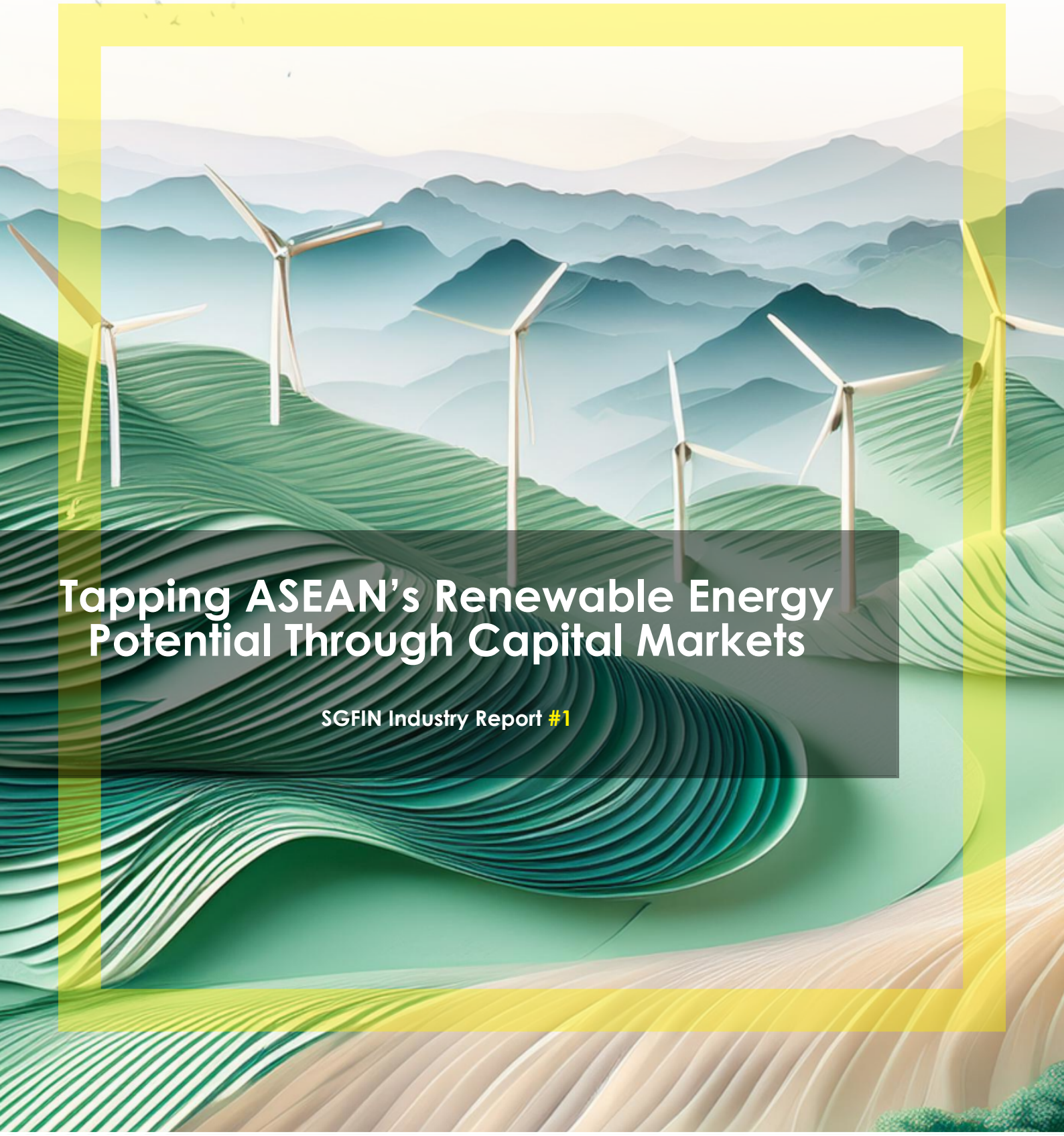

Tapping ASEAN's Renewable Energy Potential Through Capital Markets

SGFIN Industry Report #1

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The Sustainable and Green Finance Institute:

The Sustainable and Green Finance Institute (SGFIN) is a research institute established by National University of Singapore (NUS). SGFIN aims to develop deep research capabilities in sustainable and green finance with a focal point on Asia, and to provide thought leadership and shape sustainability outcomes in policymaking across the financial sector and the economy at large. Supported by exceptional domain experts across NUS, SGFIN equips businesses with critical cross-disciplinary knowledge, training, and toolkits to help integrate sustainability dynamics into their business strategies and investment decisions to better quantify the environmental and social impacts of their business developments, operations, products, and services. In essence, SGFIN seeks to help companies embed sustainability as a key pillar in their business decisions.

The ASEAN Institute of Carbon Neutrality (AICN):

The ASEAN Institute of Carbon Neutrality (AICN) is a thought-leadership institute established under the umbrella of CGS International Securities. AICN's aspiration is to motivate capital markets into mobilizing finance for climate change action in the ASEAN region. This is done through the creation and sharing of knowledge along decarbonisation themes aimed at educating and engaging the business and financial community on climate change.

Report cover image acknowledgment:

The cover image for this report was created using generative AI with Adobe Firefly with the generative AI prompt 'Double exposure part made of cut-out fabrics Pale retro art neuvou landscape low carbon energy solutions in Asia', with the suggested style being 'photo and a (stock) composition reference based on an image of a valley with a river passing through.

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Executive Summary

Singapore's geographical conditions limit its capacity for large-scale domestic renewable energy production. At the same time the technological conditions and social acceptability are not currently ripe for domestic alternative clean energy solutions like nuclear or green hydrogen. Singapore must in the near-term rapidly expand green energy imports to have any chance of meeting its 2030 and 2050 climate goals.

This report identifies and prioritizes investment opportunities in the Association of Southeast Asian Nations (ASEAN) renewable energy market that can help to address Singapore's demand for sustainable power sources, focusing on the role of capital markets. By leveraging regional resources and fostering collaboration with neighboring countries, Singapore can import the necessary green energy, making ASEAN investments a viable solution to its domestic production limitations.

There is a spectrum of political and policy environments across ASEAN, and a diversity of economic development levels, variance in the technical feasibility and deployment timelines for regional renewable energy initiatives, paired against continued exploration of an expanded pan-ASEAN energy grid. These conditions create opportunities for investors, but also a complex investment context that demands a strategy and framework which can objectively navigate this landscape in line with clearly defined principles i.e. the goal to accelerate low-carbon electricity imports into Singapore.

In this report, a comprehensive and quantitative Political, Economic, Social, Technological, Environmental, and Legal (PESTEL) analysis framework is developed and applied for this purpose. The PESTEL helps prioritise countries to invest into based on investors' principles, and in the present application ranked Malaysia, Thailand, and Vietnam as the top ASEAN countries for renewable energy investment. This establishes the target countries, upon which equity and bond screening and ranking procedures are applied to highlight opportunities to invest in companies and/or key projects that will drive forward the regional market for low-carbon electricity with a high likelihood of expanding the base of clean energy imports into Singapore.

For equity investment opportunities, a number of 'key players' are identified, which either will directly expand renewable energy supply or may (also) be undertaking projects in support of critical regional grid expansion and connectivity. With regards to bonds, out of approximately 10,000 active bonds across ASEAN, around 400 are green bonds, indicating this to be a nascent market. Despite this, there is a sufficiently broad and active green bond segment to be able to identify a range of attractive bonds/projects with high compliance to environmental standards and attractive use of proceeds.

Some attention was given to the question of how the ASEAN green bond market might be enhanced to increase bond investor confidence. Some recommendations include strengthening ASEAN Green Bond Standards with stricter criteria in relation to Environmental, Social and Governance (ESG) reporting, introducing tax benefits and grants for certification costs, improving liquidity by listing green bonds on major exchanges, and mandating detailed environmental impact reports and third-party verification to prevent greenwashing.

In conclusion, the findings in this report underscore the potential for ASEAN equity and green bond markets to support Singapore's renewable energy import needs, aligning with its climate goals and fostering regional cooperation in sustainable development.

Contents

1 Introduction and Background

Singapore has been actively considering transition pathways for it's domestic power sector, with the aspiration to reach net-zero emissions power sector by 2050 (Energy Market Authority, 2022). This aligns with a broader national agenda to achieve net-zero across the whole of the economy within the same time frame (Singapore Green Plan 2030, n.d.). To meet these objectives Singapore needs to rapidly scale up its use of low-carbon energy solutions and has made various policy revisions and announcements across 2023-2024 to support the transition. This includes a substantial increase in targets for low-carbon electricity imports Energy Market Authority (2024a) to 6 gigawatts (GW), a 50% increase over the 4GW target announced in 2021.

To appreciate how significant the energy sector transformation will be, in 2023 approximately 95% of electricity in Singapore was generated using natural gas. Stated ambitions will drastically alter the fuel mix, and by 2035 at least 30% of electricity will be from imported renewable energy sources (Economic Development Board, 2024). These are ambitious transformation targets, and will require a very different strategy towards energy investments across the Southeast Asia region.

Steps are being taken to accelerate capital flows and investments from Singapore into the region. Singapore is aiming to put into place a 'Future Energy Fund' before the end of 2024 with an initial injection of S$5billion (Energy Market Authority, 2024b). In parallel there are various initiatives being implemented by the Monetary Authority of Singapore (2022, 2023) to grow capacity for and nurture implementation of green finance, including through blended and transition finance mechanisms that can hopefully crowd additional capital into the region.

The work contained in this report offers a framework for identifying capital market investment opportunities—investments in either equities, or (green) bonds—in the ASEAN region that are aligned with low-carbon electricity imports into Singapore. It is the result of a study by a cohort of Capstone Project students (Long Wenjing, Roopa Nair, Liang Yizi, Zhou Hui)[1] in the Masters in Sustainable and Green Finance program in consultation with project partner CGS International Securities Pte. Ltd., who are an 'award-winning and market-leading integrated financial services provider, ranked among the top securities houses in Asia'.[2]

1.1 Problem Statement

Singapore faces significant challenges in expanding its domestic renewable energy production due to its limited land and geographical constraints (National Climate Change Secretariat, 2024). With a growing demand for renewable energy and constrained supply, importing green energy emerges as a strategic imperative to achieve the nation's climate objectives for 2030 and 2050. By leveraging regional resources and fostering collaboration with neighboring countries, Singapore can import the necessary green energy, making ASEAN[3] investments a viable solution to its domestic production limitations.

[1] The content and order of the report is based closely on the final version of the capstone project, supervised by SGFIN Senior Research Fellow Dr. David Broadstock. Some re-ordering of content, copy-editing and additional narrative was provided by Dr. Broadstock to translate between the format requirements for the capstone project, and this report. All additional work was done after the students final completion, and award of project grades.

[2] See https://www.cgsi.com/en/about-us for further information on the group.

[3] ASEAN refers to the Association of Southeast Asian Nations, which includes Brunei Darussalam, Cambodia, Indonesia, Laos PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. See https://asean.org/member-states/ for more information.

This report focuses on identifying and prioritizing opportunities within the ASEAN renewable energy (RE) market to meet Singapore's urgent demand for sustainable power sources. It also examined the role of capital markets in facilitating these energy imports. A critical analysis of current green bond structures within ASEAN provided insights to enhance their effectiveness in promoting renewable energy investments designed to support Singapore's energy import needs.

1.2 Scope of Study

The report explores alternative investment strategies, with a focus on enhancing Singapore's access to imported green energy from the ASEAN region, while emphasizing the role of capital markets. It included a comprehensive evaluation of the political and policy environments across ASEAN, set timelines for renewable energy supplies, and examined how these are aligned with Singapore's climate goals. The scope also involved assessing the technical feasibility of regional renewable energy initiatives. The analysis identifies public companies in key markets with existing or emerging renewable energy portfolios and conducted a thorough review of the current green bond structures in the region.

The study was carried out following a systematic approach aimed at addressing the following objectives:

1. **Political & Policy Landscape Analysis:** Gauge the political environment and policy frameworks within ASEAN to outline renewable energy supply timelines impacting upon Singapore's climate plans.
2. **Technical Feasibility & Market Risks Analysis:** Review the practicality of policies and projects, to understand the risks of delivery and feasibility of RE marketplace in a unified ASEAN grid.
3. **Identify Key Players:** Identify and rank listed companies in Singapore, and core regional markets across ASEAN, with a renewable energy portfolio or ambition.
4. **Assess Green Bond Structures:** Review existing ASEAN frameworks to determine their efficacy in supporting RE investments and Singapore's energy imports, and identify and rank bond investment opportunities currently available.
5. **Recommendations to Improve the Green Bond Structure:** Reflect upon market attributes, and frameworks, and how they might be revised to increase green bond investor confidence in the region.

The above problem statement and study objectives highlight the importance of defining a principles-based investment framework that incorporates focus on both equity investment opportunities (listed companies), as well as bonds. We are mindful that there are also other investment opportunities, including private or unlisted companies, but these were deemed out of scope to keep the analysis manageable within the study timeframe. With these objectives in mind, it is helpful to briefly introduce some additional background relating to energy transition and equity markets, and the ASEAN market for green bonds.

1.3 Energy Transition and the Equity Market

In response to the Paris Agreement and to contribute to global mitigation efforts, ASEAN countries are striving to meet their ambitious renewable energy (RE) transition and net-zero targets. Dziawgo (2021) highlights the pivotal role of the capital market in financing the transition to sustainable energy, emphasizing the need for enhanced promotion of corporate

social responsibility (CSR) concepts and reduced political risk among other things. Practical implications suggest broader use of capital markets and cost control of renewable energy sources (RES) for societal benefit. Dziawgo (2021) considers both investor and consumer attitudes, underscoring their influence on the sustainable transformation of the energy sector. Song et al. (2019) highlights how the fossil-fuel based portion of the energy market, especially crude oil, historically shares a close (financial) relationship with renewable energy stocks, with returns and volatility spillovers between the two areas of energy being particularly significant in some cases. These findings illuminate how navigating the transition through strategies that might divest from fossil energy and/or expand renewable energy portfolios needs to be done carefully. Therefore, one of our main objectives is to introduce a framework for investing in key ASEAN equity market players (listed companies) with existing RE portfolios or ambitions, which could support energy transition through both capital provision and technical expertise and facilitate achieving net-zero targets across ASEAN by their market influence.

To better appreciate the energy sector investment environment in ASEAN countries, internal and external context analyses are required. PESTEL analyses—which review political, economic, social, technological, environmental and legal/regulatory conditions—are extensively used tools to analyze market context in a holistic manner. For example, Segura et al. (2018) use PESTEL analysis to inform strategies for helping identify risks in the marine/tidal energy sector in the European Union. Song et al. (2017) have also used a PESTEL model to evaluate the feasibility, opportunities and barriers to developing the waste-to-energy incineration industry in China. Tsangas et al. (2019) used a combination of quantified PESTEL and SWOT models (strengths, weaknesses, opportunities and threats) to analyze sustainability potential in the hydrocarbon sector in Cyprus. Building on these types of frameworks we develop a quantitative PESTEL framework specifically tailored to the ASEAN context, to quantify the policy feasibility, legal risks, technological capabilities etc., which could satisfy study objectives 1 and 2, while guiding RE investments considered under objective 3.

1.4 Green Bond Markets and Frameworks in ASEAN

In recent years, green bonds have emerged as a promising financial instrument to address environmental challenges. While some studies highlight obstacles hindering the green bond market, others emphasize the significance of government support and innovative financial systems in promoting renewable energy development. Green bonds can be effective in promoting green energy projects that can significantly reduce CO2 emissions (Rasoulinezhad and Taghizadeh-Hesary, 2022). However, there remain shortcomings in the development of the green bond market. Jain et al. (2022) analyzed six economically diverse Asian countries and found that a broad lack of formal institutional support, underdeveloped domestic bond economy, early stages of capital bond market development with limited private participation, and an absence of international certification impede green bond market development in the region. Deepening capital markets will attract both domestic and international investors, aligning with the global commitment to address climate change.

Some researchers offer guidance on steps that can be taken to improve green bond market structures and increase issuances. Azhgaliyeva and Kapsalyamova (2021) suggest that green bond grants, and tax incentives, as well as cooperation and policy signals, are effective in promoting the issuance of green bonds in the private sector in Asia. Global cooperation and international standardization have positive impacts on green bond issuance as well. Furthermore, developing a digital green bond market that leverages blockchains, social networks, big data analytics, and Artificial Intelligence (AI) establishing a Green Bond Issuance Network (GBIN), implementing an international carbon tax policy, and planning to achieve green economic recovery through green bond market development will be effective tools to promote renewable energy development (Wang and Taghizadeh-Hesary, 2023).

Since the introduction of the ASEAN Green Bond Standards in 2017 and their update in 2018 (ASEAN Capital Markets Forum, 2018a), the ASEAN Sustainability Bond Standards (ASEAN Capital Markets Forum, 2018b), and the ASEAN Taxonomy for Sustainable Finance now in its third version (ASEAN Capital Markets Forum, 2024), ASEAN nations have been intensifying efforts to develop the ASEAN green bond market. With initiatives tailored to align with international standards and meet regional sustainability objectives, each country contributes uniquely to the region's green finance landscape. These policies not only improve the disclosure transparency of green bond insurance but also emphasize the integration of sustainability into financial frameworks, creating favorable conditions for sustainability focused investments. The following literature review delves into the role of finance-related policy in shaping each ASEAN member country's green bond market.

Malaysia's green finance landscape was initially shaped by the Sustainable and Responsible Investment (SRI) Sukuk Framework (Securities Commission of Malaysia, 2014), introduced to encourage financing of sustainability projects. The Malaysian government supports the issuance of green Islamic bonds, promoting the issuance of Shariah-compliant green bonds. To encourage more green bond issuances, Malaysia offers tax deductions on the issuance costs of SRI Sukuk. Malaysia actively promotes green growth through the Joint Committee on Climate Change (Bank Negara Malaysia, 2019) and the Green SRI Sukuk Grant Scheme (Securities Commission of Malaysia, 2021), demonstrating a comprehensive and collaborative approach to encourage more companies to finance green projects.

Singapore demonstrates a strong commitment to green finance with its Green Finance Action Plan 2030 (Monetary Authority of Singapore, 2022), falling under the Significant Infrastructure Government Loan Act (2021). The Singapore Green Bond Framework (2022), adhering to ASEAN Green Bond Standards, also supports substantial infrastructure projects like renewable energy and green transportation (Ministry Of Finance, Singapore, 2024). These initiatives boost market liquidity and set a benchmark for the corporate sector. Furthermore, green bond grant schemes from the Monetary Authority of Singapore (MAS) aim to catalyze the growth of Singapore's green bond market by covering up to the entire cost of external reviews, limited to a maximum of SGD 100,000. This grant scheme aims to reduce the cost burden on issuers, making it more feasible for companies to enter the green bond market (Ministry Of Finance, Singapore, 2024).

Indonesia has taken a proactive stance with its implementation of the Phase I Sustainable Finance Roadmap (Indonesian Financial Services Authority, 2015) updated every 5 years, the issuance of green Sukuks, and Indonesia Green Taxonomy 1.0 (Indonesian Financial Services Authority, 2022). These measures are bolstered by the Financial Services Authority's regulations, showcasing a successful integration of Islamic finance with green finance initiatives. Thailand has also made significant strides in developing it's sustainable finance ecosystem, through the Kingdom of Thailand Sustainable Financing Framework (Public Debt Management Office of Thailand, 2020) detailing how the Kingdom is aligning with the Paris Agreement and achieving targets for the UN Sustainable Development Goals (SDG's) by 2030. Participation in the market, and the projects being funded by green bonds, has been encouraged from state enterprises like the Electricity Generating Authority of Thailand (EGAT) i.e. as offtakers for renewable energy.

Other ASEAN nations like Vietnam, Lao PDR, Cambodia, and Brunei are in the earlier stages of green bond market development. Vietnam's policy framework supports green bond issuances as part of its broader Green Growth Strategy, while Lao PDR and Cambodia are laying foundational policies to stimulate green finance growth. Brunei's efforts focus on diversifying its economy with new initiatives for sustainable development, including green finance.

The ASEAN green bond market exhibits a growing trend underscored by loose monetary policy and an increasing issuance volume (S&P Global, 2024). The market's evolution can be traced from the birth of the World Bank's first green bond in 2008, to the rapid growth influenced by the Paris Agreement in 2015, and to the continuous expansion with more sovereign issuers and the establishment of regional standards in subsequent years (Climate Bonds Initiative, 2024). As the market matures, with record issuance volumes reported in recent years, Singapore remains a notable leader, but other ASEAN countries are also witnessing increased activity (Climate Bonds Initiative, 2023).

In assessing the use of proceeds from green bonds, it is noted that sectors such as renewable energy, energy efficiency, and clean transportation are among the most prominent options for green bond investments across ASEAN, reflecting the region's commitment to sustainable development and the fight against climate change (Asian Development Bank, 2022). However, the market is also challenged by the need for more robust frameworks to prevent greenwashing and to support sustainable recovery post-COVID-19.

To assess the adequacy of existing green bond structures, institutions like the Climate Bonds Initiative (CBI) and the International Capital Market Association (ICMA) provide benchmark assessments used in evaluating green bonds' market growth, geographical and sectoral distribution, and impact analysis. These assessments also involve reviewing issuer profiles, which range from governments to corporations and financial institutions, and standards and certification, which ensure adherence to recognized principles.

While conventional bonds and green bonds share similar characteristics in terms of structure, risk and returns profile, credit profile, pricing method, and liquidity (Bos, 2023), green bonds have unique features. Green bonds aim to contribute to projects with environmental benefits and most issuers conduct independent reviews of green bond investment frameworks (Bos, 2023). Despite their potential, green bonds also raise new concerns, such as the greenwashing problem (Bos, 2023), lower standardization in their offering, higher reporting requirements, and transaction costs. The exclusion of issuers that do not have large capital expenditure requirements for green investments limits the application of green bonds (Better Buildings, U.S. Department of Energy, 2024).

1.5 Structure of the Report

The remainder of the report is structured as follows: Section (2) sets out the broad nature of the approach/framework used to identify low carbon electricity related investments; Section (3) outlines the PESTEL methodology and its application, identifying the ASEAN countries that rank highest on the basis of the criteria applied; Section (4) presents and applied the equity screening and ranking procedure, and the sorts of companies that emerge as 'preferred' on the basis of the selection criteria applied; Section (5) similarly evaluates the bond markets, presenting additional detail on the bond screening and ranking procedure before identifying the specific bonds that emerge as 'preferred' on the basis of the applied selection criteria; Section (6) provides a closing summary of the lessons learned, including brief reference to some potential policy implications particularly with regards to the regional market for green bonds.

2 Approach to Analysis

This section provides a brief outline of the key analysis steps taken in this study. A three-phased methodology is applied to identify low-carbon electricity investment opportunities within the ASEAN region:

- Macro conditions including political, economic, social, technological, environmental and legal (policy) issues are integrated into a quantified/objective PESTEL framework to prioritize countries to invest into;
- Equity investment opportunities—within priority countries—are screened and ranked on the basis of investment principles to prioritize renewable energy/grid infrastructure focused companies, with good performance across identified company fundamentals and financial metrics;
- Bond investment opportunities—again within priority countries—are also screened and ranked on the basis of investment principles and bond-specific attributes. An additional step here was to conduct an objective and reasoned assessment of the overall adequacy of green bond markets in the region, intended to ensure that bond investments are minimally aligned with robust sustainability criteria.

Given the differences in equity and bond investments, there are differences in approach to identifying key players/opportunities in each of these. We stress that the use of the term 'key players' is to be applied very carefully and with full cognition that this is a research study, and not an investment recommendation of any sorts. The usual disclaimer applies.[4]

2.1 PESTEL Approach

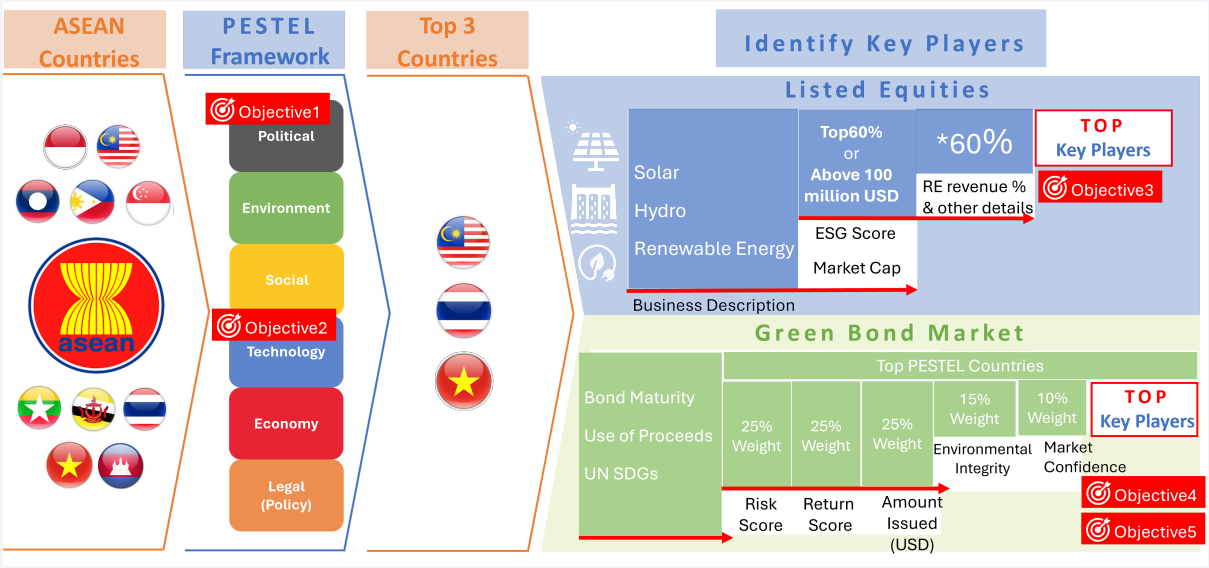
The PESTEL approach analyzed nine ASEAN countries, excluding Singapore, to evaluate factors influencing renewable energy adoption and export potential. This covered political, economic, social, technological, environmental, and legal (policy) aspects, aligning with Objectives 1 and 2 of the study. A visual depiction of the PESTEL framework and it's role within the overall methodology used in this study is given in Figure (1), which also highlights where the five study objectives are addressed within the framework.

Objectives 1 and 2 are integrated within the PESTEL framework, where explicit and objective consideration is given to the political and policy landscape, and effectiveness of applied policy frameworks and future policy plans, as well as taking a holistic view over technological opportunities and barriers.

In applying the PESTEL framework, the approach taken was to implement a proof-of-concept that the framework can be made quantitative, to limit the burden of subjectivity needed by an analyst to give an initial preference over target countries. The quantitative and customisable approach to PESTEL analysis subsequently allows for holistic ranking of ASEAN countries along a variety of objectively defined and relevant criteria. Weights on each pillar can be tailored to reflect the investors' principles and risk-appetite e.g. lowering the weight on political conditions if the investor is willing to accept increased exposure to political risk.

[4] For the avoidance of doubt: The opinions expressed in this publication are the responsibilities of the authors and do not necessarily represent or reflect the position of SGFIN. The National University of Singapore, nor the authors, shall not be responsible or accept any liability to any person for any loss, damage, costs or expenses howsoever arising, whether directly or indirectly, whether in contract, tort or otherwise from any action or decision taken or not taken, as a result of any person relying on or otherwise using this document or arising from any error or omission contained in this document.

Figure 1:
Conceptual Outline of Investment Strategy.



Source: This figure was generated by the authors.

Implementing the quantitative PESTEL framework requires access to a suite of indicators relating to the six core pillars. The required indicators will vary in their nature and scale of measurement, for example some will be continuous such as key economic benchmarks like gross domestic product (GDP). Others may have considerably less variation, such as measures describing the existence of types of policy such as emissions pricing, or other attributes that cannot be measured in continuous form.

To aid comparability among indicators, we employed a normalization method for scoring. Specifically the data are typically normalized to obtain transformed indicators that lie on a scale of 0 to 10, before analyzing, aggregating and ranking variables under individual pillars.[5] In some cases numbers will be positive when larger e.g. GDP, and in other cases negative e.g. mortality rates attributed to air pollution. For the latter, and similar variables with negative implications, the normalised score is inverted (by subtracting it from ten) so that higher numbers remain consisted with good, or best among the 'class', outcomes.

To help increase confidence and accuracy in the PESTEL pillar scores, each pillar is defined using several sub-indicators where feasible. Moving between the sub-indicators and the overall pillar score can be done in different ways. Here we apply a weighted aggregation scheme. Within pillars a simple weighting scheme is adopted, where each sub-indicator is weighted by 1, giving it equal contribution to the pillar scoring. More differentiated weighting is applied across pillars, discussed in further detail later in the report, in which different pillars are given different weights to reflect investor preferences and principles.

[5]**Normalization Method:** For indicators with a positive impact i.e. positively correlated with the likelihood of investing into low-carbon energy solutions, the normalized score is calculated as:

$$\tilde{X} = 10 \times \left(\frac{(X - X_{min})}{(X_{max} - X_{min})} \right) \quad (1)$$

where $\tilde{X}$ represents the normalized value of a given variable X.

Some series cannot be immediately normalized along a continuous scale, such as qualitative data. In such cases the variable outcomes are converted into a discrete/dummy form. For example, within the Policy pillar, there are multiple policy areas evaluated. To assign some ordinality to the policy context, the following indicative scoring principle is applied across different policy areas:

- If a country has already established policy elements relating to the area in question, then give a score of 10;
- If a country has openly communicated plans to establish in the future, give a score of 5;
- If a country has not announced, for example, to establish related policy, give a score of 0.

The above is indicative, and in practice is customised to the concept/variable in question. For example, with reference to carbon pricing, a fourth category is introduced relating to the policy development phase, which is particularly salient in the context of carbon pricing within the ASEAN region where some procrastination from announced intentions to practical implementation have been observed.

It is not taken as an objective of this study to establish the above scoring approaches as being 'right' per se, so much as it is to verify the framework as being both plausible and useful towards its objectives and with the flexibility to be adapted to differing conditions.

2.2 Identifying Key Players

Study objective 3 concerns the identification of key listed equities in the region, which is reflected in the top right part of Figure (1). The attributes used for identifying 'key players' or interesting investment opportunities, will ensure that: the target companies have a clear and measurable renewable energy (RE) focus; that target companies are sufficiently large to be of interest to an institutional investor; that overall quality governance is evidenced by good ESG performance/scores (which by virtue of the dependence on ESG rater's scoring automatically ensures external monitoring and review of ESG performance); and that companies have good performance along a selection of financial performance metrics.

In practical implementation, RE focus is determined by conducting text screens on Business Descriptions contained within LSEG/Refinitiv Workspace. The applied search terms included words such as 'renewable', 'hydro' and 'solar' for example, allowing to quickly narrow focus on a small set of firms that take these renewable technologies as being so pivotal to their business operations to warrant inclusion in their business descriptions.

2.3 Green Bond Market Opportunities

Study objectives 4 and 5 relate to understanding the existing green bond market landscape, evaluating if it is fit for purpose in identifying bond opportunities with legitimate positive environmental impacts (clean energy opportunities in the case of this report), and what could be considered to enhance frameworks to grow investor confidence.

The existing green bond standards (global and regional) were examined to help inform and develop an overview of the green bond market structures in the ASEAN in support of study Objective 4. Table (1) presents a brief outline of the existing green bond standards along several different criteria including: Alignment with Other Standards; Scope of Application; Eligibility Criteria; Use of Proceeds; Issuer Requirements; Regulatory Approach; Reporting Requirements; Verification; Environmental Objectives.

Table 1:
Summary of Existing Green Bond Standards Relevant to the ASEAN Bond Market.

Criteria	EU Green Bond Standard	Climate Bonds Standard (CBI)	ICMA Green Bond Principles	ASEAN Green Bond Standards
Alignment with Other Standards	Developed independently; Aims to set a **global benchmark**, influencing other standards.	"Developed **based on ICMA GBP**; Aligned with global environmental objectives."	**Basis for many standards**, influencing global practices in sustainable Finance	Aligned with ICMA, **reflects regional priorities**.
Scope of Application	**Applicable within EU**, influence other national and regional standards.	**Global application**, providing a **rigorous framework** for GB issuance.	**Global scope** with flexible guidelines.	**Tailored for ASEAN member countries**.
Eligibility Criteria	Projects must meet **EU environmental objectives** and technical screening.	Projects must meet **science-based criteria** by Climate Bonds Initiative.	Projects identified based on **expected benefits**.	Projects should align with **ASEAN environmental priorities**.
Use of Proceeds	Projects aligned with **EU taxonomy** for sustainable activities.	Projects aligned with **Climate Bonds Taxonomy** for carbon reduction.	Projects must provide clear **environmental benefits**.	Projects must be **environmentally beneficial** in ASEAN.
Issuer Requirements	Issuers must align with **EU taxonomy**, ensure transparency.	Issuers must meet **stringent criteria and verification**.	Issuers expected to **follow best practices with flexibility**.	Issuers encouraged to **align with ASEAN and ICMA**.
Regulatory Approach	**Voluntary with strict requirements and EU regulatory** oversight.	**Voluntary with stringent criteria** and verification.	**Voluntary guidelines** with **flexible application**.	**Voluntary, aligned with ICMA for compatibility**.
Reporting Requirements	**Mandatory detailed reporting** on fund usage and impacts.	Detailed **pre-issuance and annual reporting** required.	**Annual reporting recommended** but less prescriptive.	**Periodic reporting** on proceeds and impacts **required**.
Verification	**Mandatory external review** by approved verifiers.	**Mandatory verification** by Climate Bonds Standard verifiers.	**External review recommended** but not mandatory.	**External review recommended** but not mandatory.
Environmental Objectives	**Climate change mitigation and adaptation**, circular economy, biodiversity protection etc.	Focus on **climate change mitigation and adaptation** projects, including **renewable energy** and sustainable transport etc	Broad categories such as **climate change mitigation**, natural resource conservation etc.	Focus on **regional environmental challenges** such as **energy transition** , climate resilience etc

Source: The table was generated by the authors using information obtained from various sources.

The summary information in Table (1) provides positive and less-positive signals to green bond investors looking to invest into the ASEAN region. On the positive side, there is clearly evidence that regional standards have been set in place. These standards help ensure market boundaries and provide investors with confidence in their investment actions. However, on the less-positive side of things the ASEAN standards clearly display a lower set of bond requirements when compared for example against the EU Green Bond Standard. This is perhaps not a surprise given that the green bond market emanated from Europe, and that ASEAN development (and in turn bond) needs differ. Nonetheless, from the perspective of an international investors it highlights the need to apply additional care and diligence in screening for appropriate bond investment opportunities.

The 'adequacy' of the existing green bond market was assessed using a range of indicators designed to contrast green bonds (i) against their intended objectives and (ii) against their non-green counterparts, details of these metrics and their use are given in Section (5). As a preview to results expanded upon later, the green bond market is deemed adequate for investing into, but the assessment of adequacy provides some insights on steps that can be taken which would further increase investor confidence in this area.

To screen and prioritize the investment opportunities, the universe of active ASEAN green bonds (399 in total at the time of the study) were put through the following filtering process to screen-in 'principles-aligned' bond investment opportunities:

- **Step 1 - Maturity filter:** Select green bonds with maturity > 5 years (specifically with a maturity date on or after 01/08/2029) to ensure that only long-term investments are considered;
- **Step 2 - Use of proceeds:** Select green bonds that are related to renewable energy sector investments. This step ensures that the selected bonds directly contribute to sustainable/renewable energy projects;
- **Step 3 - Alignment with UN Sustainable Development Goals (SDGs):** Bonds aligned with UN SDG Goal 7 (Affordable and Clean Energy) and Goal 11 (Sustainable Cities and Communities) were retained;
- **Step 4 - Bond originated from top ranked countries from PESTEL analysis:** Only bonds issued among the top PESTEL ranked countries (plus Singapore which was not ranked in the PESTEL analysis) are considered, this identified a number of bonds from Singapore, Malaysia and Thailand. Bonds from these countries were prioritized due to their active green bond market and favorable political, economic, social, technological, environmental and legal environments;
- **Step 5 - Issuance volume:** Select green bonds with issuance volume more than 10 million USD;
- **Step 6 - Investment opportunities (scoring system):** A scoring system was developed to assess the investment opportunities and to identify the key players in the green bond market. The scoring system was subsequently to rank the opportunities that survived the previous five screening steps.

Applying this screening approach, we obtain a total of 221 'eligible' bonds, of which 71 are deemed of sufficient issuance size at the end of steps 4 & 5 respectively. Additional detail on, and results from, the procedure to rank and prioritise these opportunities (using step 6) are provided in Section (5).

3 Identifying Target Countries: PESTEL Model Results

In this section we present the PESTEL analysis applied to the ASEAN country members. Singapore is not included within the analysis itself owing to the purpose of the analysis i.e. to mobilise capital into equities or bonds that will accelerate the supply of low carbon electricity from other countries into Singapore. The PESTEL framework integrates considerations surrounding political, economic, social, technological, environmental and legal (policy/regulatory) matters.

- PESTEL analyses are traditionally qualitative in nature, however to be both reproducible and updatable, the decision was taken to develop a quantitative PESTEL;
- The framework makes use of open-source data points on multiple elements under each pillar of the PESTEL framework;
- A custom scoring and weighting system for individual variables, and across pillars is devised and applied, which can be tailored to align with different investment principles.

The underlying information for the PESTEL analysis is too comprehensive to unpack in its full detail. Instead this section provides a brief overview of the main indicators used to inform each of the six PESTEL pillars with a brief narrative for each.

3.1 Political Pillar

Geopolitical conditions within the ASEAN region are important and can sway major decisions and regional coordination in development of energy markets and infrastructure.

The pillar score is comprised of information on the overall nature of governance within a country under the national governance indicators category, and complemented with additional information on foreign relations and trade, and also each nations engagement with international environmental commitments through their nationally determined contributions (NDCs) and declared decarbonisation ambitions. Data sources are from the Climate Action Tracker (2024), Qiu et al. (2024) and the World Bank Open Data (2024).

Detailed indicators and scores under these three dimensions are listed in Table (2). Note that from the numbers in this table, it can be seen where custom scoring principles are applied. For example under the NDC's rating the reported scores are an aggregation of additional sub-indicators, hence the score not being limited within a zero to ten range. Similarly for the national governance indicators, the decision was made to retain the original scoring system from the data source (World Bank Open Data, 2024). This decision was partly to help balance the relative scoring across the sub-dimensions as they contribute to the overall pillar score.

Indonesia, Philippines, and Vietnam are the top three scoring countries under the political pillar. Myanmar ranks relatively well under the scoring system, but primarily due to the relative importance of fuel imports to the economy. Lao PDR is the lowest performing country, while Malaysia and Indonesia are middle ranked countries.

3.1.1 Political Pillar Additional Scoring Details

NDC ratings: The Climate Action Tracker (2024) provides 5 rating categories for a country's existing NDCs. To quantify an NDC with a "1.5°C COMPATIBLE" pathway, we give a score of 5; for ratings under the "ALMOST SUFFICIENT" category we give a score of 4; for ratings under the "INSUFFICIENT" category we give a score of 3; for ratings under the "HIGHLY INSUFFICIENT" catagory we give a score of 2; for the category "CRITICALLY INSUFFICIENT" we give a score of 1. Countries with no ratings provided are assigned a score of 0.

Future Ambitions: Qiu et al. (2024) listed the ambition enhancements within each country in 4 categories, namely "Strengthen economy-wide commitment", "Expand Coverage of commitment", "Strengthen sector-level commitment" and "Strengthen or add policies and actions". By adding up the number of ambition enhancements in each country, we normalized the sums, ranked them and gave them scores from 0 to 8. The higher the sum, the higher the score.

Table 2:
Scoring Results Under the Political Pillar of the PESTEL Framework.

Indicator	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Thailand	VietNam
National commitments									
NDCs rating	0.0	3.0	0.0	0.0	0.0	0.0	11.0	5.0	3.0
Future ambitions	3.6	0.3	10.0	3.3	4.2	7.7	1.4	0.0	2.8
Foreign relations									
Fuel imports	5.0	7.0	1.0	0.0	2.0	8.0	3.0	6.0	4.0
Trade balance	2.0	8.0	6.0	0.0	4.0	1.0	3.0	5.0	7.0
Trade complementarity index (TCI)	3.0	0.0	0.0	0.0	2.0	0.0	1.0	0.0	0.0
National governance indicators									
Voice and accountability	0.8	1.6	0.5	0.3	0.2	1.3	1.2	1.0	0.7
Political stability and absence of violence	1.5	0.5	0.8	1.3	0.2	1.2	0.3	0.7	1.0
Government effectiveness	1.5	1.2	0.5	0.3	0.2	1.3	0.7	0.8	1.0
Regulatory quality	1.5	1.2	0.5	0.3	0.2	1.3	0.8	1.0	0.7
Rule of law	1.5	0.8	0.3	0.5	0.2	1.3	0.7	1.2	1.0
Control of corruption	1.5	1.0	0.2	0.5	0.3	1.3	0.7	0.8	1.2
Total score	**21.9**	**24.4**	**19.8**	**6.7**	**13.3**	**18.5**	**23.7**	**21.5**	**22.3**

Source: The table was generated by the authors using a custom scoring system applied to a range of metrics and indicators sources from different databases listed in the main text and references.

3.2 Economic Pillar

The economic pillar provides an overall description of the strength of economies in the ASEAN region, which is important as stronger economies have greater flexibility to pursue ambitious development strategies, and weaker economies are more constrained.

Detailed indicators are given in Table (3), based mainly on data from The World Bank Open Data (2024). Indicators cover general economic growth/performance, and given the focus of the study include categories reflecting the role and importance of energy in the economy, as well as measures relating to the uptake of green bonds as a financing mechanism.

Thailand, Malaysia, and Laos ranked highest in economic criteria. The strong scoring from Laos reflects the high scores in relation to the role of energy in the economy, and in particular the share of fuel within total imports for the nation. We note that this results from 0% share of fuel

in total imports, and the use of an inverted score normalisation, hence it taking the maximum score of ten. The lowest ranked countries include Brunei, Indonesia and Myanmar, driven by factors including low GDP per capita for Myanmar, and poor unemployment records in Brunei and Indonesia among other things.

Table 3:
Scoring Results Under the Economic Pillar of the PESTEL Framework.

Indicator	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Thailand	VietNam
Economic growth/performance									
GDP per capita at PPP (USD)	10.0	0.0	1.4	0.7	4.0	0.0	0.7	2.3	1.2
Economic growth	-1.6	5.0	5.3	2.7	8.9	2.0	7.6	2.5	8.0
Total unemployment	0.0	4.1	0.0	9.4	0.0	3.0	6.1	10.0	8.6
The role of energy in the economy									
Total energy consumption per capita (kWh per capita)	0.0	9.5	9.1	9.5	5.2	9.9	10.0	6.4	8.6
Total renewable energy consumption per capita (kWh per capita)	0.0	8.2	4.5	8.1	3.5	7.4	3.3	10.0	5.0
Fuel share (%) of total exports	10.0	0.0	3.5	2.5	1.6	2.7	0.2	0.5	0.1
Fuel share (%) of total imports	0.0	7.2	8.2	10.0	5.6	7.2	7.4	6.9	8.9
Green financing sector indicators									
Number of green bonds available	0.0	0.0	0.0	0.0	10.0	0.0	0.1	2.2	0.0
Green bonds as % of total ASEAN green bond market	0.0	9.5	0.0	0.0	5.7	0.0	0.8	10.0	0.3
Total score	**18.4**	**43.6**	**31.1**	**42.8**	**44.5**	**32.2**	**36.2**	**50.8**	**40.6**

Source: The table was generated by the authors using a custom scoring system applied to a range of metrics and indicators sources from different databases listed in the main text and references.

3.2.1 Economic Pillar Additional Scoring Details

GDP per capita in purchasing power parity (PPP) terms: GDP in this study is measured in PPP terms, which adjust for relative costs of living which can differ vastly between countries. In effect this allows a fairer comparison of the relative economic productivity between nations.

Economic growth: This variable is expressed in its natural from e.g. the percentage change between GDP in the latest available period, and the preceding year. While this is the only measure which includes negative values, it is okay to apply in the scoring framework without further adjustment. Positive values are 'better' with regards to economic growth, while negative numbers are not only not good, but are in fact punitive to economies, hence it providing negatively to the aggregate score is intuitive.

3.3 Social Pillar

Social factors are important in two regards. The domestic social conditions can impact upon the within country demand for and ability to supply clean energy solutions, some of which may require access to advanced forms of human capital. From the investors perspective there may also be some interest in understanding the social conditions in countries that may

be invested into, since energy investments can bring important social co-benefits. This can allow investments supportive of the energy transition (by supporting low-carbon electricity solutions) that may also support 'just transition' aspirations to enhance social justice whenever possible while supporting new energy investments.

The social pillar evaluates countries along two core dimensions. These include measures describing the potential for positive benefits from renewable energy expansion, using data mainly from (World Bank Open Data, 2024), as well as indicators reflecting education and human capital using data mainly from (World Economic Forum, 2023). Detailed indicators and scores under these two dimensions are listed in Table (4). There are a wide variety of social indicators beyond these, and more were considered in the early development of the PESTEL model, but in the end it was decided to concentrate focus on these fewer dimensions which are agnostic towards features such as gender diversity, or support for indigenous peoples as well as local communities.

Table 4:
Scoring Results Under the Social Pillar of the PESTEL Framework.

Indicator	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Thailand	VietNam
Potential for positive effects brought by renewable energy									
Mortality rate attributed to household and ambient air pollution, age standardized (per 100,000 population) - East Asia and Pacific	1.0	7.0	5.0	9.0	4.0	8.0	10.0	3.0	6.0
PM2.5 air pollution, mean annual exposure ($\mu g/m^3$)	1.0	8.0	3.0	7.0	2.0	10.0	4.0	9.0	6.0
Population living in areas where elevation is below 5 meters (% of total population)	9.0	3.0	5.0	1.0	6.0	4.0	7.0	8.0	10.0
Education and human capital									
Jobs in RE as share of total industrial workforce (%)	0.0	0.8	2.5	0.0	2.8	0.0	0.9	2.4	1.6
Quality of education	6.4	5.5	7.4	5.6	6.5	0.0	6.2	5.8	6.6
Availability of skilled workforce (mid and high level skills)	5.5	0.8	2.0	1.8	4.1	0.0	2.6	2.4	1.4
Total score	**22.3**	**25.1**	**24.8**	**24.4**	**25.5**	**22.0**	**30.7**	**30.6**	**31.7**

Source: The table was generated by the authors using a custom scoring system applied to a range of metrics and indicators sources from different databases listed in the main text and references.

Vietnam, the Philippines, and Thailand emerged as the top three countries in terms of the measured social pillar indicators. The lowest scoring countries included Myanmar, Brunei and Laos, noting that these countries performed poorly regarding 'relevant' human capital to support overall development in their renewable energy sectors.

3.3.1 Social Pillar Additional Scoring Details

For metrics relating to the positive effects brought by renewable energy: Countries with higher values of the 'raw' renewable energy related indicators are benefited more from the energy transition, for example, by reducing the mortality rate and environmental pollution caused by

environmental contamination, and by reducing the threat of sea-level rise for people living at lower altitudes. Therefore, we ranked the raw values so that countries with larger raw values had higher scores, meaning that they benefited more from the energy transition.

Myanmar: Because of the lack of data for Myanmar under the social indicators, consideration was given to imputing values. However, after team discussion, and based on the currently challenging socio-economic conditions Myanmar faces, it was in the end decided to set these values to zero. We appreciate in reality this will underestimate the true conditions in Myanmar, and note that this is not a pivotal assumption in our main findings.

Table 5:
Scoring Results Under the Technological Pillar of the PESTEL Framework.

Indicator	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Thailand	VietNam
Existing technologies									
Renewable energy patents	0.0	0.0	0.0	0.0	10.0	0.0	2.7	0.0	0.0
Comparative advantage in low carbon technologies	0.3	1.7	1.9	0.5	10.0	0.0	5.6	8.1	5.9
Security of technological systems									
Flexibility of electricity system	6.8	7.2	5.1	9.7	7.3	0.0	7.0	10.0	9.9
System average interruption duration index	9.8	0.0	8.6	8.1	9.8	0.0	8.3	9.8	9.0
System average interruption frequency index	9.9	3.2	9.0	0.0	9.8	0.0	9.0	9.7	9.3
Electric power T&D losses (% of power generation)	9.4	8.1	8.9	0.0	9.7	0.0	8.4	10.0	9.9
Infrastructure readiness of technological solutions									
Renewable capacity build-out score	0.2	4.9	2.0	10.0	2.2	0.0	2.6	2.0	8.1
Quality of transportation infrastructure	6.2	7.0	10.0	5.6	9.5	0.0	5.9	7.8	8.0
Digital infrastructure readiness	0.0	6.4	8.5	6.5	10.0	0.0	7.9	9.3	8.4
Innovation and development									
Innovative business environment	7.9	7.5	10.0	8.0	8.7	0.0	8.0	8.0	8.6
Development of environmental technologies (% of all technologies)	0.0	0.0	5.2	0.0	6.2	0.0	10.0	5.9	6.5
Public investment in research and development (% of GDP)	2.5	1.1	2.5	0.0	9.1	0.0	2.8	10.0	4.7
Public investment in energy related technologies	0.0	0.3	10.0	0.0	3.8	0.0	1.7	0.0	1.0
Total score	**52.8**	**47.3**	**81.8**	**48.4**	**106.0**	**0.0**	**79.9**	**90.5**	**85.0**

Source: The table was generated by the authors using a custom scoring system applied to a range of metrics and indicators sources from different databases listed in the main text and references.

3.4 Technological Pillar

Technology related attributes are evaluated in Table (5), based primarily on data from World Economic Forum (2023) and the International Renewable Energy Agency. Indicators cover the availability of relevant existing technologies, the security, and readiness of existing systems to cope with expanded renewable energy capacity and the level of activity towards innovation and development of renewable energy.

Malaysia, Thailand, and Vietnam are the top three under the technology pillar. No relevant data was available for Myanmar, hence the zero scores. This obviously will be an inaccurate reflection of Myanmar's actual conditions, yet given recent domestic conditions in the country, it is not expected that Myanmar will currently be at the forefront of technology development, hence we do not foresee that the zero values would demonstrably alter our final rankings for the country. Cambodia, Laos and Brunei score lowest among the countries.

3.4.1 Technology Pillar Additional Scoring Details

Patent data: Information on renewable energy related patents are taken from the International Renewable Energy Agency (IRENA) International Standards and Patents in Renewable Energy (INSPIRE) database.[6]

Table 6:
Scoring Results Under the Environment Pillar of the PESTEL Framework.

Indicator	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Thailand	VietNam
Air									
Average PM2.5 concentration ($\mu g/m^3$)	10.0	5.4	0.0	2.8	3.4	5.5	8.9	5.2	2.8
Water									
Water sustainability	10.0	9.7	5.9	8.9	9.1	10.0	3.1	0.0	1.1
Land									
Arable land (% of land area)	10.0	3.1	6.0	8.6	5.1	9.5	4.5	0.0	3.6
Arable land (hectares per person)	10.0	0.0	6.4	3.5	1.8	9.4	8.3	0.4	7.5
Population density (people per sq. km of land area)	8.5	8.2	6.8	10.0	8.6	8.0	0.0	6.9	2.0
Natural disasters									
Frequency (number of disasters)	10.0	9.1	0.0	9.4	9.2	7.8	5.0	7.2	6.7
Intensity	0.0	8.7	1.3	9.3	9.6	8.6	2.3	7.5	8.2
Regional capacity	0.0	1.4	10.0	0.0	0.0	0.0	10.0	1.4	1.4
Total score	**58.5**	**45.7**	**36.3**	**52.5**	**46.7**	**58.6**	**42.0**	**28.6**	**33.4**

Source: The table was generated by the authors using a custom scoring system applied to a range of metrics and indicators sources from different databases listed in the main text and references.

3.5 *Environment Pillar*

Domestic environmental conditions are an important motivating factor for energy transitions. Poor environmental conditions coincide with poorer health and living conditions, and can sway public acceptability towards transitions.

In this study, in addition to considering core measures of air, land and water pollution, we also include natural disasters within this category. It has become increasingly obvious that natural disasters, especially weather-related disasters like typhoons and floods are influenced by human economic activity and the temperature rises that are driven by our economies. The frequency of natural disasters has changed, and these changes coincide with higher

[6] See www.irena.org/inspire for additional information.

damage to the built environment and impacts to economic productivity. Disaster prone regions with poor environmental conditions will observe greater benefits sooner by expanding renewable energy use and moving away from fossil fuels. Data sources are from the IQAir (2023), the World Bank Open Data (2024), and the International Disaster Database (EM-DAT) available through Centre for Research on the Epidemiology of Disasters (2024).

Detailed indicators and scores under these 4 dimensions are listed in Table (6). Brunei Darussalam, Myanmar, and Lao PDR are the top ranked countries under the environmental pillar. Thailand, Vietnam and Indonesia obtain the lowest scores, with low scores in the areas of natural disasters (for Indonesia), water sustainability (Thailand and Vietnam) among other things.

3.5.1 Environmental Pillar Additional Scoring Details

Data sources: Information used in the scoring framework for the environmental pillar are primarily obtained from the World Development Indicators (WDI), World Bank Open Data (2024) and the World Air Quality Index Project from World Air Quality Index Project (2024). Natural disasters related information are obtained from Centre for Research on the Epidemiology of Disasters (2024)

3.6 Legal Pillar

The legal pillar captures information pertaining to the use of law through policy/regulation to nurture the renewable energy sector within a country. This included the evidence for support for international cooperation in energy markets e.g. through power purchase agreements together with associated support policies such as the existence of feed in tariffs to promote renewable energy deployment.

Detailed indicators of the legal (policy) factors are given in Table (7). Indicators are sourced from the ASEAN Secretariat and UNCTAD (2023), the ASEAN Center for Energy (2022), EU-ASEAN Council (2023), The Asia Foundation (2023) and World Economic Forum (2023).

Malaysia, Thailand and Indonesia scored highest in terms of the policy pillar. For Malaysia and Thailand this is partly driven by high scoring under planned interconnection projects. For Indonesia there are generally high scores in all measured areas, and strong scoring under the category of existing interconnection projects/contracts.

3.6.1 Legal Pillar Additional Scoring Details

Evidence of contracts supporting energy interconnections between countries is taken as a sign of positive policy support for regional energy market expansion. While fiscal policies such as tax or public investment support schemes and support for carbon pricing are also evaluated.

As noted earlier in the report, different indicators will on occasion use bespoke scoring methods. Some additional details on the scoring practices for indicators within the Legal pillar are given below.

International Cooperation and Fiscal Incentives: We utilize the following scoring method to evaluate each indicator: If the country has established relevant policy elements, then give a score of 10. If the country has announced plans to establish relevant policy in the future, give

a score of 5. If the country has not announced plans to establish relevant policy, give a score of 0.

Existing Contracts: The data are sourced from the ASEAN Center for Energy (2022). For Existing Contracts, if the project status is "existing" or "2020", "2021" or "2022", give a score of 10. If it is "TBC", give a score of 5 due to its uncertainty. Weights of scores are based on project tranches. For future projects, if the construction year is in the period of 2025-2029, give a score of 10. If the construction year is between 2030-2035, give the score of 5. If the construction year is after 2035, give a score of 1. Lower scores for later construction are based on greater uncertainty about construction and a shorter timeframe to achieve carbon neutrality.

Table 7:
Scoring Results Under the Legal Pillar of the PESTEL Framework.

Indicator	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Thailand	VietNam
International cooperation, FDI in renewable energy projects									
Investment incentives	5.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Feed-in-tariffs (FIT)	5.0	5.0	10.0	10.0	10.0	5.0	10.0	10.0	10.0
PPP/PPA	5.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Land acquisition	5.0	5.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Existing contracts									
Interconnection existing projects	0.0	27.5	20.0	27.0	42.5	5.0	2.0	32.0	15.0
Interconnection future/planned projects	10.0	3.4	10.	10.0	35.0	10.0	5.0	23.4	10.0
Fiscal incentives									
Tax incentives	0.0	10.0	10.0	10.0	10.0	0.0	10.0	10.0	10.0
Public investment, loans, grants, subsidies or rebates	0.0	0.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Investment or production tax credits	0.0	0.0	10.0	0.0	0.0	0.0	10.0	0.0	10.0
Carbon pricing status									
Law/Act for carbon pricing	3.3	0.0	10.0	0.0	3.3	0.0	3.3	3.3	3.3
Carbon tax	3.3	0.0	3.3	0.0	3.3	0.0	3.3	6.7	3.3
Emissions trading system	3.3	0.0	10.0	0.0	3.3	0.0	3.3	3.3	3.3
Carbon credit	6.7	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Policy environment									
Stability of policy	4.1	3.7	5.1	4.0	4.8	0.0	3.7	3.4	4.6
Total score	**50.7**	**84.6**	**138.4**	**111.0**	**162.2**	**70.0**	**103.6**	**142.1**	**119.5**

Source: The table was generated by the authors using a custom scoring system applied to a range of metrics and indicators sources from different databases listed in the main text and references.

Carbon Pricing Status: Data are sourced from The Asia Foundation (2023). If the policy status is determined as "active", then give a score of 10; if the status is "in development", give a score of 6.7; if the status is "under consideration", give a score of 3.3; if the status is "inactive", give a score of 0.

Stability of Policy: The score of Stability of Policy (World Economic Forum, 2023) has a threshold of 1 to 7 (lower to upper). Due to the lack of data for Myanmar in this database, we give a score of zero to Myanmar. Myanmar is known to have experienced severe political instability in recent years.

3.7 Overall PESTEL Rankings

Each pillar within the PESTEL framework was re-structured into a rank-based format, with lower numbers representing higher ranks. The overall PESTEL ranking was then determined by summing the ranks across each of the individual pillars, with the lowest total number indicating the highest overall rank. Table (8) indicates that Malaysia achieved the best overall rank, followed by Thailand and Vietnam.

Table 8:
Overall PESTEL Rankings.

Indicator	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Thailand	VietNam
Political	4	6	1	9	7	8	2	5	2
Economic	9	3	8	4	2	7	6	1	5
Social	8	5	6	7	4	9	2	3	1
Technological	6	8	4	7	1	9	5	2	3
Environmental	1	7	5	3	4	2	6	9	8
Legal (regulatory)	9	7	3	5	1	8	6	2	4
Total (weighted) Rank	**8**	**7**	**4**	**6**	**1**	**9**	**5**	**2**	**3**

Source: The table was generated by the authors using a custom scoring system applied to a range of metrics and indicators sources from different databases listed in the main text and references.

The PESTEL ranking method ensures a comprehensive assessment of the feasibility of developing the RE market in each country. Therefore, in our further analysis of listed key players in equity markets with a renewable energy portfolio or ambition, we focus on listed companies in the Top 3 countries from the PESTEL model.

The following two sections proceed to review investment opportunities in Malaysia, Thailand and Vietnam. For equities each of these three countries can be considered, as each has a domestic stock exchange. For bonds, we also introduce Singapore bonds for consideration, as some Singapore issued bonds will be used to support cross-border low-carbon energy investment projects.

4 Screening for Equity Investment Opportunities

This section introduces and applies the equity screening approach, to identify and rank equity investment options in line with the investment principles applied i.e. in countries that rank well in the PESTEL analysis, and then survive a set of screening criteria designed to isolate stocks with material regional renewable energy interests.

The countries prioritised include Malaysia, Thailand and Vietnam, owing to their strong growth in renewables in recent years and potential to support renewable energy projects that will manifest in low-carbon electricity imports into Singapore. It was also agreed that Singapore key players need to be briefly reviewed, since capital investments from major Singaporean companies can help in developing regional energy projects that will support low-carbon electricity imports.[7]

Identified companies include those that may add new power generation equipment, as well as utilities companies that may play an instrumental role in expanding the grid infrastructure to support growth in regional electricity flows in the future. Focus is maintained on exchange listed companies, which may exclude some important unlisted private sector market participants. This was a practical consideration, though future work may wish to invest time in reviewing investment opportunities in the purely private sector.

Throughout this section reference is made to core financial performance, renewable business operations and aspirations of the identified companies. Unless otherwise stated, the information reported relates to the 2023 financial year and based on information from financial reports and/or the London Stock Exchange Group (LSEG)/Refinitiv Workspace.

4.1 Key Players in Malaysia

There are four steps to identify key players in Malaysia. The first step is to filter by business descriptions, keeping companies that refer to renewable energy (RE), hydro, and/or solar. Next, the companies were filtered to retain the top 60% by ESG Score and further filtered based on the top 60% by market capitalization. Finally, companies with more than 5% of their revenue from the RE segment were selected. Five companies were identified in Malaysia.[8]

4.1.1 Mega First Corporation Bhd (MFCB)

Mega First Corporation Bhd has an ESG score of 49.3, with 46.0% revenue from the RE segment according to the annual report. In FY2023, MFCB achieved clear profitability. The operating margin is 40.3% and the net profit margin is 29.1%, which are the highest among the identified companies selected. The liquidity shows a robust ability to pay off short-term liabilities. The debt-to-equity ratio is below 0.5, indicating a healthy leverage ratio, see Table (9).

MFCB engaged in hydro and solar energy projects with significant investments and future plans for expanding its solar portfolio. MFCB is the owner and operator of the Don Sahong Hydropower Project (DSHP), which is a 260MW (megawatts) run-of-river hydropower scheme in Southern Laos. A new powerhouse annex is being constructed to house the fifth turbine generator and construction is expected to be completed by the third quarter of 2024. The

[7] There is high confidence in this claim given a number of in principle agreements awarded by Singapore's Energy Market Authority towards low-carbon electricity imports into Singapore.

[8] We note that YTL Power International Bhd was a borderline consideration under the quantitative ranking driven in part by relatively low ESG scores potentially due to family ownership impacting the governance pillar score among other things. After deliberation the decision was made to retain this firm due to their large asset base, investment holdings in other renewable energy companies and other attributes discussed further in the main text.

Table 9:
Financial Performance Summary for Identified Key Players in Malaysia.

Profitability					Liquidity		Leverage
Operating margin	Net profit/loss (USD)	Net profit margin	Return on equity	Return on total assets	Quick ratio	Current ratio	Debt / Equity
Mega First Corporation Bhd (MFCB)							
40.3%	81,328,529	29.1%	12.6%	8.7%	1.7	1.9	0.4
Ranhill Utilities Bhd							
4.1%	11,214,350	2.3%	5.3%	1.8%	1.4	1.5	1.0
YTL Power International Bhd							
16.9%	429,841,246	9.3%	12.1%	3.7%	1.6	5.9	2.6
Taliworks Corporation Bhd							
26.1%	8,894,022	11.2%	6.0%	2.3%	1.4	1.7	1.1
Tenaga Nasional Berhad (TNB)							
13.5%	587,176,769	5.2%	4.7%	1.4%	1.2	1.2	2.4

Source: The information in this table was taken or calculated from information contained in company reports, or from LSEG/Refinitiv Workspace.

total capacity of the DSHP once this expansion project is completed is 325MW. Since 2019, MFCB has been involved in solar photovoltaic (PV) investment in Commercial and Industrial solar projects in Malaysia, Cambodia and the Maldives.

At present, these solar PV power projects have a combined capacity of just over 20MW. In the future, MFCB aims to secure an additional 27MW in solar projects, further expanding the Group's total solar portfolio to nearly 50MW.

4.1.2 Ranhill Utilities Bhd

Ranhill Utilities has an ESG score of 45.3, with nearly 18.2% revenue from the RE segment according to the annual report. In FY2023, Ranhill earns revenue of 484.2 million USD, with an operation margin of 4.1%. The liquidity shows a robust ability to pay off short-term liabilities, see Table (9).

Ranhill utilizes solar and hydro to generate electricity, with clear targets for reducing emissions and increasing renewable energy capacity. At Ranhill Sultan Iskandar Water Treatment Plant in Johor, solar panels provide 63kWp (kilowatt peak) of clean energy while at the Gunung Ledang water treatment plant, the mini hydro installation generates 73kWp of clean energy. In the long term (2041-2050), Ranhill plans to increase the RE share to 85% of generation capacity, which accounts for 8.2GW (gigawatts). These aspirations are set out in their company reports as part of their net-zero roadmap.

4.1.3 YTL Power International Bhd

YTL Power International is a Malaysian multi-utilities firm with operations spanning power generation, water & sewerage, telecommunications and investment holding activities. It has a presence in Malaysia, Singapore, the United Kingdom, Indonesia, Jordan and the Netherlands. In 2023 group financial net profit stood at 429 million USD with a 9.6% profit margin. Among the companies listed in Table (9) it holds the second highest return on equity

and return on total assets at 12.1% and 3.7% respectively. While the group has the largest observed debt to equity ratio, it also has the largest current ratio by quite a margin highlighting the strength of the group to weather near-term debt obligations. FTSE-Russell Green Revenues account for around 18.2% of total revenue as of the period end June 2023. In terms of ESG performance, the group's total ESG score for 2023 was around 45, though it is noted that fairly strong environmental pillar performance coincided with relatively poor governance and social pillar performance.

In 2023, revenues from power generation accounted for around 75% of total company revenues. The group has declared its intention to pivot towards renewables and sustainable energy solutions aiming for group-wide carbon neutral operations by 2050, consistent with the Malaysian Government's goal. Among various strategies that will be implemented towards these goals, Singapore based group subsidiary YTL PowerSeraya includes several actions within their '60-30' Vision (to achieve a 60% reduction in greenhouse gas (GHG) emissions from 2010 levels by 2030) through: energy efficiency improvements for existing power generating equipment; low carbon power investments such as hydrogen ready power plants; importing low carbon electricity; and utilising international carbon credits up to the 5% allowable limit.

4.1.4 Taliworks Corporation Bhd

Taliworks has an ESG score of 44.5, with 6.7% of its revenue coming from the RE segment according to their annual report. With a 339.7 million USD market capitalization with 79.4 million USD revenue in FY2023, Ranhill achieves an operating margin of 26.1% and net profit margin of 11.2%. Observed liquidity confirms the ability to cover short-term liabilities, see Table (9).

New acquisitions are an important next step for Taliworks to become a prominent player in the renewable energy space. In 2022, Taliworks successfully acquired four solar assets near Kuala Lumpur International Airport (KLIA), with a total capacity of 19MWp (megawatt peak). Going forward in 2024, Taliworks plans to replace the solar panels in the other two project sites (TR Sepang and TR CPark) and explore viable investments in new solar development.

4.1.5 Tenaga Nasional Berhad (TNB)

Tenaga has an ESG score of 54.6, with 6.0% revenue from the RE segment according to the FTSE Russell Green Revenues from Refinitiv. Tenaga is Malaysia's largest electricity utility company, with the largest market capitalization and revenue among the five companies selected. In FY2023, Tenaga had reasonable profitability and robust liquidity. It is noteworthy that Tenaga has a high leverage ratio, see Table (9).

TNB has made significant investments in renewable energy plants, both domestically and internationally, to diversify its energy mix. Until 2023, Tenaga has 22 large hydro plants and 110 renewable energy plants (mini-hydro, solar, wind and biomass), accounting for 4,375MW RE capacity. Tenaga ambitiously plans to increase the RE capacity to 8.3GW by 2025. RE investments will be accelerated by 2050. The announcement of a number of flagship projects, which will come into operation in phases over the next view years, strengthens Tenaga's position in the RE space.

A summary list of the flagship projects planned to come online in the near future includes:

- Hybrid Hydro-Solar Project, commercial operation dates between 2025-2040, overall capacity 2424MW;

- 5 x 100 MW Solar Park, commercial operation date 2026, overall capacity 750MWp;
- 1 x 30 MW, 2 x 9MW, commercial operation date 2025, overall capacity 48MW.

4.2 Key Players in Thailand

There are four steps to identify key players. The first step is to filter companies in all sectors by business descriptions with keywords like renewable, solar, hydro, wind, etc. Next, we filtered the companies by the top 60% of ESG scores and further filtered them by the market capitalization above 100 million USD. Finally, companies with Corporate Green Revenue beyond 50% were selected. Therefore, three companies were identified.

Table 10:
Financial Performance Summary for Identified Key Players in Thailand.

Profitability					Liquidity		Leverage
Operating margin	Net profit/loss (USD)	Net profit margin	Return on equity	Return on total assets	Quick ratio	Current ratio	Debt / Equity
CK Power PCL (CKP.BK)							
22.4%	39,709,759	14.8%	5.4%	2.1%	1.7	1.7	1.1
Gunkul Engineering PCL (GUNKUL.BK)							
17.0%	40,045,327	19.4%	10.6%	4.5%	0.9	1.1	1.4
BCPG PCL (BCPG.BK)							
44.8%	29,984,668	21.9%	3.7%	1.7%	-	1.0	1.5

Source: The information in this table was taken or calculated from information contained in company reports, or from LSEG/Refinitiv Workspace.

4.2.1 CK Power PCL (CKP.BK)

CK Power PCL demonstrates strong ESG performance, with the latest overall score being 68.7, and derives 84% of its revenue from its core business, the production and sale of clean energy. Financially, the company maintains its leading position with strong profitability, solid liquidity, and leverage ratios, highlighting its financial health and commitment to RE, see Table (10).

CK Power has set ambitious RE plans and programs. Their RE plans include reaching a total RE Generation of 29,004MW in 2037 and achieving 95% capacity from renewables by 2043. By 2023, CK Power had delivered 17% of Thailand's total renewable electricity, with a total installed capacity of 3,633 MW, which is largely comprised of hydroelectric power (1,900MW), followed by co-generation power (238MW) and solar power (29MW). CK Power's diverse portfolio and forward-looking goals underscore its leadership in the RE transition.

4.2.2 Gunkul Engineering PCL (GUNKUL.BK)

GUNKUL Engineering PCL stands out for its robust ESG performance (69.9) and an impressive 95.9% of its revenue derived from RE segments. The company is also a leader in producing and distributing electricity from RE power plants. Financially, the company maintains robust fundamentals though its liquidity and leverage ratios indicate potential areas for monitoring improvement, see Table (10).

GUNKUL's RE plans are ambitious, aiming to double its electricity production capacity to 2,000MW within 5 years, supported by a substantial investment budget of 45,000 million Baht. Currently, GUNKUL has over 1,000MW of RE capacity across 4 countries through solar and wind (170MW) projects. These initiatives underscore GUNKUL's commitment to sustainable energy and its strategic vision for growth in the RE sector.

4.2.3 BCPG PCL (BCPG.BK)

BCPG PCL also demonstrates a strong commitment to RE, with 84.9% of its revenue coming from clean energy sources. Financially, BCPG shows respectable performance in operating profitability, with net profit margin of 21.9%, and liquidity measured through a current-ratio exceeding one, see Table (10). It is however noted that the debt to equity ratio is the highest among the three identified firms.

BCPG aims to become a prominent clean energy player focusing on sustainable growth in the Asia Pacific region by 2025. It plans to significantly expand its contracted RE generation capacity to 29,411MW by 2037, up from an original target of 19,684MW. Since its establishment in 2015, BCPG has leveraged solar, hydropower, wind (and natural gas) across Thailand, Philippines, Laos, Vietnam, etc. The company's current production capacity stands at 2,025.2MW, with 1,249.9MW in operation and 775.3MW under development, highlighting its substantial contribution to clean energy development.

4.3 Key Players in Vietnam

The identification process has four steps. The first step is to filter by business descriptions, related to renewable energy (RE), hydro, and solar etc. Next, the companies were filtered to require a market capitalization above 100 million USD and then further filtered on the companies' sectors and specific main business activities and percentage of revenue from the renewable energy sector. Remaining companies were then assessed on the basis of key financial performance metrics. Four companies were identified, see Table (11).

Table 11:
Financial Performance Summary for Identified Key Players in Vietnam.

Profitability					Liquidity		Leverage
Operating margin	Net profit/loss (USD)	Net profit margin	Return on equity	Return on total assets	Quick ratio	Current ratio	Debt / Equity
Power Generation Joint Stock Corporation 3 (Genco3)							
2.7%	41,843,827	2.3%	6.9%	1.7%	1.2	1.5	2.8
Vinh Son Song Hinh Hydropower JSC							
42.5%	39,048,905	38.7%	21.6%	10.3%	1.1	1.2	1.1
Ha Do Group JSC							
33.3%	26,127,598	23.0%	11.2%	4.5%	1.0	1.4	1.2
PC1 Group JSC							
5.2%	5,498,814	1.8%	2.7%	0.7%	1.3	1.5	2.5

Source: The information in this table was taken or calculated from information contained in company reports, or from LSEG/Refinitiv Workspace.

4.3.1 Power Generation Joint Stock Corporation 3 (Genco3)

Genco3 has a generally balanced financial performance, although the observed debt-equity ratio is the highest observed across the key players in the three target countries, see Table (11). Net profits are respectable at almost 42 million USD, though the net profit margin is itself quite modest at 2.3%.

This utility company has the largest scale among Vietnam's listed companies in terms of power generating capacity at 5,492MW. Three out of its eight subsidiaries and affiliated companies are renewable energy companies. The group still has a considerable coal thermal power generation capacity equivalent to 37% of its total power generating fleet, together with around 44% natural gas based power. Remaining vigilant of coal phase-out and managed use of natural gas as a transition fuel will be important for investors.

4.3.2 Vinh Son Song Hinh Hydropower JSC

Vinh Son Song Hinh Hydropower JSC is an independent renewable power producer and affiliate company of genco3. The company has robust financial performance. For instance, its operating margin is highest among the Viatnamese firms given in Table (11) at 42.5%. The group also has the lowest debt to equity ratio among the identified key players, although still exceeding a value of 1.

This company is a renewable independent power producer as an affiliated company of genco3, which has 3 hydro-power stations and power generation accounts for almost 100 percent of the total revenue. In addition to the production and distribution of its own clean electricity, Vinh Son Song Hinh Hydropower also engages in project management and execution supervisory services for hydroelectricity and other supporting services such as irrigation. The group also is understood to trade materials and equipment for the broader hydroelectricity industry.

4.3.3 Ha Do Group JSC

Although Ha Do Group JSC is a real estate company, 67% of its revenue comes from the energy sector, with hydro revenue comprising the largest portion of the energy sector. Key highlights from Ha Do Group's financial performance include net profit exceeding 26 million USD and a high operating margin at 23.0%, see Table (11).

The group not only supports renewable energy provision, through supporting construction of hydropower plants, but also supports the build out of grid infrastructure (power transmission lines). The group not only constructs power plants, but also engages in generation and trading of hydropower. Through the hospitality arm of the group they also provide ecotourism services.

4.3.4 PC1 Group JSC

The company's energy sector accounts for about 20% of total revenue. It has ten renewable energy power plants which have supplied the national grid with 4 billion KWH (kilowatt hours) of clean electricity. Also, it has a generally sound financial performance, see Table (11), albeit a relatively low return on total assets at 0.7%.

4.4 Key Players in Singapore

This section is brief, since the most significant players within the Singapore context are well known. There are two companies of particular interest, which have a track record of major energy related investments both within Singapore and abroad, including within the ASEAN region, and for some of the low-carbon electricity supply projects that have received in principle approval from Singapore's Energy Market Authority (EMA). These are:

- **Sembcorp:** Sembcorp's expertise in energy and urban development solutions helps to considerably improve Singapore's renewable energy infrastructure. Sembcorp had a total turnover in FY2023 of S$7,042m, with turnover for its renewables segment at S$703m, which increased 40% over its 2022 renewables sector turnover. The Energy Market Authority (EMA) granted conditional approval, on 24 October 2023, to Keppel Energy Pte. Ltd. to import 1.2GW of low-carbon electricity from Vietnam into Singapore.[9]
- **Keppel:** Keppel, known for its ingenuity in offshore and marine engineering, is a key player in creating offshore wind and floating solar projects in Singapore, pushing the boundaries of sustainable energy solutions. In their 2023 financial year highlights, Keppel notes that of it's total 5.9GW of energy infrastructure holdings, 4GW are for renewable, most of which being solar, but also with a fairly large amount of wind power included. The Energy Market Authority (EMA) granted conditional approval, on 16 March 2023, to Keppel Energy Pte. Ltd. to import 1GW of low-carbon electricity from Cambodia into Singapore.[10]

Sembcorp and Keppel are key contributors to Singapore's move to renewable energy. Sembcorp and Keppel are symbolic of the country's commitment to energy sustainability and lowering carbon emissions, marking a significant step toward a greener future.

[9] See https://www.ema.gov.sg/content/dam/corporate/news/media-releases/2023/20231024-EMA-Media-Release-EMA-Grants-Conditional-Approval-of-Electricity-Imports-from%20Vietnam.pdf.coredownload.pdf for additional detail.
[10] See https://www.ema.gov.sg/news-events/news/media-releases/2023/ema-grants-conditional-approva-for-1-gigawatt-of-electricity-imports-from-cambodia for additional detail.

5 Screening for Green Bond Investment Opportunities

Not all ASEAN countries have financial exchanges, and for this reason, it is important to consider bonds as an alternative investment vehicle. There is an active ASEAN bond market, with numerous active green bonds in the identified target countries. Bonds offer investors the opportunity to directly back well-defined projects (or groups of projects) in a highly targeted fashion, and green bonds offer specific opportunities to invest in projects with clear environmental benefits, such as low-carbon electricity projects.

Bonds also offer investors the opportunity to invest directly into government issued bonds and projects, bringing into consideration a broader range of investment opportunities than can be achieved through equity investment alone.

The section proceeds with a broad assessment of the ASEAN regional bond market, and it's general 'adequacy' from the dual perspectives of bond market activity and the guiding principles/playbook for bond issuers in the region. This is intended to complement a custom scoring system that is developed and applied to screen and rank bond investment along a series of key criteria such as bond liquidity/risk, returns and other factors.

The findings from the assessment of regional markets are used to inform a brief assessment at the end of the section over some possible policy implications and options that might be considered to enhance regional bond markets activity and performance. This discussion also serves to guide investors on what factors might increase overall investor confidence into the regional green bond market.

5.1 Existing Green Bond Market In ASEAN

There is an active ASEAN bond market, with numerous green bonds having been issued among the identified target countries. These green bonds promise to deliver projects with a primary focus on green projects including for example low-carbon energy projects. Moreover, the bond market in ASEAN countries shows a diverse presence of both corporate and non-corporate bonds.

Among the ASEAN nations, Singapore, Malaysia, Indonesia, and Thailand emerged as the top four countries in terms of bond issuances. Malaysia holds the highest number of green bonds, while Singapore leads in issuance volume, reflecting its robust financial infrastructure and active bond market. It is however noteworthy that the total amount invested is Malaysia's 290 corporate green bonds 9.3 billion USD, which translated into an average bond size of around 32 million USD. While the total amount will be based on a range of different projects of different size, it suggests that there are likely to be many smaller scale green bonds than compared with other markets.

The ASEAN bond market comprises 399 green bonds compared to 9,715 non-green bonds that are currently active. This significant difference in the number of green versus non-green bonds highlights the relatively nascent stage of the green bond market in the region. However, the presence of these 399 green bonds also indicates a strong interest in sustainable finance across ASEAN.

5.2 Adequacy of Existing Green Bond Structures

To assess the adequacy of green bond structures, a multi-criteria filter was used to evaluate both green and non-green bonds, calculating the proportion of bonds that meet specific

Table 12:
Green Bond Market Overview in Terms of Number of Active Issuances and Amount Invested by Country.

Criteria	# of bonds	Amount invested (Billion USD)
Corporate green bonds		
Indonesia	9	3.4
Malaysia	290	9.3
Philippines	7	5.9
Singapore	13	8.1
Thailand	58	8.6
Vietnam	0	0.0
Non-corporate green bonds		
Indonesia	5	15.4
Malaysia	0	0.0
Philippines	0	0.0
Singapore	11	14.1
Thailand	5	6.8
Vietnam	1	0.1

Source: The table was generated by the authors using information obtained from LSEG/Refinitiv Workspace.

assessment criteria relative to the total number of bonds in each category; 399 for green and 9,715 for non-green. A detailed summary of the variables used in the assessment, and their construction, is given in the Appendix (see Table (A1)), with the following subsections present a key overview of the findings obtained using them.

5.2.1 Market Perception and Liquidity

Market perception and liquidity are critical factors for bond attractiveness. The analysis showed that 26% of green bonds are listed on exchanges, compared to 44% of non-green bonds. This lower percentage for green bonds could be due to the newer market segment not yet reaching the same level of exchange listing as traditional bonds. However, the TRPS/composite price, reflecting market sentiment and trading activity, averaged 101.6 for green bonds (87% qualified) versus 101.3 for non-green bonds (57% qualified), arguably indicating some market equivalence between the two types of bond, see Figure (2).

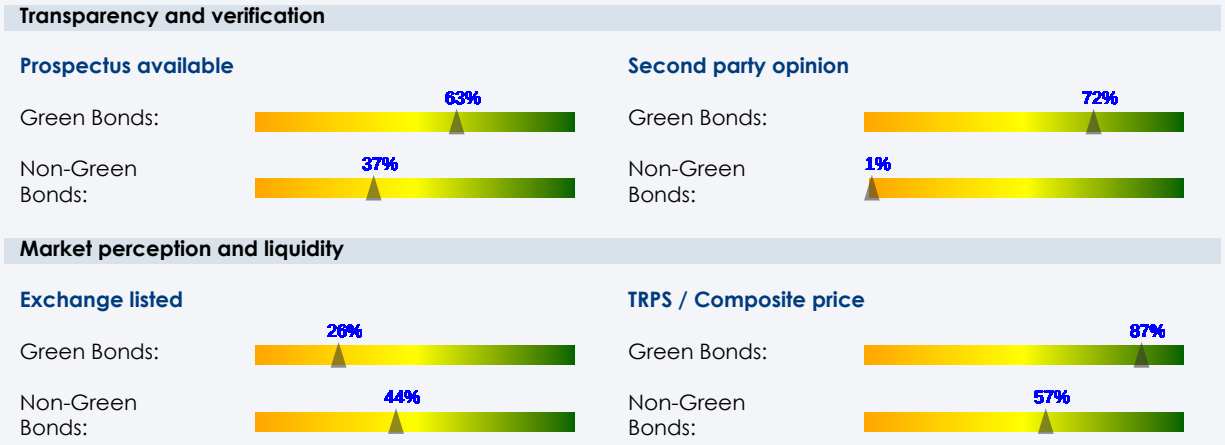
5.2.2 Transparency and Verification

Green bonds demonstrate significantly higher transparency and credibility. A higher percentage of green bonds, 63%, have an available prospectus compared to 37% of non-green bonds, indicating greater transparency. Furthermore, 72% of green bonds have second-party opinions, which validate their environmental credentials through independent reviews. In contrast, only 1% of non-green bonds have such verification, suggesting a higher level of credibility that can be placed behind of green bonds, see Figure (2).

5.2.3 Environmental Integrity

Environmental integrity assesses the overall environmental, social, and governance (ESG) performance of bonds. Green bonds excel in this area, with 98% qualifying as ESG bonds compared to only 2% of non-green bonds. Additionally, green bond issuing companies scored 96.3 on average for controversies, indicating fewer negative incidents, compared to a score of 94.0 for companies issuing non-green bonds. This broadly correlates with the idea that companies issuing green bonds will in general have better ESG performance.

Figure 2:
Summary Assessment of ASEAN Green Bond Transparency, Verification and Credibility/Confidence Indicators (% of Bonds Which Satisfy Criteria).



Source: This figure was generated by the authors using data from LSEG/Refinitiv Workspace.

5.2.4 Risk Assessment

Risk assessment focuses on the presence of guarantees, seniority of bonds, and risk classification on the basis pf project/asset/credit/hybrid backing. Only 6% of green bonds are guaranteed, compared to 17% of non-green bonds. Moreover, only 26% of green bonds hold seniority in case of issuer bankruptcy, as opposed to 61% of non-green bonds. Additionally, 57% of green bonds have risk classification information provided, compared to only 22% of non-green bonds, suggesting stronger backing and potentially lower risk.

However there is an alternative explanation which is that green bonds have lower risk due to increased oversight e.g. through second party opinions, and which is why they can preserve similar TRPS prices without the need for as much security against default risk.

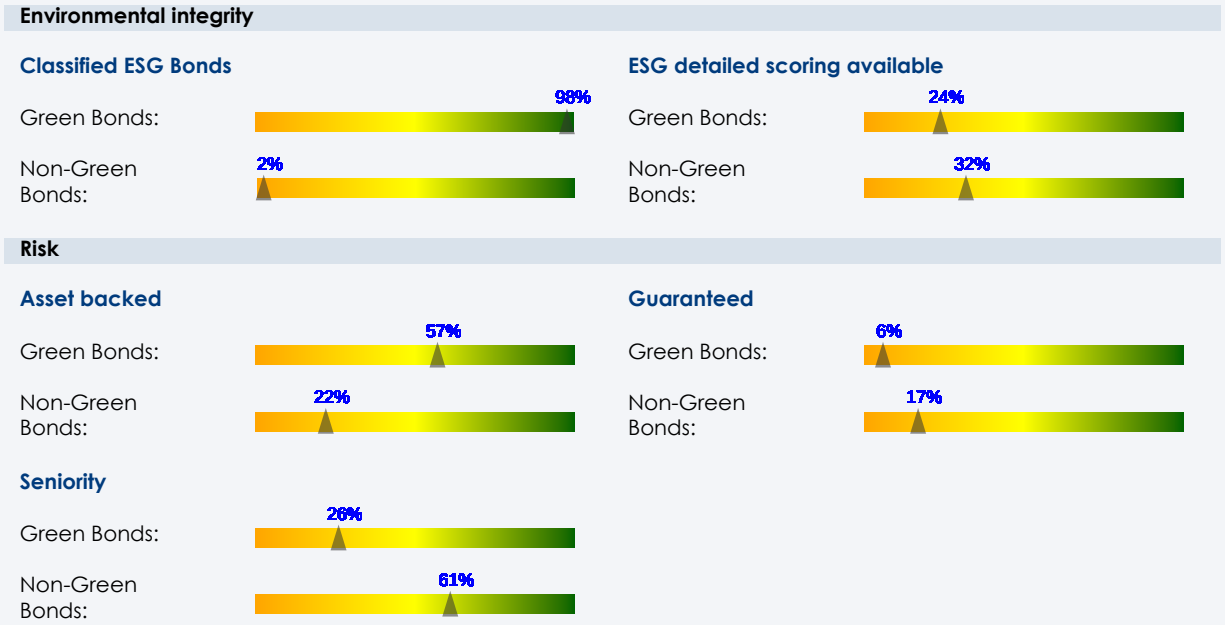
5.2.5 Adherence to Standards

A significant proportion of green bonds demonstrated strong adherence to green bond standards like the Climate Bonds Standard (CBS), ASEAN Green Bond standards, and the International Capital Market Association Green Bond principles (ICMA GBS). Specifically, 84% of green bonds comply with ICMA, indicating a robust commitment to sustainability and environmental integrity within the green bond market, see Figure (4). Only 12% are CBI compliant, while 51% align with the ASEAN principles and standards.

5.2.6 Use of Proceeds

This criterion assesses funds raised from green bonds are allocated towards achieving environmental goals, particularly by way of those those aligned with relevant UN Sustainable Development Goals (SDGs). The analysis revealed that 85% of green bonds are directed toward projects that support SDG 7 (Affordable and Clean Energy). This underscores the focused impact of green bonds on renewable energy and sustainability initiatives, see Figure (4).

Figure 3:
Summary Assessment of ASEAN Green Bond Environmental Integrity and Default-Risk Indicators.



Source: This figure was generated by the authors using data from LSEG/Refinitiv Workspace.

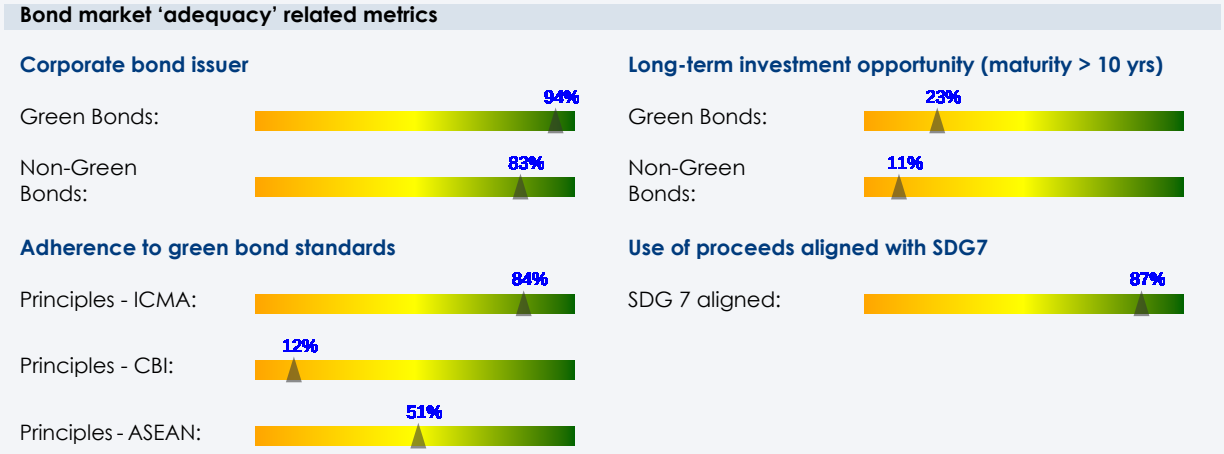
5.2.7 Long-Term Investment Opportunity

Bonds with a maturity of less than 10 years were filtered out to evaluate the identification of long-term investment prospects which some institutional investors may prefer. Around 23% of the green bonds qualified under this criterion as opposed to the 11% of non-green bonds, indicating a better long-term opportunity in the green bond market, see Figure (4). This is also consistent with the practical reality that non-green bonds will include many smaller projects compared with green bonds, many of which are being put in place to overhaul large portions of energy sector infrastructure.

5.3 Inferences on Adequacy of Bond Market

The multi-criteria analysis reveals that green bonds in the ASEAN market exhibit several strengths compared to non-green bonds, although they also face some challenges. Green bonds tend to have higher transparency, verification, and adherence to standards and principles, with significant proportions aligned with meeting environmental and sustainability criteria. Market confidence in green bonds is also evident through favorable TRPS/composite price scores, reflecting growing investor sentiment and trading activity.

Figure 4:
Summary Information on ASEAN Green Bond Market 'Adequacy'.



Source: This figure was generated by the authors using data from LSEG/Refinitiv Workspace.

However, green bonds appear to be lagging in respect of market perception and liquidity, indicated by a lower percentage listed on exchanges. While they rely less on guarantees and seniority for risk mitigation, green bonds show stronger backing through available risk scores and classifications. Furthermore, green bonds present better long-term investment opportunities and alignment with the UN sustainable development goals, particularly in renewable energy. Despite these challenges, the positive trends in transparency, adherence to standards, and long-term sustainability potential underscore the growing appeal and promise of the green bond market in ASEAN. As the market matures, these attributes will likely attract more investors, driving further growth and stability in the green bond segment.

5.4 Key Opportunities in the ASEAN Green Bond Market

The following criteria were used to further rank the green bonds which survived the screening procedure described in Section (2.3) e.g. that meet with bond maturity requirements, use of proceed criteria, are aligned with SDG goal 7 (renewable energy) or SDG goal 11 (sustainable cities and communities), are issued by firms in countries which rank highly in the PESTEL analysis, and are of a sufficient issuance size. The additional criteria that will be used here in ranking specific bonds include the same broad areas using in assessing green bonds adequest e.g. risk; return; issuance volume; environmental integrity; market confidence.[11]

Each criteria element was assigned a weight based on its relative importance in evaluating green bonds: 25% for each of risk, return, and issuance volume; 15% for environmental integrity; and 10% for market confidence. The choice of these weights can be adjusted to suit the investors' principles.[12]

[11] Refer to Appendix Table (A1) for additional detail on the specific indicators under each criterion and their individual scoring procedures.

[12] After scoring, a number of bonds were manually screened out, following deliberations between study team members surround more subjective evaluation matters. This step is not inconsistent with the core strategy of using quantitatively informed criteria to screen and rank opportunities, rather it reinforces the flexibility of the overall framework to be tailored to match investors principles, targets and aspirations. We also note that green bonds which had an issuance volume of less than 10 million USD were removed from the sample set. A total no of 71 green bond projects investment opportunities were identified in ASEAN with 13 in Singapore, 36 in Malaysia and 20 in Thailand.

In the following subsections, the top 10 ranked bonds—or fewer where less than this survive the screening—in each of the target countries are briefly introduced. However, given the amount of information relating to each bond, and the project or group of projects they support, it is not possible to unpack the details in depth. Identifiers are provided so that the discerning reader may seek additional information.

5.4.1 Top 10 Ranked Bond Opportunities in Malaysia

Table 13:
Identified Key Opportunities in the Malaysian Green Bond Market.

Issuer / ISIN	Value (USD) / Use of Proceeds	Total weighted score	Rank: Amount issued)	Amount invested	Environmental integrity	Market confidence	Returns	Risks
PNB Merdeka Ventures Sdn Bhd (MYBVS1704143)	$121,276,595 (Green Construction/Buildings)	9.8	10.0	10.0	10.0	10.0	9.6	9.6
PNB Merdeka Ventures Sdn Bhd (MYBVR1901105)	$46,808,510 (Green Construction/Buildings)	9.7	9.8	9.8	10.0	9.6	9.6	9.6
PNB Merdeka Ventures Sdn Bhd (MYBVQ1903079)	$23,424,190 (General Purpose)	9.7	9.6	9.6	10.0	9.6	9.5	9.9
PNB Merdeka Ventures Sdn Bhd (MYBVP1903063)	$25,553,662 (Energy Efficiency)	9.7	9.7	9.7	10.0	9.6	9.4	9.9
PNB Merdeka Ventures Sdn Bhd (MYBVP2102459)	$48,977,853 (General Purpose)	9.7	9.9	9.9	9.5	9.6	9.4	9.9
PNB Merdeka Ventures Sdn Bhd (MYBVO1903058)	$22,359,454 (Energy Efficiency)	9.7	9.6	9.6	10.0	9.6	9.3	9.9
PNB Merdeka Ventures Sdn Bhd (MYBVN1903043)	$21,294,718 (Energy Efficiency)	9.6	9.5	9.5	10.0	9.6	9.2	10.0
Telekosang Hydro One Sdn Bhd (MYBDW1900071)	$12,776,831 (Project Finance)	9.5	9.4	9.4	9.5	9.1	9.9	9.2
Telekosang Hydro One Sdn Bhd (MYBDX1900087)	$12,776,831 (Project Finance)	9.5	9.4	9.4	9.5	9.1	10.0	9.1
Pengurusan Air Selangor Sdn Bhd (MYBVN2301346)	$53,191,489 (General Purpose/Working Capital)	9.4	9.9	9.9	9.2	10.0	9.0	9.3

Source: The table was generated by the authors using information obtained from LSEG/Refinitiv Workspace, and an author-developed custom scoring and ranking system.

Malaysia has the largest bond market in terms of quantity of bonds issued, however this includes many small-scale bonds that do not survive the investment screening criteria. This was the market where the most effort was applied in screening. Table (13) shows the top 10 ranked bonds, which ultimately related to three companies. Telekosang Hydro One is

perhaps the most attractive with the objective being to nurture low-carbon electricity imports. Telekosang Hydro One is a Joint-Venture Company with Inno Hydropower (T) Sdn. Bhd. which is focused on the production of hydro renewable energy resources that can jointly improve electricity security and social development. Whereas PNB Merdeka Ventures is a real estate operator and Pengurusan Air Selangor Sdn Bhd is a water services provider.

5.4.2 Top 10 Ranked Bond Opportunities in Thailand

Table 14:
Identified Key Opportunities in the Thailand Green Bond Market.

Issuer / ISIN	Value (USD) / Use of Proceeds	Total weighted score	Rank: Amount issued)	Amount invested	Environmental integrity	Market confidence	Returns	Risks
BCPG PCL (TH741103D903)	$109,379,272 (Eligible Green Projects)	9.8	10.0	10.0	9.9	9.5	9.8	9.6
Global Power Synergy PCL (TH648803H606)	$109,289,617 (Energy Efficiency)	9.8	9.8	9.8	9.9	10.00	9.7	9.6
Bangkok Mass Transit System PCL (TH101703BB08)	$114,754,098 (Clean Transport)	9.8	10.0	10.0	10.0	9.5	10.0	9.2
BCPG PCL (TH741103B907)	$109,379,272 (Eligible Green Projects)	9.7	10.0	10.0	9.9	9.5	9.6	9.6
Energy Absolute PCL (TH3545039804)	$54,689,636 (Energy Efficiency)	9.7	9.5	9.5	9.9	9.5	9.7	10.0
B Grim Bip Power 2 Co Ltd (TH857203D505)	$91,530,054 (Energy Efficiency)	9.7	9.6	9.6	9.0	9.5	10.0	10.0
Electricity Generating PCL (TH046503IB00)	$103,825,136 (Renewable Energy Projects)	9.7	9.7	9.7	9.2	10.0	9.9	9.6
Ratch Group PCL (TH063703FB06)	$109,379,272 (Clean Transport)	9.7	10.0	10.0	9.4	9.5	9.5	9.9
Global Power Synergy PCL (TH648803F808)	$68,306,010 (Energy Efficiency)	9.6	9.5	9.5	9.6	9.5	9.3	9.9
BTS Group Holdings PCL (TH022103AB03)	$16,393,442 (Clean Transport)	9.5	9.2	9.2	10.0	9.5	9.6	9.6

Source: The table was generated by the authors using information obtained from LSEG/Refinitiv Workspace, and an author-developed custom scoring and ranking system.

The top ranked bonds identified in Thailand differ in nature than those for Malaysia, insofar as they are primarily for projects in the areas of energy and transportation, see Table (14). These include several bonds from BCPG PCL, who were also identified as one of the leading equity options for Thailand with 84.9% of their revenues coming from clean energy related business, see Table (10).

Thailand's bonds not only are more visibly energy-focused than those identified for Malaysia, but they are also generally of a larger scale. In Malaysia only two of the top ten bonds had a

value exceeding US$50m, whereas in Thailand nine of the top ten have a value greater than US$50m. This suggests a market with more frequent and larger investment opportunities.

5.4.3 Top 10 Ranked Bond Opportunities in Singapore

Table 15:
Identified Key Opportunities in the Singapore Green Bond Market.

Issuer / ISIN	Value (USD) / Use of Proceeds	Total weighted score	Rank: Amount issued)	Amount invested	Environmental integrity	Market confidence	Returns	Risks
Sembcorp Financial Services Pte Ltd (SGXF23837739)	$297,066,468 (Energy Efficiency)	9.8	9.7	9.7	9.8	9.7	9.9	9.8
Sembcorp Financial Services Pte Ltd (SGXF87707232)	$259,933,160 (Energy Efficiency)	9.8	9.6	9.6	9.8	10.0	9.8	9.8
Mpact Treasury Company Pte Ltd (SGXF59943971)	$111,399,925 (Energy Efficiency)	9.6	9.2	9.2	9.3	10.0	9.7	10.0
Singapore, Republic of (Government) (SGXF47639806)	$3,856,136,447 (Climate Change Adaptation)	9.6	10.0	10.0	10.0	9.7	9.1	9.4
Mapletreelog Treasury Company Pte Ltd (SGXZ92919893)	$55,699,962 (Green Construction/Buildings)	9.6	9.0	9.0	9.3	10.0	9.8	9.9
Public Utilities Board (SGXF59503676)	$594,132,937 (Energy Efficiency)	9.6	9.8	9.8	10.0	9.7	9.3	9.3
National Environment Agency of Singapore (SGXZ80450612)	$964,034,111 (Eligible Green Projects)	9.5	9.8	9.8	9.7	9.3	9.4	9.3
CapitaLand Ascendas REIT (SGXF50149396)	$222,469,410 (Clean Transport)	9.5	9.3	9.3	9.7	9.7	10.0	9.1
CapitaLand Ascendas REIT (SGXF53470518)	$74,266,617 (Clean Transport)	9.5	9.1	9.1	9.7	9.7	9.6	9.7
National University of Singapore (SGXZ10515765)	$222,799,851 (Energy Efficiency)	9.5	9.4	9.4	9.3	9.3	9.5	9.7

Source: The table was generated by the authors using information obtained from LSEG/Refinitiv Workspace, and an author-developed custom scoring and ranking system.

Table (15) shows the top 10 ranked bonds for Singapore. The configuration of bonds differs compared with Thailand and Malaysia, with a number of government/agency bonds entering the list. This includes a multi-billion dollar government issuance, separate bonds from the National Environment Agency, and Public Utilities Board. Meanwhile state supported entities including Sembcorp is state owned, and the National University of Singapore which is a public university. In other words there is a considerably different balance of corporate versus non-corporate bonds appearing among the top ranked opportunities in Singapore.

The top ranking bonds are from Sembcorp, who also are identified as an interesting equity

investment option owing to their business track record and conditional approvals for low-carbon electricity imports from Vietnam to Singapore, as discussed in Section (4). Mapletreelog Treasury Company Pte Ltd, MPACT Treasury Company Pte Ltd, and Capitaland Ascendas REIT are all in the real-estate business and may not offer the most attractive projects for the purpose of facilitating low-carbon electricity imports. However given their property portfolios they may potentially be major players in the demand/purchase of cross border power-purchase agreements for low carbon electricity into Singapore.

5.5 Enhancing the ASEAN Green Bond Market

Considering the ongoing evolution of the ASEAN green finance sector, strategic interventions are essential to augment the efficacy and appeal of green bonds, aligning them more closely with key environmental and sustainability criteria and ambitions.

To maximize the impact of green bonds, prioritizing countries with robust infrastructure and a proactive stance towards green initiatives is crucial. Nations like Singapore, Malaysia, and Thailand demonstrate significant advancements in green finance, evidenced by substantial green bond issuances and well-established regional frameworks. These countries have the necessary infrastructure and high investor interest, making them ideal focal points for targeted green bond investments.

Emerging markets within ASEAN, which have embraced strategic planning and regulatory endorsements of sustainable practices, also present viable opportunities. These countries are improving transparency in sustainability disclosures and showing promising growth in their green finance sectors.

Aligning with international standards set by the International Capital Market Association (ICMA) and the Climate Bonds Initiative (CBI) enhances the credibility of green bonds and ensures global competitiveness. Supportive policies that incentivize green bond issuance are equally important, such as tax benefits for issuers and investors, grants for certification costs, and reduced regulatory hurdles for qualifying green projects. Credit enhancements are suggested to reduce the perceived risk associated with green bonds, attracting a broader range of conservative investors. Strengthening the ASEAN Green Bond Standards to include stricter ESG criteria will address regional sustainability challenges more effectively and encourage higher standards of environmental integrity.

Investing in green bonds with high ESG ratings is essential for maintaining market integrity and investor trust. Integrating ESG performance targets directly into bond yields could revolutionize green finance by linking financial returns to the achievement of specific ESG targets. Mandating detailed environmental impact reports from issuers will help prevent greenwashing and ensure investments genuinely contribute to environmental sustainability. Independent third-party verification to assess project compliance with ESG criteria can enhance transparency and accountability

Listing green bonds on major exchanges is proposed to improve market liquidity and facilitate investor access. This would increase the visibility of green bonds and ensure they are readily available to a global investor base, enhancing trading volumes and market depth.

In conclusion, the recommendations provided herein aim to bolster the ASEAN green bond market by focusing on regulatory support, market accessibility, and stringent adherence to ESG frameworks. Through these strategic interventions, ASEAN can lead by example in the global green finance arena, driving substantial progress in sustainable development and climate change mitigation.

6 Conclusions and Policy Implications

Investing into clean energy projects, and the companies which conduct them is one way to accelerate the transition to a net-zero economy, in line with Singapore's ambitious targets to decarbonise. However understanding how and where to invest, on the basis of today's landscape requires some effort.

This report considered a specific framework for identifying investment opportunities—in both equity and green bond markets—primarily aimed at supporting low-carbon electricity imports from ASEAN countries into Singapore. This will not only facilitate, but potentially accelerate, the transition to a domestic decarbonised power sector while also benefiting the development of the renewable energy sector more broadly across the ASEAN region.

There is a historically complex regional geopolitical landscape and increasingly unstable global political economy, as well as a lack of clarity regarding technology and policy pathways for decarbonisation. To calibrate an objective understanding and tool for navigating these conditions, an investment framework is outlined that initiates with a quantitative PESTEL assessment to prioritise countries to invest into based on their current political, economic, social, technological, economic and legal (regulatory) contexts. This can help navigate excessive risks in any or multiple of these dimensions, or at the very least allow a prudent investor to approach investment opportunities with eyes wide open to the macroeconomic conditions in play. Malaysia, Thailand, and Vietnam were identified as the top/preferred countries for renewable energy investments, based on the principles and weights applied in the quantitative PESTEL framework.

With priority countries objectively selected, the next phases in the investment framework were to screen and rank investment options in both the equity and green bond markets. Key players in the renewable energy sector, such as Mega First Corporation in Malaysia, CK Power in Thailand, and Power Generation Joint Stock Corporation 3 in Vietnam, demonstrate significant potential as partners for Singapore's renewable energy imports. Their strong ESG performance and substantial investments in renewable energy align with Singapore's climate objectives, making them valuable collaborators in the region's sustainable energy transition. Singapore's own companies, Sembcorp and Keppel, are key contributors to the nation's renewable energy efforts, further solidifying the regional network required for sustainable energy development.

The evaluation of the ASEAN green bond market revealed significant strengths in transparency, adherence to ESG criteria, and long-term sustainability potential. However, challenges such as market perception and liquidity gaps necessitate targeted interventions for market enhancement.

Strategic recommendations include enhancing regulatory frameworks, incentivizing green bond issuances through tax benefits and grants, and improving market liquidity by listing bonds on major exchanges. Strengthening ASEAN Green Bond Standards with stricter ESG criteria and mandating comprehensive environmental impact reporting will ensure market integrity and investor trust, which are vital for sustainable finance growth.

By implementing these measures, ASEAN can position itself as a global leader in green finance, supporting regional energy security and advancing progress towards sustainable development goals.

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Appendix: Green Bonds Scoring Criteria

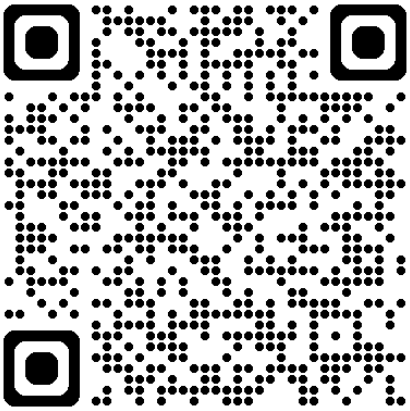
The table below presents detail on the key variables and scoring criteria applied in assessing and screen green bond investment opportunities in the ASEAN. These cover metrics describing issuance volume, environmental integrity, market confidence, risk, and financial returns. Additional discussion on their usage and interpretation is provided in the main text within Section (5).

Appendix Table A1:
Metrics Used to Score and Rank ASEAN Green Bonds.

Metrics used to score and rank green bonds.		
Criterion & Indicator	**Metric/Logic**	**Scoring**
Issuance Volume		
Amount issued (in USD)	Indicates the bond's market significance, with higher amounts showing more substantial issuance	Ranked and normalized, highest issuance receives a normalized score of 10
Environmental Integrity		
Certifications	Shows alignment with green bonds standards/principles such as CBI, ASEAN, and ICMA	• CBI Standard: 2 points • CBI taxonomy, ASEAN, or ICMA aligned: 1 point
ESG bond	Indicates if the bond meets environmental, social and governance standards	• If yes, assign 1 point
ESG score	Reflects the bond issuer's ESG rating, with higher scores indicating better performance	• If ESG score > 70, assign 1 point
Second party opinion	Validates the bond's green credentials through independent review	• Top tier auditor: 2 points • Middle tier auditor: 1 point
Market Confidence		
Exchange listed	Indicates if the bond is listed on an exchange, affecting liquidity and accessibility	• If listed, assign 1 point.
Prospectus available	Availability of a prospectus, ensuring transparency and informed investment decisions	• If available, assign 1 point.
TRPS/composite price	Reflects market sentiment and trading activity, higher prices indicate higher confidence an liquidity	• TRPS>100: 1.5 points (high demand / quality) • 90 $\leq$ TRPS $<$ 100: 1 point • 80 $\leq$ TRPS $<$ 90: 0.5 points • TRPS $<$ 80: 0 points (low demand / quality or high risk)
Risk		
Bond grade	Measures credit quality, with investment grade indicating lower risk	• If investment grade, assign 1 point.
Sinking fund	Indicates a mechanism to reduce default risk by setting aside funds	• If yes, assign 1 point
Guaranteed	Shows if the bond's principal and interest payments are backed by a guarantee	• If guaranteed, assign 1 point
Credit risk rating (CRR)	Reflects the bond's credit rating by rating agencies	• If rated, assign 1 point
Risk classification	Indicates the type of backing (credit, project, asset, hybrid) affecting the bonds risk profile	• Any backing available, assign 1 point.
Yield spread to worst (YTSW)	Measures the difference between bond yield and benchmark, indicating potential risk	• YTSW $\leq$ 100bps: 3 points • 101 $\leq$ YTSW $\leq$ 200bps: 2 points • 201 $\leq$ YTSW $\leq$ 300bps: 1 points • YTSW $\geq$ 300bps: 0 points
Yield spread to maturity (YTSM)	Similar to YTSW but considers yield if bond is held to maturity	• YTSM $\leq$ 100bps: 3 points • 101 $\leq$ YTSM $\leq$ 200bps: 2 points • 201 $\leq$ YTSM $\leq$ 300bps: 1 points • YTSM $\geq$ 300bps: 0 points

Continuation of Table A1

Criterion & Indicator	Metric/Logic	Scoring
Macaulay duration	Measures bond's sensitivity to interest rate changes; shorter durations indicate less risk	• < 5 years: 3 points • 5-10 years: 2 points • 10-15 years: 1 point • >15 years: 0 points
Controversies score	Assesses the bond issuer's involvement in controversies; lower scores indicate more controversies	• <50: 0 points • 60-99: 1 point • 100: 2 points
Bond Returns		
Yield to maturity (YTM)	Expected total return if the bond is held to maturity, compared against benchmarks (10 year government bond yield for the country): Singapore (2.98%); Malaysia (4.05%); Thailand (2.66%)	• YTM < Benchmark (BM): -1 point • BM <= YTM <= BM + 0.5%: 0 points • BM + 0.5% < YTM <= BM + 1%: 0.5 points • BM + 1% < YTM <= BM + 1.5%: 1 points • BM + 1.5% < YTM <= BM + 2%: 1.5 points • BM + 2% < YTM <= BM + 2.5%: 2 points • YTM > BM + 2.5%: 0 points (considered too risky)
Yield to worst (YTW)	Expected lowest yield if the bond is called or prepaid before maturity, compared against benchmarks (10 year government bond yield for the country): Singapore (2.98%); Malaysia (4.05%); Thailand (2.66%)	• YTW < Benchmark (BM): -1 point • BM <= YTW <= BM + 0.5%: 0 points • BM + 0.5% < YTW <= BM + 1%: 0.5 points • BM + 1% < YTW <= BM + 1.5%: 1 points • BM + 1.5% < YTW <= BM + 2%: 1.5 points • BM + 2% < YTW <= BM + 2.5%: 2 points • YTW > BM + 2.5%: 0 points (considered too risky)
End of metrics used to score and rank green bonds.		



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