Southeast Asia’s
Green Economy 2022 Report
Investing behind new realities
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Reference

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The insights and content of this report also benefited from the wisdom of >50 leading industry experts across SEA and beyond. The richness and clarity of thought in this report would not have been possible without the thought leadership from these individuals. To all who answered our call or wrote a thoughtful email – we owe you our deepest thanks.
Prologue

Last year, we examined the building blocks that Southeast Asia (SEA) has developed as part of its journey towards Net Zero, with focus on better understanding needed climate actions and sustainability themes unique to the region. In doing so, we highlighted the interconnections between our environmental biodiversity, community livelihood, and economic opportunities. We further defined individual and collective actions to drive a holistic approach and lead in the race towards Net Zero.

Since then, COP26 has fueled critical progress towards a green transition, with six new SEA countries committing to Net Zero targets. While this is an important step in the right direction, clear transition pathways are yet to be defined. Across the region, we observed gaps in emission reduction plans and investment commitments. The road from Glasgow to Kuala Lumpur, Manila, and Singapore has further been complicated by energy and food security concerns. Significant financial support is needed.

This year’s report starts to build a perspective on green investments in SEA – where the investment should flow to drive the most tangible impact in this decade and what it takes to realize the impact. Notwithstanding a long list of potential levers across the carbon abatement curve that would need to be deployed to ultimately achieve Net Zero, it is important to recognize the urgency and need for greater focus on solutions that will deliver carbon savings sooner than in the longer-term future. In this report, we set out to identify the region’s decarbonization themes by carbon abatement potential and attractiveness for investors, with the outlook towards 2030. We identified a shortlist of investable themes that are most pragmatic in delivering both returns and carbon impact, with specific opportunities within the priority themes.

While the scale of opportunities and the need to act are clear, there are current impediments holding back the scaling of SEA green economy. Many disconnects presently limit the ability to translate potential opportunities into accessible markets and investments. We frame many of these impediments and recommendations to address them.

We hope this report will provide a catalyst for a more open and honest discussion about constraints to unlock the green economy, clarify investable and addressable decarbonization pathways for the decade, inspire stakeholders to take actions, and unlock investment flows to accelerate the transition towards Net Zero.
As a global society, we continue to face the adverse externalities of carbon emission, but recent headlines have signaled a positive trajectory towards a low-carbon reality. COP26 has triggered new waves of much-needed climate moves – new ambitions and targets were declared in the last 12 months. Six new SEA countries declared their net zero commitments; corporates also picked up the transition momentum with new SBTi commitments almost tripling between 2021 and 2022. At the same time, green capital flows have seen an uptick with half of all investments in the last two years coming in the last three quarters.

Yet it is not enough. SEA still faces tremendous challenges to close the emission gap of ~3 Gt (gigatonne) by 2030 to be aligned to 1.5°C pathway. $3 trillion in green investment is needed to build the energy infrastructure and nature-based solutions to close the gap, of which less than 1% has been invested to date.

The journey ahead is further complicated by recent global economic and political disruptions – the war in Ukraine, concerns over energy security, and increasing commodity prices have all added complexity to overall transition planning.

We remain bullish on the $1T green economy opportunities in SEA; however, we need to step up as a region to strengthen the investable market and increase capital flows into green opportunities. SEA needs to move from promises to actions, and the time to act is now. To capture this opportunity, SEA businesses must lead with innovative breakthroughs and collaboration across stakeholders. Regulatory and market players need to focus the transition effort on deployment of ready solutions. While not a silver bullet, proven technologies with positive ROI will impact small business owners and farmers at the base of SEA economy to enable sustainable transition.

At Bain, we champion the change we want to see in the world. As we are helping clients find ways to leverage sustainability as a source of value and competitive advantage, we have redoubled our efforts to embed sustainability in our internal operations. Since 2021, we are a net-negative carbon company, offsetting more than 100% of our scope 1, 2, and 3 emissions with nature-based carbon removal projects.

Since launching Further™ last year, our integrated ESG engine with leading experts and solutions, we continue to push the boundaries in building thought leadership across ESG challenges. We recently appointed our first global managing partner on ESG to oversee our collective ambition of creating a more sustainable, equitable, and inclusive world. We invite you to join us as we strive to progress along the Net Zero journey.
Foreword by Temasek

Steve Howard
Chief Sustainability Officer
Temasek

The fight to keep global warming under 1.5°C has reached the critical phase. Bold, aggressive measures are needed to address the climate crisis; we must act urgently to drastically reduce carbon emissions across all sectors today, so that our future generations can inherit a liveable, sustainable planet.

SEA’s role in the green transition has tremendous potential to make long term, meaningful impact in a vibrant part of the world. The region’s tenacious growth will give it a bigger share of the global marketplace, thanks to thriving economies, underpinned by an expanding middle class that will double by 2030. SEA’s population is also young, with more than half its people under 30 years of age.

But no country, community or company can do it alone. Partnerships will help catalyze capital, sustain commitment and multiply positive impact, while accelerating the development and eventual deployment of sustainable solutions at scale. And meaningful financing will be critical for realizing the full potential of decarbonization levers across all green investment asset classes.

Adopting a high climate ambition agenda will not only deliver environmental and social benefits, but also help to deliver better and more sustainable returns over the longer term that will be beneficial for people and planet.

Technology and innovation are key to this mission. Such solutions help mitigate the causes of the ongoing climate crisis, support the transition to low carbon business models, and aid in mainstreaming the adaptation to climate change.

But substantial amounts of capital are required to bring new solutions to scale, especially in hard-to-abate sectors like transportation and heavy industry. Given the scale and urgency of the necessary transitions, there is a need for government, corporations and investors to work together in not only developing but accelerating sustainable solutions. The opportunities are immense, but unlocking them will take collective will and unprecedented collaboration.

At Temasek, sustainability underpins all that we do. We have committed to halve the carbon emissions of our portfolio by 2030, and to become net zero by 2050. SEA, propelled by a fast-growing digital economy, is an important region for Temasek, with new ventures underway.

GenZero, a $5 billion carbon solutions platform that aims to accelerate decarbonization, is one such venture. GenZero investments will seed a portfolio of sustainable forest assets across the region, as well as protect and restore natural ecosystems. GenZero is also partnering Climate Impact X, a global carbon exchange and marketplace which aims to establish a trusted and credible carbon trading infrastructure based in Asia.

We hope this report will give you useful insights into SEA’s potential, and hope that you can contribute to accelerating climate action for our collective sustainable future.

Let us work together and focus our best efforts on the transformation to a sustainable economy, so every generation prospers.

Steve Howard
Chief Sustainability Officer
Temasek
The road to decarbonization is not just a sprint or a marathon – it is in fact both.

Globally, we seem to be facing three barriers in our quest towards decarbonization: meaning, measurement, and markets. Today, there isn’t a universal understanding of what “net-zero” means, there isn’t a universal unit to measure and assess the climate impact of a net-zero approach, and overall we are not providing enough opportunities to help markets mature and achieve their net-zero targets.

For SEA in particular, it is this third challenge that we need to solve. This region is indeed unique, with over 50% of SEA’s GDP (gross domestic product) coming from small and medium enterprises (SMEs), making it crucial that we transition these companies into the green economy and empower them in their sustainability journey.

Though it is encouraging that there has been a growing number of sustainability commitments from corporations, there is also currently a 3 Gt (gigatonne) emission gap that we need to close within SEA alone. Since there will likely never be a panacea for the climate crisis, we shouldn’t wait before we act – it is crucial we double down on the available decarbonization solutions in the market now, while at the same time continue to develop future solutions that we should invest in tomorrow.

This is exactly why Microsoft believes in making our technology more accessible to SMEs and startups — to help them accelerate their contributions to the green economy and create positive impact. Take for instance Indonesian digital platform Jejak.in and startup givvable that was founded by two sisters in Australia – both platforms are powered by AI and Microsoft Azure, providing governments and suppliers respectively with data to make informed and sustainable decisions.

Partnering with various companies around the globe, like clean energy company Xurya and B2B marketplace for carbon removal Puro.earth, are other great examples of leveraging currently available technology and working collectively to accelerate towards net-zero together with like-minded organizations.

When it comes to future solutions, established businesses and MNCs should continue to pave the way for upcoming innovators to emerge in SEA. It is this drive towards co-innovation that will allow investment opportunities in the region to flourish, and is one of the reasons Microsoft created a $1 billion climate innovation fund to accelerate tech development and deployment of new climate innovations in underfunded, less mature markets. Other capabilities, like the new features in Cloud for Sustainability that will launch in a couple of days, will also leverage the latest tech to power SMEs at varying stages of the green transition.

Today, we reaffirm our commitment to becoming carbon negative by 2030, and removing all carbon from the environment that Microsoft has emitted either directly or by electrical consumption since we were founded in 1975, by 2050.

While these are ambitious enough goals, we cannot simply stop at decarbonization: we must also take action to become water positive, zero waste, and protect our planet’s ecosystems and biodiversity.

After all, the future belongs to us, and as one of the organizations leading sustainability efforts, we need to set a path for future leaders to follow, and ensure we all get there together.

Sandy Gupta
President
Microsoft Asia Pacific

Foreword by Microsoft
About Southeast Asia’s Green Economy 2022 Report

2020
Pathway to Full Potential
Assess SEA’s green economy potential and strategic pathways

2021
Opportunities on the Road to Net Zero
Develop a collective action plan for SEA to capture economic opportunities

2022
Investing behind new realities
Identify investable opportunities and what it takes to accelerate the net zero transition

Extensive efforts behind Southeast Asia’s Green Economy 2022 Report

~10K deals in SEA screened from 2020 to early 2022

~30 decarbonization levers screened for prioritization

>50 interviews with various investors and sector experts based in SEA

5 deep dives on priority levers that possess highest carbon abatement potential and investability
### Summary by the numbers

<table>
<thead>
<tr>
<th>Rising commitments and material prize in SEA ...</th>
<th>... with increasing investment in last 2 years ...</th>
<th>... but more can still be done to unlock full potential</th>
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<tbody>
<tr>
<td><strong>8 out of 10</strong></td>
<td><strong>$15 billion</strong></td>
<td><strong>~3 Gt</strong></td>
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<td>SEA countries committed to Net Zero targets</td>
<td>invested cumulatively by various investors in SEA since 2020, with ~45% deployed in last three quarters (Q3 2021 till Q1 2022)</td>
<td>emission gap for SEA to 1.5°C aligned levels in 2030</td>
</tr>
<tr>
<td><strong>2-3x</strong></td>
<td><strong>$11 billion</strong></td>
<td><strong>$3 trillion</strong></td>
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<tr>
<td>estimated growth in number of new SBTi commits by corporate firms in SEA between 2021 and 2022</td>
<td>deployed cumulatively by corporate firms in SEA since 2020, with a focus on Renewables and Built environment</td>
<td>cumulative investment required in SEA to be on track to 1.5°C by 2030</td>
</tr>
<tr>
<td><strong>$1 trillion</strong></td>
<td>~3x</td>
<td>~50%</td>
</tr>
<tr>
<td>annual green economic opportunities for SEA by 2030</td>
<td>more investment value on sustainability-focused start-ups by private equity/venture capital investors in SEA in 2021 than 2020</td>
<td>of SEA’s GDP is contributed by SMEs who need to be engaged for the green economy</td>
</tr>
</tbody>
</table>

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Note: (1) Science Based Targets initiative; (2) Small and medium enterprise
Executive summary

The Year 2022 is an inflection point for SEA as the region works to translate COP26 climate commitments to tangible action

Momentum is growing across both public and private sectors

COP 26 has accelerated climate action, with six SEA governments setting net-zero targets in last 12 months, and two piloting carbon taxes

More corporations are committing to net zero, as new SBTi commitments have nearly tripled

Entrepreneurial energy is also growing with increased focus on building and scaling sustainable solutions, especially in the energy and agri-food space, combined with exponential growth (~3x) in PE/VC sustainability investments between 2020 and 2021

Consumers are choosing climate – many are willing to try sustainable options and have expressed desire for more options in sustainable investment solutions

SEA is at the same time well short of where it needs to be on carbon and investment to reach 2030 goals

As nations are deep at work translating COP26 targets to real action, significantly more needs to be done with concrete roadmaps, incentives and climate financing plans

Despite bolder new ambitions, there is still a large emission gap of 3 Gt to be closed by 2030

Investments needed to close the emissions gap are estimated between $1-3T, while current investment level is only less than $208

Renewed concerns about energy security, food security, and widespread inflationary forces are competing with climate change for urgent attention, calling for a comprehensive systemic approach to address these national priorities

In this context, we analyzed green capital flows to identify opportunities and how to unlock the full potential of the green economy
Executive summary

Digging deeper into investor action, one sees many bright spots across asset classes and themes – yet far from full potential

**Encouraging growth in green investment observed over 2020 and 2021**

SEA has high potential for sustainability impact. Transitioning key sectors and developing the green economy still offers a huge prize: $1T annual economic opportunity by 2030

We have seen the potential country commitments in SEA green investments accelerate over the past 12 months. More than $15B new green capital has been deployed since 2020 - half of that deployed in the most recent three quarters

Key corporate investments (~75% of green capital) have focused on Renewables and Built environment

PE/VC firms are investing in start-ups scaling next-gen solutions in Alternative proteins and E-mobility niches such as two-wheeler electric vehicles

**Renewables (Solar and Wind) represent a $30B opportunity1 by 2030**

Corporate investment in renewable energy solutions is accelerating in the region and accounted for at least $6.6B in corporate green investments since 2020

**For Solar**, we expect clear opportunities in C&I projects in Philippines and Malaysia, with continued potential in utility scale projects

**For Wind**, there’s also a clear opportunity for onshore and offshore wind project development in Vietnam and Philippines, given capacity requirement (to fulfill bold targets), favorable geography and attractive returns (8-15%)

Both Wind and Solar are growing due to tech maturity and attractive returns, but still need a conducive market structure (e.g., allow scaled play), grid upgrades, and improvement in bankability of projects to accelerate trajectory to full potential

**Electric mobility represents a $50B opportunity1 by 2030 with challenges to ramp up and scale**

E-mobility looks poised to take off in Indonesia, Thailand, and Vietnam, especially for two-wheeler electric vehicle manufacturing and sales

While foreign OEMs3 dominate vehicle and cell manufacturing, there are opportunities to partner with foreign OEMs to set up SEA battery manufacturing plants

To unlock the full potential with E-mobility, SEA countries need to improve market access and overcome transition costs, with proper incentives and infrastructures

Note: (1) Sized in annual revenue; (2) Commercial and industrial; (3) Original equipment manufacturer
Executive summary

Digging deeper into investor action, one sees many bright spots across asset classes and themes – yet far from full potential (Cont.)

**Forest conservation among largest carbon abatement levers, $20B opportunity\(^1\) by 2030**

Established investors are building the foundations for trading carbon credits generated from nature-based solutions, notably including the launch of CIX\(^2\).

Moving forward, we expect continued growth and a looming supply crunch with a shortage of high-quality credits but also a growing investable space, especially in Indonesia and Malaysia.

More expertise is needed upstream with project origination and development to increase project viability and security to enable SEA to better tap nature as a key source of carbon capture and reduction.

**Built environment represents a $40B opportunity\(^1\) across many segments**

Built environment is one of the top focus areas for corporate investors and infrastructure funds.

Significant opportunities reside in energy-saving technology such as efficient cooling solutions (e.g., efficient cooling for data centers), especially in Singapore, Philippines and Thailand, and green building products to aid construction of green buildings in Singapore and Indonesia.

Development of enabling policies, enhanced financing, and better awareness & collaboration required to reach full potential.

**Sustainable farming represents a $30B opportunity\(^1\) by 2030**

Precision agriculture and Farmer service platforms are most attractive opportunities due to strong regulatory support, especially in Malaysia, Thailand and Vietnam.

To reach full potential, it is key to improve farmer’s connectivity to the market (esp. through public-private partnerships) & financing, and support innovative models (e.g., AgTech start-ups).

**Promising as these sectors appear, current activity is far from the scale needed to unlock economic potential or carbon impact**

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Note: (1) Sized in annual revenue; (2) Climate Impact X
Executive summary

If the scale of the opportunity and need to act are clear, what are the impediments holding back scaling the green economy?

**Insufficient incentives to help decarbonization levers to scale quickly**

Decarbonization is top-of-mind for investors but is limited by scale of opportunities and inconsistent returns.

Opportunities for private capital are limited to small scale in many sectors.

Many new projects lack sufficient incentives to meet threshold return.

**Bias toward new solutions vs. proven, low-risk levers**

Greater priority on “revolutionary” decarbonization solutions vs. “evolutionary”, proven ones.

Proven solutions offer low-risk impact across SME and other segments of economy that are not engaged today; implementation challenges exist but there is clear decarbonization potential.

**Lack of clarity on system costs for energy transition**

Renewable are competitive on LCOE basis, but integration and system costs are not fully reflected in discourse; addressing the full cost roadmap is necessary to scale investment moving forward.

Genuine change requires serious plans to address who pays for the new (e.g., renewables, grid upgrades) and phasing out of the old (e.g., coal assets).

What needs to change to meet the climate promises of COP26 and capture the economic prize of SEA green economy?

**SEA should take four key actions to accelerate green investment**

**Unlock opportunities in proven solutions**: Adopt a more holistic decarbonization program with stronger framework & incentives to expand market access and enroll mass-segment participants like SMEs.

**Confront system costs for energy transition**: Clarify full costs on renewables-power transition; define funding sources and mechanisms to attract investments.

**Strengthen green financing**: Leverage financial services sector to develop abatement investment products that lower the cost of capital for businesses to transit.

**Drive creative regional collaboration**: Scaleup regional collaboration to unlock new potential and mitigate risks; foster partnerships across value chain, industries, and public/private sectors.
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A year of new challenges

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Identifying near-term investable opportunities

The current disconnect
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Recommendation
Actions to accelerate and scale the green economy

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Country insights
Introduction

2022: Moving from promises to action

A year of new challenges
Introduction

More SEA countries commit to Net Zero and start to translate ambitions to actions

Parallel momentum is building across investors, corporates, and regional consumers

However, large emission and investment gaps still exist to deliver 2030 promises

Renewed concerns about energy security and inflation add to the complexity

The following sections of this report set off to address the key findings and gaps with pragmatic recommendations for SEA
COP26 raised SEA’s climate ambition, with eight out of ten countries now having net zero targets and two new countries piloting carbon taxes.

<table>
<thead>
<tr>
<th>Net Zero</th>
<th>Brunei</th>
<th>Cambodia</th>
<th>Indonesia</th>
<th>Lao PDR</th>
<th>Malaysia</th>
<th>Myanmar</th>
<th>Philippines</th>
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<td>(2050+)</td>
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**Emissions reduction**

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<td>indonisa</td>
<td>Jul 2021</td>
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<td>lao pdr</td>
<td>May 2021</td>
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<td>singapore</td>
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<td>thailand</td>
<td>Oct 2020</td>
<td>~20%</td>
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<td>vietnam</td>
<td>Sep 2020</td>
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**Carbon pricing (in USD)**

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<th>Carbon pricing to be implemented by 2025</th>
<th>NA</th>
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<th>Carbon tax and ETS under consideration</th>
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<tr>
<td>~$2/tCO$_2$e for coal power, full market by 2025</td>
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<td>Carbon tax (~$4/tCO$_2$e) implemented, to increase to $40-60 by 2030</td>
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<td>Manhattanized from 2021 GE Report</td>
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<td>ETS under consideration</td>
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<td>ETS legalized – Pilot Carbon Exchange from 2025</td>
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**Renewables capacity**

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<tr>
<td>Capacity</td>
<td>30%</td>
<td>25%</td>
<td>~48%</td>
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**Nature**

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<tr>
<td>Increase forest reserves from 41% to 55% by 2035</td>
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<td>Increase forest cover to 60% of total area by 2030</td>
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<td>Protect 5.8m ha of forests and 1.9m ha of peatlands by 2030</td>
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<tr>
<td>Increase forest cover to 70% of total area (conditional) by 2030</td>
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<tr>
<td>Protect &gt;20% of terrestrial and 10% of coastal areas by 2025</td>
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<tr>
<td>Increase forest under public protection to 30% of total area by 2030</td>
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<tr>
<td>Eliminate net loss in natural forests, mangrove, seagrass, coral cover by 2028</td>
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<tr>
<td>Plant 1m more trees and add 130ha of new parks by 2030</td>
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<td></td>
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<tr>
<td>Increase forest cover to 55% of total area by 2037</td>
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<tr>
<td>Increase forest cover to 42% of total area by 2030</td>
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</tbody>
</table>

Note: (1) Committed to carbon neutrality by 2050, no direct commitments on net zero (expecting 2050+); (2) By or around 2050; (3) Emissions reduction refers to target reduction by 2030 from BAU. Unconditional reduction targets are non-dependent on external support. Conditional targets depend on sufficient support from international community; (4) Reflects emissions intensity of GDP relative to BAU; (5) Target has not been revised since 2011, expressed as % of consumption; (6) Unconditional target of 11% non-hydro renewables by 2030; (7) Solar capacity target by 2030, as % of estimated total capacity | Source: UNFCC NDC Registry; ACCEPT; UNFCC; New Straits Times; Eco-business (1); Government of Thailand; Climate Action Tracker; Reuters (1); CNA (1); VietnamPlus; ASEAN State of Climate Change Report; ASEAN Plan of Action for Energy Cooperation; Reuters (2); Mongabay; Greenplan; Power-technology; TheEdge; JTC; Eco-business (2); Government of Philippines; icap; BusinessInquirer; BangkokPost; IEA; UN; Platform2020redesign; nupi; lORB; Updated from 2021 GE Report; No changes from 2021 GE Report; Does not exist; Regional target of 35% by 2025 (from ~24% in 2018)
As nations start the hard work to translate COP26 targets to real actions, significant gaps need to be closed through specific action plans, governance, and financing.

**Ambition yet to translate into action**

Despite increased ambitions ahead of COP 26, SEA nations (aside from Singapore) have yet to translate much of their promises into clear actions.

**Not on track for 1.5°C scenario**

No country expected to reach emission reduction compatible with the 1.5°C scenario by 2030 (i.e., emissions 45% below 2010 levels).

**Policies and actions in the works**

Need for updated roadmaps on national and key sector levels (e.g., for energy), as well as clear policies and incentives for fossil fuel phase-out to align with the new ambitions. For example, Indonesia introduced carbon tax for coal power, but current level ($2) is insufficient to incentivize the transition.

**Climate financing insufficient to support unconditional NDCs**

SEA countries need to specify climate financing plans in the national budgets (similar to Singapore’s plan in Budget 2022 to issue $25B green bonds by 2030). Initial green bond issuances in 2021 are a promising start, but the volume needs to increase 15-20x to cover the investment gap by 2030.

---

**Note:**

1. Total of $23.6B out of $350B investment need by 2030 for the 6 countries; 2. Committed to carbon neutrality by 2050, no direct commitments on net-zero (expecting 2050+); 3. By or around 2050; 4. Alternative Energy Development Plan; 5. Green bonds issues in 2021; All amounts in USD

Source: Straits Times; Business Times; Lit. search; Climate Analytics; Climate Action Tracker

---

**Table: Action plans in place but need to improve enforcement and governance**

<table>
<thead>
<tr>
<th>Net-zero target by 2050</th>
<th>Decarbonization Action Plan</th>
<th>Reporting &amp; Governance</th>
<th>Climate Financing (e.g., green bonds$)</th>
<th>Overall assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaysia Plan (2060)</td>
<td>✗ 10Y electricity supply plan, moratorium on new forest clearance, carbon tax (only applicable for coal)</td>
<td>✗ Need to improve coordination across key ministries to define joint governance and reporting mechanism</td>
<td>✗ $6.25B of green sukuk</td>
<td>Action plans in place but need to improve enforcement and governance; potential conflict with energy security and economic goals. Expected to be able to achieve NDCs</td>
</tr>
<tr>
<td>Malaysia Plan (2065)</td>
<td>✔ Need for more explicit climate policies beyond 12th Malaysia Plan</td>
<td>✗ Need for formal regulations and a governing body to oversee climate policies/goals</td>
<td>✖ $48 of green sukuk</td>
<td>Need for more clarity on concrete steps and financing; at risk of not achieving NDC targets by 2030</td>
</tr>
<tr>
<td>Thailand Plan (2060)</td>
<td>❌ Most climate-specific policies drafting still underway. AEDP, national EV roadmap</td>
<td>✗ Need for more consistent policies (Energy Conservation Promotion Act); governing body (NCCC) set up to oversee national climate policies</td>
<td>✖ $2.85B of green bonds</td>
<td>Need for more concrete execution and financing plans; at risk of not achieving NDC targets by 2030</td>
</tr>
<tr>
<td>Vietnam Plan (no target)</td>
<td>✔ ETS, pilot carbon exchange in ’25, development strategy on renewable energy but no carbon tax yet</td>
<td>✔ Presence of inter-ministerial governing body, but no carbon tax to enforce and regulations (e.g., environmental protection) only applicable to biggest emitters</td>
<td>✔ $2.85B of global sustainability bonds</td>
<td>Need for stronger ambition, implementation; able to achieve NDC targets by 2030 (unconditional target far below region average)</td>
</tr>
<tr>
<td>Indonesia Plan (2020)</td>
<td>✔ $4 industrial carbon tax since ’19 ($40-60 by ’30), Energy Conservation Act, Climate Action Plan, power sector roadmap</td>
<td>✔ Presence of inter-ministerial governing bodies and regulations that mandate reporting for private companies (e.g., Carbon Pricing Act)</td>
<td>✖ $3B of green bonds ($25B planned by 2030)</td>
<td>Significant progress and expected to achieve NDC targets (but not 1.5°C scenario yet) – regulatory and financing infrastructure in place with concrete action plans</td>
</tr>
</tbody>
</table>
All stakeholders across SEA are advocating for greater change in climate action

<table>
<thead>
<tr>
<th>Corporates</th>
<th>Investors</th>
<th>Consumers</th>
</tr>
</thead>
</table>
| **2 – 3x**

estimated growth in number of new SBTi commitments between 2021 and 2022

Valuation of firms with SBTi commitments (US$B)

<table>
<thead>
<tr>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>115</td>
<td>57</td>
</tr>
</tbody>
</table>

| **20%**

net growth in number of impact investors since 2020 in SEA

15% of SEA investments deployed in 2020-2021 were sustainability related

1 in 2

APAC investors consider climate change metrics for decision-making

<table>
<thead>
<tr>
<th>Indonesia</th>
<th>Vietnam</th>
<th>Philippines</th>
<th>Malaysia</th>
<th>Thailand</th>
<th>Singapore</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>37</td>
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<td>57</td>
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<tr>
<td></td>
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<td>115</td>
</tr>
</tbody>
</table>

| **20%**

of SEA population believes that governments can allocate more resources to climate change

78% Singaporeans willing to try cell-based options, 45% cite sustainability as the primary motivation

| **79%**

of SEA population understands the urgency of reducing coal-power reliance

79% of SEA population understands the urgency of reducing coal-power reliance

91% of SEA consumers desire more options in sustainable investment solutions

“What has been truly encouraging since the onset of COVID is that no conversation with our customers now goes without mentioning decarbonization. The new (regional) awareness has been fantastic…”

MD, Energy & Sustainability Asia, Microsoft

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Note: (1) Number of corporates with newly formed SBTi commitments as of Q1 2022 is 18. 2–3x increase assumes 18 additional companies joining the SBTi initiative by EOY 2022 on the low end, and 36 additional companies joining the SBTi initiative by EOY 2022 on the high end; (2) Valuation of public company is the market capitalization, valuation of private companies estimated by taking revenues x (price/sales ratio), four large private companies without sales numbers, excluded from calculations, valuations, and number of firms are cumulative; | Source: Bain APAC ESG Study 2022; EMIS; SBTi; Company Financials; CapIQ; HSBC; Economist; Yusof Ishak Institute; UOB; World Economic Forum; CNBC; KrASIA; Lit. search; Bain analysis
Growing activities observed from corporates especially across EVs and renewables

Leading corporates are contributing to country decarbonization efforts

Corporate involvement has **accelerated the development of the EV ecosystem in SEA**, from battery R&D to manufacturing to charging infrastructure

**Increased renewables ambitions** are observed across corporates in numerous countries, with **continued focus on solar and wind**

Investment and government support will further accelerate progress

EV investments, especially in manufacturing, are **accelerated by foreign direct investment**, with potential to further accelerate through broad-based fiscal and non-fiscal **government incentives**

### adaro
- Announced **10-year pivot to clean energy**, with plans to potentially spend $1 billion on Adaro Aluminum Indonesia to cater for metal demand for EV components
- Installed **solar PV panels in the Kelanis facility**

### SPgroup
- **Investing $30-40M** to create Singapore’s first brownfield district cooling system
- **Expected to improve cooling efficiency** from 19K refrigeration tons (RTs) to 7K RTs
- **Estimated reduction of 1,359 mt of CO2 emissions per annum**

### Petronas
- **Continued progress against 2050 net-zero targets**, with deployment of 66 MWp solar energy at the group’s assets across Malaysia
- ~1GW of solar assets operational and under construction

### PTT
- **Increased renewables energy production target** by 50% to 12GW by 2030
- **Investing $1-2B** with Foxconn to build new EV manufacturing facility by 2024; plans to install 300 new charging stations by 2022 and 1,000 new EV fast chargers by 2026

### Ayala
- Ayala subsidiary AC Energy is **investing $274M** in Philippine Solar and Wind projects
- Started installation of EV charging stations across malls in Philippines via wholly owned subsidiary IMI

### VinFast
- **Installed 500 EV charging stations** across Vietnam in 2021
- Signed MOU with PetroViet to install EV charging stations across PetroViet’s service stations
- Delivered 42K electric bikes in 2021
- Achieved ~60K EV 4-wheeler pre-orders as of Apr 2022

Source: Adaro; Bloomberg; Petronas (1); Petronas (2); Petronas (3); The Edge Markets; Reuters (1); PTT; Nikkei (1); Nikkei (2); Techwire Asia (1); Techwire Asia (2); Forbes; Philippine Daily Inquirer; VnExpress; Reuters (2); The Business Times; CNBC; UBS, Viet Capital

Non-exhaustive
More and more start-ups are emerging to develop sustainable solutions for SEA

Start-ups on sustainability are emerging

Cumulative growth in number of founded start-ups (indexed to 2015)¹

```
13X    1     2     3     4     5     6     7
```

Investor demand observes rapid increase

Value of PE/VC sustainability investments in SEA ($M)²

```
Year  2020  2021
181    545
3X
```

"The green economy is an important area of focus for any private equity or venture capital fund that does not want to miss out on the next wave of growth."

Managing Partner, Quest Ventures

Start-up examples

- Built environment
  - BBP
  - SENSOR FLOW

- Solar and Wind
  - XURYA
  - SUN CABLE

- Mobility
  - ION MOBILITY
  - beam

- Sustainable farming
  - TaniHub
  - sayurbox

Note: (1) Only includes publicly known and funded operating start-ups that are sustainability-related; (2) Only includes publicly available deals, excludes deals sizes <10m
Source: Crunchbase; CB Insights; Capital IQ; AVCJ; Industry participant interviews; Bain analysis
Despite recent progress, a large emission gap of 2.6-3.2 Gt exists vs. 2030 targets

SEA estimated emissions gap to deliver 1.5°C emissions pathway in 2030¹

<table>
<thead>
<tr>
<th>Year</th>
<th>2018</th>
<th>2030 BAU</th>
<th>2030 1.5°C compatible</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEA emissions (GtCO₂e):</td>
<td>3.5</td>
<td>3.6</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Note: (1) Assumes 9% - 21% of unconditional NDC target emissions abated due to planned policies, range extrapolated from existing planned policies for MY, SG, ID, TH, VN, and PH; Source: Climate Watch; Climate Action Tracker; Climate Analytics; UNFCCC; CAIT historical emissions (ret. Apr 2022); Lit. search; Bain analysis
Material investments needed to decarbonize vs. the 1.5°C pathway by 2030

**Key takeaways**

**Material gap in financing exists today** to abate 2.6-3.2 Gt CO2e by 2030 – immediate action needed to achieve 1.5°C target

**$3T of cumulative investment needed by 2030** for SEA to transition to a green economy; **~$2T needed to build sustainable infrastructure** across energy, waste, and industrial and construction sectors

---

**Note:** (1) Derived from 2030 planned policy projections for MY, SG, VN, PH, and TH; BAU numbers used for BN, KH, LA, and MM; (2) Non-exhaustive, only publicly available private-sector investments, including deals >$10M USD, involving targets based in SEA, excluding JVs due to data availability; (3) $3T cumulative estimate from 2022–2030 derived from assumed annual global financing estimate of $5.1T, assumes that SEA financing required is emissions proportionate to global financing required; financing required scaled by delta between SEA emissions per capita and global emissions per capita; financing split by sector obtained from emissions per sector | Source: CAIT, Climate Action Tracker; UNFCCC, CAIT historical emissions (ret. Apr 2022); AVCJ; CapIQ; Crunchbase; Preqin; Pitchbook; World Resources Institute; Industry participant interviews; Bain Green Financing model; Bain analysis
All governments have been confronted in 2022 with the need to rebalance actions around energy security (given Ukraine conflict) and inflation vs. net zero promises

**Energy security** is one of the top priorities for rapidly industrializing economies in SEA – importance further escalated by recent Russia-Ukraine conflict.

Concerns over foreign resource dependency and supply chain volatility when transitioning to alternative energy source from low-cost domestic coal (e.g., Indonesia).

While private sector green financing and capital is growing, it is insufficient. Public sector needs to play a bigger role to fill financing gaps.

System costs are significant (e.g., renewables grid costs, EV infrastructure investment) and could impact national budget requirements.

Despite renewed carbon ambitions, short-term economic priorities and development goals could slow down progress in driving decarbonization agenda.

Global pressure exists to accelerate Net Zero ambitions and start delivering carbon commitments to meet 1.5°C targets.

Natural disasters and climate hazards will increasingly impact community livelihoods unless tangible actions are taken.
The situation further exacerbated by the recent Ukraine conflict and resulting inflation; effects likely to linger and slow down decarbonization actions.

The global economy is facing inflation disruption, now at a 10-year high.

Commodity prices at a historic high due to the Russia-Ukraine conflict.

Recent macroeconomic trends, rising commodity prices and supply chain constraints, have caused severe cost-push shocks globally, leading to a reprioritization of decarbonization goals as countries shift towards economic security.

Potential slow-down in SEA for energy, economic and job security.

"The abundance of coal calls for a different approach to align both the ambition to decarbonize and reduce dependence on coal, and safeguard jobs of the many coal miners."

Bain Advisor, Indonesia

Note: (1) Does not include the recent impact of the Russia-Ukraine war
Source: FAO; International Energy Outlook 2021; OECD; Rystad Energy; World Bank; Lit. search; Bain analysis
SEA is challenged by fundamental questions as it plots a path to a green economy

The region is facing **challenges**

- **~3 Gt** emission gap for SEA to 1.5°C aligned levels in 2030
- **$3 trillion** cumulative investment required in SEA to be on track to 1.5°C by 2030
- **Renewed concern** over energy security and inflation

Key questions to be answered in order to **drive necessary green investment**

- What sectors possess the largest decarbonization potential?
- What is the size of opportunity and what will it take to reach full potential?
- What are the accessible near-term opportunities for investment?
Where to invest

Identifying near-term investable opportunities
SEA has high potential for climate action; effectively tackling environmental issues requires holistic view across the multiple building blocks of the green economy

Key building blocks on the green economy journey

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Key building blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>Solar, Wind, Hydropower, Geothermal, Marine energy, 4th gen nuclear, Sustainable biomass/biogas/biofuel, Green hydrogen, Carbon capture and storage, Fuel substitution¹, etc.</td>
</tr>
<tr>
<td>Agri-food &amp; Forestry</td>
<td>Sustainable farming, Alternative proteins, Food loss and waste, Forest conservation², Peatland protection, etc.</td>
</tr>
<tr>
<td>Industrial</td>
<td>Recycling, Industrial electrification, Compostable bioplastics, and other recyclable plastic alts., etc.</td>
</tr>
<tr>
<td>Cities</td>
<td>Built environment, Mobility &amp; transport¹, Green cement, Waste-to-energy, etc.</td>
</tr>
<tr>
<td>Others</td>
<td>Healthcare, Education, Retail, etc.</td>
</tr>
</tbody>
</table>

SEA is uniquely positioned to expand green economy

<table>
<thead>
<tr>
<th>SEA makes up ...</th>
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<tbody>
<tr>
<td>20%</td>
<td>of the world’s biodiversity</td>
</tr>
<tr>
<td>10%</td>
<td>of the world’s population</td>
</tr>
</tbody>
</table>

However, it still has much room to improve since ...

<table>
<thead>
<tr>
<th>Projected increase in SEA CO₂ emissions</th>
<th>~60%</th>
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</thead>
<tbody>
<tr>
<td>to ~2400 MtCO₂ by 2040</td>
<td></td>
</tr>
<tr>
<td>of total primary energy supply in SEA comes from non-renewable sources</td>
<td>~85%</td>
</tr>
<tr>
<td>annual rate of deforestation, highest of any major tropical region globally</td>
<td>~1.2%</td>
</tr>
</tbody>
</table>
A material economic and climate prize exists regionally in SEA if fully pursued

A total of ~$1T annual green economic opportunities across sectors

<table>
<thead>
<tr>
<th>Sector</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>$250B</td>
</tr>
<tr>
<td>Agri-food &amp; forestry</td>
<td>$225B</td>
</tr>
<tr>
<td>Industrial</td>
<td>$200B</td>
</tr>
<tr>
<td>Cities (incl. Built environment and Mobility(^1))</td>
<td>$185B</td>
</tr>
<tr>
<td>Other(^2)</td>
<td>$74B</td>
</tr>
</tbody>
</table>

Substantial green economic opportunities can be captured from early action

Note: $1T economic opportunities by 2030 consists of both direct and indirect benefits from the sectors listed, where direct benefit refers to revenue generated from sales/implementation of sustainable solutions (e.g., sale of EV), while indirect benefits refers to secondary value achieved through implementation of sustainable solutions that is not directly monetizable (e.g., reduction in cropland due to improved agriculture practice); (1) Includes Public Transportation and Electric Mobility; (2) Refers to Healthcare, Education and Retail | Source: Bain analysis

Urgent need for green financing to decarbonize the region due to major emission gap of 2.6-3.2 Gt in 2030

Without immediate action, existing trajectory implies low likelihood of reaching 1.5°C compatible emission range by 2030

Substantial opportunity to capitalize on estimated $1T in annual green economic opportunities to SEA

Majority of opportunity based on emissions contribution required for energy transition
To better understand near-term opportunity, this report assessed levers based on interviews with investors, sector screening, and deep dives of priority subsectors.

**A** Analyzed deal flows across asset classes last 2 years

~10K deals in SEA screened from 2020 to early 2022

...to understand past capital flow and expected trajectory from various investors (corporates, PE/VC, infrastructure funds, sovereign wealth funds, pure-play green funds, etc.) in SEA

...to recognize patterns (e.g., thematic and geographic focus, average deal size and lead investors) to spot opportunities

**B** Conducted interviews with leading SEA investors

>50 interviews with various investors and sector experts based in SEA

...to understand overall investment landscape and investor outlook

...to comprehend underlying opportunities and hurdles in SEA's green economy and discuss solutions that can be deployed in the near and long term

**C** Screened the universe of decarbonization levers

>30 decarbonization levers for initial screening

...to assess carbon abatement materiality from 2020-2050 across SEA

...to conduct in-depth analysis on value chain and extract specific investment opportunities in SEA towards 2030

...to understand practical hurdles and propose key actions to accelerate trajectory to full potential

**D** Deep dive analysis on subset of select levers

~5 deep dives on priority levers that possess highest carbon abatement potential and investability

13 prioritized decarbonization levers for further screening

...to assess attractiveness for investment from now to 2030 across six dimensions for prioritization

With contributions from
SEA’s potential is attracting greater green investment: $15B since 2020

Still few bankable deals relative to investor interest, similar to emerging economies in other regions

SEA “green” capital deployed by investor type ($B, 2020-Feb 22)

- Corporates
- PE/VC
- SWF
- Green funds
- Infra funds

~45% of cumulative capital was deployed in last 3 quarters

Source: AVCJ; CapIQ; Crunchbase; Preqin; Pitchbook; Industry participant interviews

Southeast Asia

"Biggest green investors want to write $100M cheques. Those opportunities are rare in SEA."
Director, Global Impact Investor

"Small ticket size in SEA is a symptom of a larger problem. Investment need is there but big projects are funded by large players with legacy issues [e.g., coal, palm oil] and new players lack a lending track record."
Director, SEA PE Investor

"In Vietnam, projects don’t yet have the PPA terms required by international lenders to make them bankable, thus, project remain on balance sheets or require support from local banks less aware on sustainability."
Director, APAC Infrastructure Investor

Africa

"Particularly challenging is the low volume of projects with sufficient track record and capacity development to align with the risk appetite of investors. This is problematic ... worldwide."

Latin America

"30% of foreign investors are concerned about the development of the pipeline of impact investments."

~45% of cumulative capital was deployed in last 3 quarters

"In Vietnam, projects don’t yet have the PPA terms required by international lenders to make them bankable, thus, project remain on balance sheets or require support from local banks less aware on sustainability."
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"Particularly challenging is the low volume of projects with sufficient track record and capacity development to align with the risk appetite of investors. This is problematic ... worldwide."

"30% of foreign investors are concerned about the development of the pipeline of impact investments."
Investment in the green economy cuts across multiple asset classes, deployed by a broad range of investors, with corporates being the largest

<table>
<thead>
<tr>
<th>Corporates</th>
<th>PE/VC</th>
<th>Infrastructure funds</th>
<th>Sovereign wealth funds</th>
<th>Pure-play green funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive majority of investment (~75% of total green capital) in region, big infrastructure focus</td>
<td>Focused on next-gen solutions, start-ups scaling hot topics from mature markets (e.g., e-scooters)</td>
<td>Focused on next-gen solutions, start-ups scaling hot topics from mature markets (e.g., e-scooters)</td>
<td>Undersized in SEA: large funding gap in infra needed for green transition (e.g., est. ~$2T in SEA investment by 2030)²</td>
<td>Still a niche investor segment in region, strategically targeting opportunities to scale in Renewables, Alt. proteins</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capital deployed¹</th>
<th>Cumulative, '20- Feb’22</th>
<th>$11B deployed over 86 deals</th>
<th>$1B deployed over 23 deals</th>
<th>$1B deployed over 6 deals</th>
<th>$1B deployed over 12 deals</th>
<th>$0.5B deployed over 9 deals</th>
</tr>
</thead>
</table>

| Average deal size | ~$130M | ~$45M | ~$173M | ~$84M | ~$54M |

| Thematic focus | Top levers by investor | $6.6B in Solar/Wind renewable energy | $2.5B in Other renewables³ (e.g., Hydro, Geothermal) | $1.1B in Built environment (e.g., HVAC, data center energy efficiency) | $0.6B in Alternative proteins (e.g., e-scooters) | $0.1B in Mobility (e.g., e-scooters) |

| Capital deployed¹ | Cumulative, '20- Feb’22 | 37% of value in Thailand-based targets | 70% of value in Singapore-based targets | 36% of value in Singapore-based targets | 43% of value in Philippines-based targets | 44% of value in Singapore-based targets |

| Example investors | Non-exhaustive | Ayala | jungle | TPG | SUSI Partners | Infrastructure Trust | GIC | Temasek | abcIMPACT | BlackRock | TEMASEK |

Note: Geographic focus is tagged according to deal details. If data is unavailable, estimates were based on target company’s reported portfolios in different countries; (1) ~$2B worth of deals involve more than one investor category and are counted under each investor type, only including deals >$10M USD, involving targets based in SEA, and “green” based on relevance to carbon abatement/sustainability; (2) Based on Transforming Energy Scenario from the International Renewable Energy Agency, as reported in Green Economy 2020 Report; (3) “Other renewables” refers to geothermal, hydroelectric and enablers not directly related to a single lever – e.g., grid resilience.
The largest investors in the region, corporates deployed $11B since 2020

Investment highly concentrated in Renewables, Built environment

Corporate green capital deployed in SEA ($M, cumulative, 2020 – Feb 2022)

<table>
<thead>
<tr>
<th>Category</th>
<th>Cumulative Deployment ($M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar/Wind energy¹</td>
<td>~$6.6B</td>
</tr>
<tr>
<td>Other renewables</td>
<td>~$2.5B</td>
</tr>
<tr>
<td>Built environment</td>
<td>~$1.1B</td>
</tr>
<tr>
<td>Other</td>
<td>484</td>
</tr>
<tr>
<td>Mobility</td>
<td>252</td>
</tr>
<tr>
<td>Fuel substitution</td>
<td>168</td>
</tr>
<tr>
<td>Waste mgmt. and circularity</td>
<td>164</td>
</tr>
<tr>
<td>Sustainable biomass/ biogas/biofuel</td>
<td>33</td>
</tr>
<tr>
<td>Alternative proteins</td>
<td>13</td>
</tr>
</tbody>
</table>

¹: Driven by the maturity and scalability of tech
Newer solutions (e.g., floating solar, offshore wind) being explored by corporates, but expect 3-5 yrs. before economically feasible

**Sunseap** ($815M deal, 2021)
Singapore-based integrated developer of solar energy projects (both C&I and utility) across SEA and Asia; acquired by Iberian energy producer EDP Renewables

**Star Energy** ($450M deal, 2022)
Energy company with controlling stakes in geothermal energy assets in Indonesia

**Built environment**: ~$1.1B cumulatively deployed
Growth in demand for “green” built environment projects largely driven by government regulations and incentives
E.g., Singapore Ministry of National Development: implementation of BCA Green Mark Scheme to create sustainable built environment practices

**PCI Private Limited** ($326M deal, 2021)
Singapore-based company providing smart home appliances

Note: (1) Deals in target companies with renewable energy portfolios that are primary solar/wind are tagged as Solar/Wind; however, this may include other types of renewable energy
Source: AVCJ, CapIQ, Crunchbase; Preqin; Pitchbook; Industry participant interviews
$1B PE/VC funds invested since 2020, largely in start-ups scaling existing solutions

Alternative proteins and Mobility top themes for PE/VC

Note: (1) Deals in target companies with renewable energy portfolios that are primary solar/wind are tagged as Solar/Wind; however, this may include other types of renewable energy

Source: AVCJ; CapIQ; Crunchbase; Preqin; Pitchbook; Industry participant interviews
$1B deployed by infra funds since 2020; investment themes similar to corporate

Infra investment concentrated in Built environment and Solar/Wind

Infrastructure fund capital deployed in SEA ($M, cumulative, 2020 – Feb 2022)

- Built environment: ~$500M cumulatively deployed
  - Largely infrastructure players investing in large-scale cooling system projects (e.g., more efficient district cooling plants)
  - Buoyed by macrotrends in urbanization and increased affluence across region

- Solar/Wind energy¹: ~$200M cumulatively deployed
  - Largely driven by PE/corporate-based infrastructure funds (e.g., KKR Infrastructure Fund) investing in utility-scale projects
  - Renewable infrastructure development driven by increasing readiness of tech, but still have room to grow by improving availability of financing and regulation

Note: (1) Deals in target companies with renewable energy portfolios that are primary solar/wind are tagged as Solar/Wind; however, this may include other types of renewable energy

Source: AVCJ, CapIQ, Crunchbase, Preqin, Pitchbook; Industry participant interviews
Investors are focused on a select set of themes for future investments in SEA

What we have heard from investors on the future...

**Overall SEA green transition**

“SEA has ~10% of world’s pop. and ~10% of carbon emission. **Investments in sustainability will accelerate (vs. last 10 years) because the reality of irreversible damage [of carbon emissions] is sinking in, as evident in more commitments from corporates in SEA**”

“**Capital for sustainability is coming in fast** into SEA’s ecosystem… and “mini-corn” start-ups are entering growth stage much faster…”

**Renewables**

“**Renewable energy remains to be largest investment theme in SEA, especially solar.** A future hot topic will be Solar REITs, given high real estate exposure in SEA…”

“Most investments will go in renewables in the future because of increasing electricity consumption from rising affluence in SEA, and technologies are mature…”

**Electric mobility**

“**Start-up progress [in EV] will continue to accelerate in the next 5–10 years**, driven by improving tech readiness…for instance, EV charging station is now a reality, and it is becoming more financially feasible…”

“**2-wheeler EV will have a huge potential in SEA**, given price consciousness. A potential future investment theme for us will also include EV battery…”

**Sustainable farming**

“World and this part of the world (SEA) needs to grow 15% more food by 2050…**digital agriculture will play a key role to help us get there**…”

“The **potential of agricultural productivity is expected to grow in SEA** and there is plenty of secondary benefits such as reduction in waste…”

Source: Investor interviews
Compiled 30 levers with decarbonization potential; each has varying technology maturity

<table>
<thead>
<tr>
<th>Proven</th>
<th>Market ready</th>
<th>Emerging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive commercial solutions or solutions with established proof of stability</td>
<td>Solutions that are commercially available, but not competitive yet or solutions with demonstrations in final operating conditions</td>
<td>Solutions with pre-commercial demonstrations</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Alternative proteins (plant-based and food tech alts.)</td>
<td>Green hydrogen</td>
</tr>
<tr>
<td>Solar</td>
<td>Food loss and waste</td>
<td>CCUS</td>
</tr>
<tr>
<td>Organic waste mgmt.</td>
<td>Geothermal</td>
<td>Marine energy</td>
</tr>
<tr>
<td>(Re-/afforestation and forest protection)</td>
<td>Mobility &amp; transport</td>
<td>Blue carbon ecosystem protection</td>
</tr>
<tr>
<td>Onshore wind</td>
<td>Recycling</td>
<td>Industrial electrification</td>
</tr>
<tr>
<td>Efficient power gen. &amp; trans.</td>
<td>Sustainable biogas/biomass/biofuel</td>
<td>Green cement</td>
</tr>
<tr>
<td>Landfill mgmt.</td>
<td>4th gen nuclear</td>
<td></td>
</tr>
<tr>
<td>Refrigerant mgmt.</td>
<td>Peatland protection</td>
<td></td>
</tr>
<tr>
<td>Waste-to-energy</td>
<td>Sustainable farming</td>
<td></td>
</tr>
<tr>
<td>Biochar production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel substitution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Coal to natural gas)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Built environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Energy efficiency solutions for buildings)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Based on ETP Clean Energy Technology Guide’s scores of technological readiness (global) and Bain expert review
Source: ETP Clean Energy Technology Guide; Lit. search; Bain analysis
Any potential investment for returns and climate impact is closely linked to three sectors (energy, nature, and agri-food) that capture 90% of SEA’s carbon budget.

Three sectors contribute to ~90% of SEA emissions

2018 carbon emission volume (MtCO₂e)

**Sector content examples**

- **Energy:** Emissions from energy generation and consumption across all industries, e.g., mobility and heating in manufacturing/industrial/agriculture processes.
- **Nature:** Emissions and removal of carbon from human-induced land use, land use change and forestry, e.g., urbanization, deforestation.
- **Agri-food:** Emissions from enteric fermentation from livestock, fertilizer application, manure management, etc.
- **Waste:** Direct emissions from landfills, wastewater treatment, sewage, etc.
- **Industrial and construction:** Non-energy-related emissions such as release of embodied carbon in cement.

Note: Sectors based on IPCC definitions; (1) Includes emissions from Vietnam, Thailand, Singapore, Philippines, Myanmar, Malaysia, Laos, Indonesia, Cambodia and Brunei.

Source: Climate Watch
Potential investable sectors were screened for (1) carbon abatement potential and (2) multiple investment criteria, to arrive at a holistic view of relative attractiveness.

### Top decarb levers

<table>
<thead>
<tr>
<th>Sustainable farming</th>
<th>Renewables (Solar, Wind)</th>
<th>Forest conservation</th>
<th>Built environment</th>
<th>Electric mobility</th>
<th>Alternative proteins</th>
<th>Peatland protection</th>
<th>Food loss and waste</th>
<th>Fuel substitution</th>
<th>Efficient power gen. &amp; trans.</th>
<th>CCUS</th>
<th>Green hydrogen</th>
<th>Industrial electrification</th>
</tr>
</thead>
</table>

### Abatement potential 2050

### Technology readiness

### Public awareness and sentiment

### Economics

### Investor interest

### Regulatory incentives

### Enabling infrastructure

### Investment Attractiveness To 2030

#### High

#### Low

#### Criteria agnostic

### Note:

- Based on: (1) Project Drawdown numbers scaled to SEA; (2) Tech maturity for adoption; (3) Level of policy stability, policy execution efficiency, and socioeconomic context; (4) Revenue and growth potential; (5) Publicly available private-sector investments from 2020, involving targets based in SEA; (6) Level of regulatory financing support including carbon tax, government subsidies and financing incentives to support adoption; (7) Availability of existing and developing infrastructure to support adoption (e.g., EV charging stations) | Source: Lit. search; Industry participant interviews; Bain analysis

### SECTOR PRIORITIZATION

<table>
<thead>
<tr>
<th>SECTOR</th>
<th>Prioritization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable farming</td>
<td>High</td>
</tr>
<tr>
<td>Renewables (Solar, Wind)</td>
<td>High</td>
</tr>
<tr>
<td>Forest conservation</td>
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<td>Green hydrogen</td>
<td>High</td>
</tr>
<tr>
<td>Industrial electrification</td>
<td>High</td>
</tr>
</tbody>
</table>
Which sectors today offer returns and can help meet regional targets to 2030? A subset of sectors were prioritized through screening and investors inputs.

Decarbonization levers prioritization

Key Insights

13 levers expected to contribute 90%+ of SEA abatement potential

- **Forest conservation** and **Sustainable farming** hold large potential for investment in most countries except Singapore, with high abatement potential
- **Solar, Mobility & transport** and **Built environment** are highly investable across most major SEA countries
- **Wind** presents a significant opportunity in specific countries, e.g., Vietnam and Philippines
- **CCUS** and **Green hydrogen** hold high abatement potential, but would take time to reach tech maturity and commercial readiness
- **Peatland protection** is a high abatement lever, but investable only in Indonesia and Malaysia

Note: (1) Includes only the top abatement levers for 6 major SEA countries: Indonesia, Singapore, Vietnam, Thailand, Philippines, Malaysia; top abatement levers was identified by using numbers from Project Drawdown for global carbon abatement potential and scaled to SEA countries based on specific factors (e.g., emission profile, topography, etc.) | Source: Project Drawdown, Factiva, Quid, WEF, Global Data, Climate Action Tracker, AVCJ, S&P Capital IQ, ETP Clean Energy Technology Guide; Lit. search; Industry participant interviews; Bain analysis.
What are the **specific investment opportunities** within these prioritized sectors and **actions required to accelerate the trajectory** to full potential?

- **Forest conservation**
  - Page 42-46

- **Sustainable farming**
  - Page 47-51

- **Renewables (Solar and Wind)**
  - Page 52-59

- **Built environment**
  - Page 60-64

- **Electric mobility**
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  - Page 65-70
Investment in nature-based solution projects, and carbon credit trading are important levers to reach Net Zero

Forest conservation is the largest carbon abatement lever in region and will represent a $\sim$20B opportunity by 2030.

**Where to Invest:**

- **Forest conservation**

**Recent developments**

- **Carbon management/credit exchange tech** – emerging local carbon credit-trading platform and opportunity to scale global carbon intelligence platform in SEA

- **Forest conservation project development** – given SEA’s carbon stock, assuming conducive regulation and governance to de-bottleneck supply

- **Project operators moving upstream looking to support ecosystem buildout**

- **Project consulting capacity building** – clear gap with no large SEA players, opportunity to de-risk by professionalizing the industry

**Investment opportunities**

- **Earlier-stage capital looking for start-ups/innovative models to scale**

- **Mature capital looking for high CAPEX project development**

- **Singapore-based global carbon exchange and marketplace**

- **Global carbon intelligence platform player expanding into SEA (e.g., collaborates with Climate Impact X on nature-based offset projects)**

- **Tropical Asia Forest Fund 2 – forestry fund targeting SEA ($120M first close in Mar 2022, with Temasek and ADB among investors)**

- **Rimba Raya (among world’s largest REDD+ reserves) announced plan to reforest 10K hectares through to 2031, ~15% increase vs. existing area**

**Note:** Scope includes afforestation, i.e., growing new forest on currently unforested land (unforested for >10 years), reforestation, i.e., restoring forest on previously forested land (forest within the last 10 years), and forest protection, i.e., legal protection of forest lands (leading to reduced deforestation rates), excludes peatland conservation.

Source: Industry participant interviews; Lit. search; Bain analysis
### Significant potential value in developing projects and trading carbon credits

**Factbase**

<table>
<thead>
<tr>
<th>Project origination, feasibility, development and design</th>
<th>Implementation</th>
<th>Monitoring and carbon measurement</th>
<th>Credit verification, registry and issuance</th>
<th>Carbon credit sales and trading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated SEA market size ($B, 2030)</td>
<td>~1</td>
<td>~1-2</td>
<td>&lt;1</td>
<td>~15-17 (Including $6-8B in derivative sales)</td>
</tr>
<tr>
<td>(PDD consultants may charge equivalent of 10-20% of carbon sales revenue)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Indicative profit margins**

- ~15%<sup>1</sup>
- ~30%<sup>2</sup>
- 15-20%<sup>3</sup>
- 15-20%<sup>4</sup>

**Headwinds**

- Lack clear regulatory framework to enable more transparent project development
- Lack localized expertise, talent required to support scale projects
- Standards vary across programs, verification is infrequent, difficult to scale
- Lack clear regulatory, accounting framework to measure offset assets
- Existing platforms very nascent (excl. Singapore)

**Tailwinds**

- Supportive regulation and increasing demand for durable and reliable offset projects from corporate emitters and speculators, expect to drive local carbon markets growth
- Continued increase in carbon prices
- Increasing sustainable forestry practices requirements to obtain financing from financial institutions

**Assessment**

<table>
<thead>
<tr>
<th>Adoption readiness</th>
<th>Regulatory support</th>
<th>Scalability</th>
<th>Room for local player</th>
<th>Overall assessment for SEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attractive</td>
<td>Attractive</td>
<td>Attractive</td>
<td>Attractive</td>
<td>Attractive</td>
</tr>
<tr>
<td>Opportunistically attractive</td>
<td>Opportunistically attractive</td>
<td>Opportunistically attractive</td>
<td>Opportunistically attractive</td>
<td>Opportunistically attractive</td>
</tr>
<tr>
<td>Unattractive</td>
<td>Unattractive</td>
<td>Unattractive</td>
<td>Unattractive</td>
<td>Unattractive</td>
</tr>
</tbody>
</table>

**Note:**

1. Based on global players;
2. Based on current SEA projects;
3. Global MRV margins estimated at ~20% today, expect to shrink as sector matures;
4. Exchange estimated using regional stock exchange profit margins

Source: Industry participant interviews; Lit. search; Bain analysis

---

**WHERE TO INVEST**

**Forest conservation**

- Large opp. to develop, own, invest in forest conservation projects
- Smaller opp. to scale tech-based solutions, however, it’s R&D likely dominated by foreign players
- Whitespace opp. for local/regional project owners to move up/downstream into technical advisory and project implementation

No large near-term registry, issuance opp.

Opportunity to support emerging local players, however, limited due to unclear regulation
Investment opportunities focus on project development in Indonesia & Malaysia, with potential to build out carbon credit trading in SEA

% of SEA investable forestry carbon stock¹

- **66%**
  - Largest potential given significant forestry assets
- **16%**
  - Large potential, 2nd to Indonesia given significant forestry assets
- **9%**
  - Smaller forestry assets, however, foresee some potential given growing government support
- **6%**
  - Insignificant potential due to small forestry assets and lack of regulatory clarity
- **3%**
  - Insignificant potential due to small forestry assets, however, may be headquarters for regional players
- **~0%**
  - Insignificant potential due to lack of regulatory clarity

Note: (1) Investible SEA forest carbon stock (measured as tCO2/yr.) using data from 2012-2017, based on Nature Communications analysis published in 2021, only those six SEA countries are included in the carbon stock breakdowns; (2) 3-5% for reseller, up to 50% for exchange | Source: Industry participant interviews; Lit. search; Bain analysis

## Opportunities

### Project origination, feasibility, development and design

1. **Attractive given overall large forestry land and strong investor interest:**
   - Significant investable carbon stock among SEA countries, opportunity for project developers, large funds to consolidate land to build scale projects
   - Growing investor interest given scale (e.g., Rimba Raya in Indonesia is among the largest globally, MNCs, conglomerates making forest conservation commitments in Malaysia)
   - Need for clearer government regulation to increase international interest in domestic project development

2. **Strategic development opp. when sector matures given:**
   - Ambitious government targets (e.g., Thailand plans to increase forest cover to 53% of total country area, Vietnam plans to plant 1B trees by ’25)
   - Lack incentives to drive more actions

### Carbon credit sales and trading

1. **Estimated SEA market size ($B, 2030)**
   - **15-17**
   - **Indicative profit margins** >50%

2. **Estimated SEA market size ($B, 2030)**
   - **Indicative profit margins**

Note: (1) Large carbon credit potential volumes
   - Opp. for adjacent corps. (e.g., banks) given:
     - Large carbon credit potential volumes
     - Platform's success is still uncertain, dependent on regulation and enforcement (e.g., Indonesia: ICDX, very nascent; Malaysia: government aiming to implement new platform by end '22)
   - Momentum building in carbon trading platform, opp. to become regional/global hub
     - No domestic carbon credit volume
Ability to scale is capped by project viability, and implementation of Article 6 frameworks; full potential can be quickly unlocked with better access and policies

Key actions to accelerate trajectory to full potential

**Increase project viability**

- **Establish clear regulatory framework** to improve land access
  - Ensure transparency (e.g., land-tenure licensing) to improve investor confidence and de-bottleneck project development supply

- **Inspire trust among landowners in outlook for forestry projects**
  - Developers/investors to create financing structures that fairly share upsides and risks (on carbon credit price volatility) with landowners

- **Enhance access to financing**
  - Leverage emerging tech (e.g., blockchain) to reduce borrowing and transaction costs by limiting the intervention of intermediaries (e.g., used by agroforestry projects in Africa)

**Refine project ecosystem to facilitate project security and stability**

- **Enhance data transparency and enforce strong regulatory standards along the value chain** to boost confidence among carbon credit buyers:
  - Project developers/owners should invest in and leverage technology (e.g., machine learning using satellite imagery) to improve data accuracy in carbon stock measurement
  - Government should establish clear offset credits accounting and verification frameworks to standardize credits verification frequency, coupled with strong enforcement

- **Enhance local expertise** to improve project implementation
  - Strengthen local capabilities (e.g., project implementation skills) to scale projects via knowledge transfer from global experts

- **Develop regional carbon markets** with enhanced trading infrastructure
  - Increase involvement from government and strategic players to support buildout (e.g., invest in projects to accelerate development of platforms to solidify trading systems)
  - Will boost broader local/regional demand for carbon credits, hence, making higher carbon credit price possible

**Establish clear regulatory framework to improve land access**

- Ensure transparency (e.g., land-tenure licensing) to improve investor confidence and de-bottleneck project development supply

**Improve market accessibility**

- **Strengthen collaboration/partnerships**

  - **Educate key actors** (e.g., landowners, developers) on investability of forest conservation
    - Provide legal advisory services to educate on risks and benefits, to build trust and cooperation

  - **Drive collaboration between government bodies to attract partnerships and investments**
    - Streamline administrative and bureaucratic activities

Source: Industry participant interviews; Lit. search; Bain analysis
What are the **specific investment opportunities** within these prioritized sectors and **actions required to accelerate the trajectory** to full potential?

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  Page 52-59

- **Built environment**  
  Page 60-64

- **Electric mobility**  
  Page 65-70
Precision agriculture and farmer service platforms present large potential opportunity to drive yield improvements and reduce related emissions

Sustainable farming is one of the top carbon abatement levers for SEA and will represent a $30B opportunity by 2030

Earlier-stage capital looking opportunistically for start-ups/innovative models to scale, mature capital supporting CAPEX-intensive production systems

**Precision agriculture** – large potential especially given yield benefits, large agribusinesses lead investments, and potential for early-stage capital entry

**Nutrient inputs** – rising prices, awareness of emissions around nitrogen fertilizers creating opportunity for regional/local manufacturers

**Controlled env. agriculture** – potential to scale in urban areas (e.g., Singapore) if costs fall, extremely capital intensive, both institutional fund and PE/VC interest

**Farmer services platform** – as an enabler to expand farmer access to more sustainable practices, tech (e.g., large agribusinesses build in-house, VC-backed sustainable farming)

**Recent developments** (not exhaustive)

**IRGA and Kingoya** (2022) Malaysia-based AgTech solution provider, IRGA, acquired Kingoya, plantation tools manufacturer to expand automation, mechanization, and digitization in agri

**Enza Zaden** (2022) Holland-based seed player set up R&D farm/center in Malaysia to innovate seed varieties tailored to needs of local growers and market

**Unfold** (2020) Tie-up between Temasek and Bayer for vertical farming innovation to boost Singapore’s food supply

**Indonesia farming service providers** (connecting growers directly to buyers) successfully raised next funding rounds in >2 years with participation from follow-on investors

Note: Scope excludes livestock and solutions for and benefits from food-loss reduction, supply chain improvements, processing improvements, aligned to agricultural decarbonization levers as defined in Project Drawdown; (1) $10B out of the $30B is revenue from yield increase due to adopting more productive green agriculture practices/solutions

Source: Lit. search; Bain analysis
Precision agriculture and farmer service platforms are most attractive due to regulatory support, market adoption readiness, and big addressable market

**Supply of inputs**
- Higher-yield inputs
- Greener nutrient management

**Production and harvesting**
- Precision agriculture
- Regenerative agriculture and lower-impact farming
- Farmer service platforms
- Controlled environment agriculture

**Estimated SEA market size ($B, 2030)**
- ~4 (Majority will go to global players)

**Indicative profit margins**
- 15-25%<sup>4</sup>
- 5-10%<sup>4</sup>
- ~10%<sup>5</sup>

**Factbase**

**Headwinds**
- Low farmer affordability, know-how and access
- Less optimized to specific crops (vs. chemical fertilizer)
- Farmers lack affordable connectivity, capital and skill
- Several solutions are not yet economical for farmers
- Nascent carbon market
- Lack of farmers buy-in and financing for transition
- Farmers lack affordable connectivity which results in some cases of low digital skills
- Uneconomical (est. 3-10x more costly vs. traditional)

**Tailwinds**
- Gov’t subsidies (e.g., Malaysia: certified seeds, organic fertilizer)
- Shortages, rising prices of nitrogen fertilizer due to crisis (Russia and Ukraine: ~30% of global supply)
- Government plans supporting tech innovation (e.g., Thailand 4.0 plan includes “smart agri” focus)
- MNCs’ support (e.g., Indonesia: global CPG companies setting targets for regenerative agri)
- Growth in start-up activity, digital solutions key enabler to scale
- Supportive government regulation (e.g., Singapore targets 30% domestically produced food by ’30)

**Assessment**

**Adoption readiness**
- Attractive

**Regulatory support**
- Attractive

**Scalability**
- Attractive

**Room for local player**
- Attractively attractive

**Overall assessment for SEA**
- Commodified, dominated by foreign players
- Rising prices presents opp. for local/regional players
- Attractive opp. with tech maturity, farmer readiness, and government support
- Nascent SEA carbon market a roadblock
- Attractive opp. with farmer readiness and strong government support
- Limited scalability due to economics of vertical farming and limited crop selection

**Solutions can drive additional ~8-16B revenue from yield improvement**

**WHERE TO INVEST**

Note: (1) Including more sustainable rice growing practices, avoided burning, and other more sustainable practices that may be monetizable through carbon credits; (2) ~$2-7B from organic fertilizer, ~$1-2B from biopesticide; (3) From carbon credit sales, excl. additional services, resale, derivatives; (4) EBIT margin based on global manufacturers; (5) EBITDA margin for global precision agriculture equipment manufacturers; (6) Gross margin based on global brand owners; (7) Based on Singapore example; (8) Additional revenue from yield increase due to adopting more productive green agriculture practices/solutions | Source: Industry participant interviews; Lit. search; Bain analysis

Potential opportunity to invest in 1) *integrated players* as they possess strong distribution networks (scaling potential), and 2) *advisory services*
Within precision agriculture and platforms, Malaysia, Thailand and Vietnam are most attractive due to infrastructure readiness and strong regulatory support.
**Issues with accessibility and economics are limiting the market adoption at scale; full potential can be unlocked through concerted gov’t/industry/finance actions**

Key actions to accelerate trajectory to full potential

<table>
<thead>
<tr>
<th>Improve market accessibility</th>
<th>Confront transition costs</th>
<th>Strengthen green financing</th>
<th>Closer collaboration/partnerships</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Support innovative models to monetize</strong></td>
<td><strong>Improve farmer connectivity</strong></td>
<td><strong>Increase volume, improve access to green financing</strong></td>
<td><strong>Facilitate public-private partnerships</strong></td>
</tr>
<tr>
<td>Increase growth-stage financing to develop <strong>innovative business models</strong> with clear monetization potential</td>
<td>Increase <strong>investment/support for farmer connectivity</strong></td>
<td>Boost investment momentum through <strong>government support</strong></td>
<td><strong>Establish partnerships</strong> between motivated agribusinesses to continue connecting with growers</td>
</tr>
<tr>
<td>– Back AgTech start-ups with clear potential for scale</td>
<td>– Deploying rural connectivity infrastructure not commercially sustainable for MNOs today, requires more government subsidy</td>
<td>– E.g., Singapore equity program: government co-funding early-stage Sustainable farming with private investors</td>
<td>– E.g., government of India’s platform (multi-stakeholder agri ecosystem) opens up data, infrastructure, research expertise to private players</td>
</tr>
<tr>
<td>– Develop, scale carbon credit market for regenerative agri</td>
<td>– Connectivity <strong>critical to drive scale adoption of digital solutions</strong> (especially, for smallholders) and make them financially viable</td>
<td>Improve economics for AgTech funds by <strong>reducing farm ownership fragmentation</strong></td>
<td><strong>Accelerate adoption via government agencies serving as flagship adopters</strong> for new tech (that serve to benefit smallholders)</td>
</tr>
<tr>
<td>– Issue certifications for sustainable produce that may command consumer premium</td>
<td>– E.g., facilitate payments, lending, trading, automation hardware (e.g., drones), and advisory services</td>
<td>– E.g., Nepal and India: farming cooperatives enable members’ crops to be machine-sown and harvested</td>
<td>Corporate partnerships to provide <strong>stipends</strong> and <strong>training</strong></td>
</tr>
</tbody>
</table>

**WHERE TO INVEST**

**Sustainable farming**

Source: Industry participant interviews; Lit. search; Bain analysis
What are the **specific investment opportunities** within these prioritized sectors and **actions required to accelerate the trajectory** to full potential?

- **Forest conservation**
  - Page 42-46
- **Sustainable farming**
  - Page 47-51
- **Renewables (Solar and Wind)**
  - Page 52-59
- **Built environment**
  - Page 60-64
- **Electric mobility**
  - Page 65-70
Solar will drive largest impact in energy transition; sustained investment in C&I and utility-scale projects will be critical to enable the transition across SEA

Renewables (Solar and Wind) is one of the top carbon abatement levers for SEA and will represent a ~$30B opportunity by 2030, of which Solar represents ~$20B

**WHERE TO INVEST**

**Solar**

Capital with higher-risk appetite looking for earlier-stage/growth projects

- **Small C&I solar** – smaller companies with fewer large-scale projects, less of a track record (to operate), which require funding for larger projects

- **Hybrid players** – players with C&I and utility-scale projects, especially projects across SEA in portfolio

Mature capital with lower-risk appetite, may be looking for steady cashflow

- **Large C&I solar** – large local companies participating to ride ESG wave, large C&I projects which mid-sized PE funds invest to capture higher IRR (vs. utility-scale)

- **Utility-scale solar** – tech is mature, scalable enough to generate adequate returns, though foresee some margin erosion due to competitive bids and uncertainty around tariffs longevity and difficulty to finding bankable projects (i.e., access is low)

Investment opportunities

**Recent developments** (not exhaustive)

- **Constant Energy** (~$65M loan, 2020 and 2021)
  Thailand-based integrated developer of smaller-scale C&I solar energy projects across SEA was granted bank loan from Thai TMB Bank and secured loan from Swiss impact fund, Global Climate Partnership Fund

- **Sunseap Group** (~$815M deal, 2021)
  Singapore-based integrated developer of solar energy projects (both C&I and Utility) across SEA and Asia, acquired by Iberian energy producer EDP Renewables

- **Cleantech Solar** ($150M deal, 2021)
  Singapore-based solar integrated developer with projects (large C&I) across SEA and Asia, received investments from Singapore’s Keppel

- **Santa Cruz Solar Energy** ($138M deal, 2021)
  Philippines-based utility-scale solar farm developer (~300MW) based in Zambales province, invested in by Philippines’s AC Energy

Source: AVCJ; CapIQ; Crunchbase; Prequin; Pitchbook; Industry participant interviews; Lit. search; Bain analysis
C&I and utility-scale project development are most attractive investment opportunities, due to maturity of market and potential returns

<table>
<thead>
<tr>
<th>Factbase</th>
<th>Project development</th>
<th>Installation/EPC</th>
<th>Ongoing operations and maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated SEA market size ($B, 2030)</td>
<td>~6-8 (Majority will go to foreign players, especially China)</td>
<td>~1-3</td>
<td>~1-3</td>
</tr>
<tr>
<td>Est. project IRR (current)</td>
<td>6-8% (Projects deployed with battery storage today estimated to have low project IRR)</td>
<td>8-13^2</td>
<td>8-10</td>
</tr>
<tr>
<td>Headwinds</td>
<td>• High competitiveness in PV manufacturing, eroding margin due to scale from China (~60% of global share)</td>
<td>• Lack of supportive policies (e.g., no renewal of FiT, unbankable PPAs)</td>
<td>• Frequent “race to the bottom” for bidding due to commoditized services (especially in EPC)</td>
</tr>
<tr>
<td>Tailwinds</td>
<td>• High potential for battery storage given ability to resolve curtailment that is enabled with lower battery storage CAPEX, expected to happen by 2030</td>
<td>• Robust demand for solar energy, to provide significant share of SEA’s renewable energy by 2030</td>
<td>• PV equipment is more prone to damage due to tropical climate in SEA</td>
</tr>
<tr>
<td>Adoption readiness</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Regulatory support</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Scalability</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Room for local player</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Overall assessment for SEA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Assessment

- **Attractive**
  - Opportunity for C&I given high returns (12-15%) and growth in the coming years
  - Opportunity for Utility given larger scale (allow more capital deployment) and decent returns (8-10%)
  - Potential in integrated developers due to higher margins captured through strategic in-house capabilities (in EPC and O&M)

- **Opportunistically attractive**
  - Minimal opportunity due to high competitiveness from undifferentiated solutions and low margins (as turnkey pricing is heavily exposed to volatility in PV components)

- **Unattractive**
  - Opportunity for Utility given larger scale (allow more capital deployment) and decent returns (8-10%)

**Note:** Numbers may not add up due to rounding; (1) Refers to PV module (crystalline silicon and thin film) and battery storage solution but excludes inverter; (2) Captures 80% of value across value chain highlighted, with an est. 20% of value given to EPC/O&M players that developers outsourced to.

Source: Industry participant interviews, Analyst reports, Lit. search
Specific investment opportunities reside with Malaysia and Philippine C&I projects and selective utility-scale projects in Indonesia, Vietnam and Thailand

% of SEA total installed capacity for Solar\(^1\) and outlook

<table>
<thead>
<tr>
<th>%</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>71%</td>
<td>Expect strong growth with largest capacity addition in SEA by 2030 but watch out on grid curtailment and pricing schemes</td>
</tr>
<tr>
<td>15%</td>
<td>Expect strong growth driven by utility scale floating solar projects</td>
</tr>
<tr>
<td>7%</td>
<td>Expect moderate growth, given highly competitive market with increasing margin compression</td>
</tr>
<tr>
<td>4%</td>
<td>Expect solar to lead renewable energy, given large pipeline of proposed projects</td>
</tr>
<tr>
<td>2%</td>
<td>Expect moderate growth given lack of space for large scale projects</td>
</tr>
<tr>
<td>1%</td>
<td>Expect strong growth due to exports in the coming years (e.g., to Singapore)</td>
</tr>
</tbody>
</table>

Opportunities

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 C&amp;I</td>
<td><strong>Estimated SEA market size ($B, 2030)</strong></td>
</tr>
<tr>
<td>2 Utility</td>
<td><strong>Estimated SEA market size ($B, 2030)</strong></td>
</tr>
</tbody>
</table>

**Large opportunity for C&I projects:**
- High level of solar adoption from C&I segment and projects has attractive returns (est. project IRR at \(-15\)%)
- Tailwind from RPS\(^2\) (from 2023) to boost capacity needed for solar energy
- Need for clarity in policies as government has yet to finalize details of green energy auction, even after expiration of FIT scheme
- Some challenge to scale C&I, given smaller ticket sizes (i.e., smaller capital deployment)

**Supportive government to propel C&I projects:**
- Government allocation of additional 300 MW of net-metering capacity quota from 2021 to 2023, with Net Offset Virtual Aggregation that allows owners to sell excess to the grid or use it to offset bills at other sites on a “one-on-one” basis
- Attractive returns with estimated project IRR of \(-12\)%
- Some challenge to scale C&I, given smaller ticket sizes (i.e., smaller capital deployment)
- Foreign ownership caps for FiT eligibility (49% max) further limit large-scale projects

**High potential in export market in the coming years:**
- Significant pipeline/MOUs (est. five large-scale/utility-scale projects) to build solar plant/floating solar to export solar energy to Singapore
- Estimated project IRR of 8-10%
- Need for conducive policies to develop solar (e.g., bureaucratic permit process, no FIT schemes in sight)
- State-owned PLN has strict requirements which may affect adoption (e.g., extra requirements, installation permission)

**Opportunistically attractive in Utility:**
- Decent returns (est. project IRR at \(-10\)%), with alleviation from margin compression due to pilot of direct purchase power agreement in 2022
- Largest capacity addition in SEA by 2030
- Expired FIT schemes with no visibility of replacement and suspension of new utility-scale project
- Persistent curtailment issues (due to solar boom in ’19-’20) with often no compensation by Vietnam Electricity (EVN)

**May be opportunistically attractive given:**
- Gov’t push on building large scale floating solar
- Estimated project IRR of 9-10%
- No acceptance of large-scale projects under FIT

Note: Residential projects has an est. $2B SEA market size but is excluded on this page, therefore total market size here will not match previous page; (1) For 2020; (2) Renewable portfolio standards require power distribution utilities to source a minimum proportion of energy from renewable energy sources (e.g., solar) and is set to increase by 2.52% annually from 2023
Source: GlobalData; Industry participant interview; Analyst reports; Lit. search
Investment opportunities in mainly project development (both onshore and offshore) to drive next wave of energy transition

Renewables (Solar and Wind) is one of the top carbon abatement levers for SEA and will represent a ~$30B opportunity by 2030, of which Wind represents ~$10B.

**Early-stage capital with higher-risk appetites**
- Wind project development (offshore and onshore)
  - Capture high returns (especially in offshore due to higher risk), though FiT scheme replacement policies still unclear (e.g., Vietnam may switch to auction scheme, resulting in margin erosion)
- Pure play small-scale solutions (e.g., technology service provider for O&M and offshore support vessels) but very limited in SEA now; expect growth in solutions needed to reduce operating complexity (e.g., O&M) and close supply gaps (e.g., more installation vessels required to install turbines) as wind grows

**Mature capital with lower-risk appetites, looking for steady cash flow**
- Mature/operational onshore wind projects
  - Less-risky projects that are already operational or from developers with proven track record (e.g., AC energy has existing portfolio of projects across Indonesia, Vietnam, and Philippine)
- MO4 and North Star (2022) – global example
  - SaaS company that equipped its analytics software on offshore support vessels to raise in-field operational efficiencies, lower emissions, and increase safety

**Recent developments (not exhaustive)**
- Ørsted and T&T (2021)
  - Signed MOU between leading Danish offshore developer and Vietnam’s energy developer to co-develop multi-GW pipeline of offshore wind projects off the coasts of Southern Vietnam
- Bayog Wind Power Corp
  - ($138M deal, 2021)
  - Philippine-based wind project developer (~160 MW Pagudpud wind project) based in Ilocos Norte province, invested in by Philippine’s AC Energy
- Mui Dinh Wind Park
  - (~$66M deal, 2020)
  - Vietnam-based operational wind farm located in Southern Vietnam, invested in by Thailand’s Banpu

Note: O&M refers to operations and maintenance
Source: AVCJ; CapIQ; Crunchbase; Preqin; Pitchbook; Industry participant interviews; Lit. search; Bain analysis
Attractive investment opportunity in offshore project development due to higher return and potential, selective opportunity in operating onshore projects

<table>
<thead>
<tr>
<th>Estimated SEA market size ($B, 2030)</th>
<th>Project development</th>
<th>Installation/EPC</th>
<th>Ongoing operations and maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>~2-4 (Majority will go to foreign players, especially China, Europe, United States)</td>
<td>~1</td>
<td>~1-3</td>
<td>~3-5</td>
</tr>
</tbody>
</table>

**Factbase**

<table>
<thead>
<tr>
<th>Est. project IRR (current)</th>
<th>Manufacturing</th>
<th>Project development</th>
<th>Installation/EPC</th>
<th>Ongoing operations and maintenance</th>
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<td>6-7% (Projects deployed with battery storage today estimated to have low project IRR)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Headwinds**

- Expansion by OEM manufacturers to cost-effective countries like India adds to cost pressures
- Lack of FIT schemes, with possible transition to more competitive auctions
- Current PPA terms don’t follow international standards nor protect foreign investors
- High costs, driven by complexity of offshore installation
- Lack of ready talent pool with high expertise/technical know-how

**Tailwinds**

- Some potential for battery storage given ability to resolve curtailment that is enabled with lower battery storage CAPEX, expected to happen by 2030
- Strong demand for wind, especially offshore, to fulfill capacity targets by 2030
- Large geography (in select countries) that is conducive to harness wind energy
- Need for more supplies/specific solutions (e.g., vessels for offshore installation) due to growth of offshore projects
- Rise of digital solutions that enhance autonomous inspections and improve data analytics to reduce cost

**Assessment**

- Attractive
- Opportunistically attractive
- Unattractive

**WHERE TO INVEST**

| Wind |

**Note:** Numbers may not add up due to rounding; (1) Refers to wind turbine components and battery storage solution; (2) Captures 80% of value across value chain highlighted, with an est. 20% of value given to EPC/O&M players that developers outsourced to

Source: Industry participant interviews; Analyst reports, Lit. search
Attractive investment opportunity mainly in Vietnam and Philippine in both offshore and onshore, given large future potential (due to geography) and appealing returns.

**WHERE TO INVEST**

### Wind

**Opportunities**

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Offshore</th>
<th>Onshore</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>23%</td>
<td>16%</td>
</tr>
<tr>
<td>% of SEA total installed capacity for Wind and outlook</td>
<td>Estimated SEA market size ($B, 2030)</td>
<td>Est. project IRR</td>
</tr>
<tr>
<td>&gt;3 GW of capacity added in 2021 (highest in SEA), expect strong growth and market leadership, with increasing share of offshore</td>
<td>12-15%</td>
<td>12-15%</td>
</tr>
<tr>
<td>Expect strong growth in the long term, especially in offshore due to government interest</td>
<td></td>
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</tr>
<tr>
<td>Expect minimal growth in new capacity addition</td>
<td></td>
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</tr>
<tr>
<td>Expect minimal growth in new capacity addition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of favorable geography to capture wind energy</td>
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</table>

**Note:**
1. For 2020.
2. Renewable portfolio standards require power distribution utilities to source a minimum proportion of energy from renewable energy sources (e.g., wind) and is set to increase by 2.52% annually from 2023.

Source: GlobalData; Industry participant interview; Analyst reports; Lit. search
Opportunities exist, however scaling of investment in both C&I and utility projects requires continued extended incentives, market structure changes and financing.

Key actions to accelerate trajectory to full potential

### Improve market accessibility

**Extend incentives (FiT) and ease transition**
- Extend FiT to incentivize project development, lower investment risks
  - Consider extending FiTs for project development (e.g., solar, onshore) to drive renewable energy transition
  - Compensate higher-risk projects proportionately (e.g., future FiT for offshore should be higher than onshore)

**Ease transition to more competitive schemes, (e.g., auction) with clear communication and sufficient notice**
- Publish guidelines and timelines to visibility of project investment (e.g., more accurate expectations of expected return)

**Establish conducive market structure**
- Facilitate large-scale/cross-country platform plays to help build regional champions
  - Raise capacity allocation in tenders (i.e., avoid allocating to a long tail of developers) so proficient developers can harness economies of scale for electricity generation
- Ensure policy transparency and consistency with international standards/mature markets (i.e., reduce flip-flopping on policies)
- Provide key project data (ideally done by government) to developers
  - Data such as sun radiation, wind speed, and potential land-clearance cost

### Confront transition costs

**Modernize grid and subsidize energy storage**
- Accelerate and formalize grid upgrades needed to integrate renewable energy, given high curtailment today
  - Prioritize power grid projects and accelerate development of SEA/regional power grid
  - Step up effort to provide better transmission (e.g., longer transmission lines to connect sunny and windy areas)
  - Share regulatory blueprint and technical frameworks for grid development
- Subsidize battery-storage solutions to drive adoption, given high cost today

### Strengthen green financing

**Improve financing (bankability of projects)**
- Revise current PPA terms to meet international standards (e.g., curtailment and compensation)
  - PPA revisions, regulatory clarity, etc. will improve investor confidence in new, smaller players, which is critical to develop ecosystem
- Collaborate with capital providers to improve financing terms for green projects
  - Enhance secondary market deal flow (e.g., sale of asset)
  - Developers can sign extra agreements with offtaker to address deficiencies in current PPA

Source: Industry participant interviews; Lit. search; Bain analysis
What are the **specific investment opportunities** within these prioritized sectors and **actions required to accelerate the trajectory** to full potential?

- **Forest conservation**
  - Page 42-46

- **Sustainable farming**
  - Page 47-51

- **Renewables (Solar and Wind)**
  - Page 52-59

- **Built environment**
  - Page 60-64

- **Electric mobility**
  - Page 65-70
Significant potential in energy-saving cooling technologies and green building product exists in the near-term; untapped opportunities vs other decarbonization levers

Built environment is one of the top carbon abatement levers for SEA and represents a ~$40B opportunity by 2030

WHERE TO INVEST

Built environment

WHERE TO INVEST

Energy-saving tech (e.g., IOT, data analytics) – Interest and adoption driven by cost-savings business case, with increasing interest from local players (especially in the cooling space)

Cooling-as-a-service (i.e., no upfront CAPEX, shared savings) – Emerging innovative business model (incl. broader Energy-as-a-Service), with demand driven by cost-savings and enabled by energy-saving tech/hardware

Green building products – large but fragmented potential market for building products (e.g., better insulation), expect increase in adoption as regulation evolves to require these products for green building certifications, accelerated by cost-savings business case

District cooling – growing interest in SEA, but expect opportunities to remain small/more strategic, given that tech is largely for new buildings and that master planning is needed

Investment opportunities

Earlier-stage capital looking for start-ups/innovative models to scale

Mature capital looking for high CAPEX project development

PCI Private Limited
($326M deal, 2021)
Singapore-based company providing smart home appliances (including IoT solutions, telematics, embedded systems), invested in by Canadian electronics company Celestica

UAE & IFC announced plans to invest in Cooling-as-a-service and district cooling (2021)
Joint venture between UAE’s national central cooling company and IFC to deploy $400M in SEA and India

Viglacera Corporation
($96M deal, 2020)
Vietnam-based company that provides sustainable construction materials, invested by Vietnam Electrical Equipment Joint Stock Corporation

Bulim District Cooling System Plant (2020)
Singapore-based Keppel District Heating and Cooling Systems (DHCS) secured $220M contract to develop and operate district cooling system in Jurong Innovation District

Recent developments

(not exhaustive)

Source: AVCJ; CapiQ; Crunchbase; Preqin; Pitchbook; Industry participant interviews; Lit. search; Bain analysis

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Recent developments

(not exhaustive)

Source: AVCJ; CapiQ; Crunchbase; Preqin; Pitchbook; Industry participant interviews; Lit. search; Bain analysis
Though majority of lies value is in new buildings, opportunities in building operations (e.g., cooling, automation) are more investible in short term with quick payback.

<table>
<thead>
<tr>
<th>Design and planning</th>
<th>Building construction</th>
<th>Building operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green architectural and engineering services</td>
<td>Substitute for raw material (e.g., green cement and steel)</td>
<td>Green building products (e.g., framing and insulation)</td>
</tr>
<tr>
<td><strong>Estimated SEA market size</strong> (S$, 2030)</td>
<td><strong>Indicative EBIT</strong></td>
<td><strong>Efficient cooling</strong> (e.g., district cooling, efficient HVAC systems)</td>
</tr>
<tr>
<td>2-4 (dominated by international players)</td>
<td>4-8%</td>
<td>7-10²</td>
</tr>
<tr>
<td><strong>Headwinds</strong></td>
<td><strong>Tailwinds</strong></td>
<td><strong>Building Automation Systems</strong></td>
</tr>
<tr>
<td>Lack of technical capabilities outside of Singapore</td>
<td>Increasing prevalence of building information modeling (e.g., in Singapore), facilitating easier sustainable building design, retrofits</td>
<td><strong>Opportunity to scale innovative solutions</strong> (e.g., efficient cooling of data centers, including more broad Energy-as-a-Service) and start-ups that provide energy-saving tech (e.g., IoT control)</td>
</tr>
<tr>
<td><strong>Factbase</strong></td>
<td><strong>Assessment</strong></td>
<td><strong>Opportunity to provide E2E energy advisory</strong> (incl. reporting tools), given infancy of green building and need to still achieve emission targets</td>
</tr>
<tr>
<td><strong>Adoption readiness</strong></td>
<td><strong>Regulatory support</strong></td>
<td><strong>Growing interest for corporates to scale district cooling</strong> (though it requires master planning and buy-in from both public and private sector)</td>
</tr>
<tr>
<td><strong>Regulatory support</strong></td>
<td><strong>Room for local player</strong></td>
<td><strong>Some opportunity to provide E2E energy advisory</strong> (incl. reporting tools), given infancy of green building and need to still achieve emission targets</td>
</tr>
<tr>
<td><strong>Scalability</strong></td>
<td><strong>Overall assessment for SEA</strong></td>
<td><strong>Clear potential</strong> for green building products as more building certification systems (e.g., Singapore’s BCA Greenmark) are mandated and government targets are enforced</td>
</tr>
</tbody>
</table>
Most attractive opportunity in efficient cooling solutions, with large potential for green building materials and product

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>1 Efficient cooling</th>
<th>2 Green building products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated SEA market size ($B, 2030)</td>
<td>7-10</td>
<td>20-25</td>
</tr>
<tr>
<td>Indicative EBIT</td>
<td>15-20%</td>
<td>5-15%</td>
</tr>
</tbody>
</table>

### Efficient cooling
- **Attractive investment opportunity** as seen in strong deal flows and rise of more start-ups in this space:
  - Strong deal flows in district cooling projects, paired with strong outreach effort by Singaporean companies to educate and enable other SEA countries for widespread adoption
  - Smaller-sized opportunities in cooling tech (e.g., data center cooling startup), with potential to scale regionally

### Green building products
- **Likely some opportunity in green building products** to achieve green building targets
  - Aggressive government targets and incentives (e.g., granting greater floor space for green buildings)
  - Rising demand for green building products (for both new and retrofits), as regulation evolves (Singapore will also lead SEA)
  - However, most materials and equipment will be more expensive (“green premium”) and lower supply chain predictability, given likelihood of being imported from outside of SEA

### Impressive to solve national issue presents opportunity to grow:
- **High electricity cost** (highest in SEA), therefore likely to incentivize innovation in energy and cooling efficiency tech
- Government mandated AC efficiency standards, however, struggle with enforcement unless cost savings possible

### Strong government mandate and interest:
- Government-mandated Thailand’s cooling sector to be more climate friendly (under RAC NAMA) and provided support (assisted domestic producers, built training facilities to upskill and train more technicians)
- Emerging interest in district cooling projects (e.g., for government complex in Bangkok)

---

**Note:** (1) Estimated by EDGE as of Apr 2022 (in partnership with IFC), no published government target

**Source:** Industry participant interviews; Analyst reports; Lit. search

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### “Green building” targets and expectations across SEA

<table>
<thead>
<tr>
<th>Region</th>
<th>Target</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>80% of buildings (by gross floor area) by 2030</td>
<td>Vietnam</td>
<td></td>
</tr>
<tr>
<td>Estimated 30% of buildings by 2025</td>
<td>Malaysia</td>
<td></td>
</tr>
<tr>
<td>Estimated 20-25% of buildings by 2025</td>
<td>Philippines</td>
<td></td>
</tr>
<tr>
<td>Estimated 20-25% of buildings by 2025</td>
<td>Thailand</td>
<td></td>
</tr>
<tr>
<td>1,750 green buildings by 2030 (vs. 550 in 2020)</td>
<td>Singapore</td>
<td></td>
</tr>
</tbody>
</table>

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**No published government targets or estimates by third-party organization**
Market maturity and awareness still in early stage in many countries; full potential requires the right policy, financing and market education and could be easily done

<table>
<thead>
<tr>
<th>Improve market accessibility</th>
<th>Strengthen green financing</th>
<th>Closer collaboration/partnerships</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Develop enabling policies</strong> (to achieve standards compliance)</td>
<td><strong>Enhance financing</strong></td>
<td><strong>Strengthen awareness and collaboration</strong></td>
</tr>
</tbody>
</table>
| *Set standards* and promote compliance (e.g., established certifications like EDGE, green building codes) for new and existing buildings | **Create financial products with favorable terms to provide lift off** for developers  
  - E.g., increased LTV ratio for green building development, thereby lowering down payment | **Educate key actors** (e.g., developers, owners) on net benefit (especially, cost savings) to shift mindsets (i.e., remove siloed thinking)  
  - Assess building lifecycle costs to build accurate business case (e.g., include lifetime degradation and maintenance cost)  
  - Develop and share performance of proven/certified landmark green real estates/building technology proactively to demonstrate feasibility and instill confidence |
| **Provide enabling policies** to empower actors to fulfill targets/requirements  
  - Provide preferential approval and allowance (e.g., building height) for green buildings  
  - Establish training institutes to build technical capabilities (e.g., build, design, appraise)  
  - Create data repository (of building blueprints) to aid green construction and retrofitting  
  - Provide import tax exemptions on and grants for green building expenditure | **Collaborate with capital provider to scale and instill robustness for sustained fund flows**  
  - Formalize green buildings as an asset class, with rigorous performance monitoring and reporting  
  - Develop guidelines to issue green bonds (for developers) | **Communicate sustainability goals** (e.g., to achieve 80% green building of all buildings by 2030) to all stakeholders  
  - Developers should communicate to access better and cheaper financing  
  - Operators should communicate to create demand for green buildings |

**Establish more public-private partnerships**, where government should take the lead and set examples (e.g., government-related organizations to lead pilot projects and create sandboxes)
What are the **specific investment opportunities** within these prioritized sectors and **actions required to accelerate the trajectory** to full potential?

- **Forest conservation**
  - Page 42-46
- **Sustainable farming**
  - Page 47-51
- **Renewables (Solar and Wind)**
  - Page 52-59
- **Built environment**
  - Page 60-64
- **Electric mobility**
  - Page 65-70
Opportunity for investors near term are focused on two-wheelers (2Ws), partnering with OEMs for local manufacture, and develop charging infrastructure.

Electric mobility is one of the top ten carbon abatement levers for SEA and will represent a $50B opportunity by 2030.

WHERE TO INVEST

Electric mobility

Opportunities for investors near term are focused on two-wheelers (2Ws), partnering with OEMs for local manufacture, and developing charging infrastructure.

**Electric Mobility**

- **2W Electrification** – given cost, urban density, existing usage, opportunity in SEA's mass e-2W ecosystem (e.g., local manufacturing, battery swapping).
- **EV/Battery Manufacturing** – corporate partnerships with foreign battery/auto OEMs when local partners are required (e.g., in Indonesia, foreign battery OEMs are required to have local partner to manufacture, access raw materials).
- **EV/Charging Infrastructure** – large local corporates installing, operating charging infrastructure, opportunity is expected to grow as EVs scale, but profitable model still to be proven.

**Investor Opportunities**

- **Beam** ($93M deal, 2022) - Singapore-based e-scooter firm operating across APAC.
- **ION Mobility** ($7M, 2021) - Singapore-based EV manufacturer, operations across Singapore, Indonesia, China.
- **Swap Energy** (Undisclosed amount, 2022) - Indonesia-based battery swapping start-up, 1.5k station target by '22.
- **Hyundai and LG Energy Solution** ($1.1B, 2021) - JV for battery cell plant to manufacture BEV batteries in Indonesia.
- **VinGroup** (Multiple investments) - Vietnam-based conglomerate with $174M internal investment to build local battery-cell plant and aims to set up ~40K charging ports in near term.

**Recent Developments**

- **Beam** ($93M deal, 2022)
- **ION Mobility** ($7M, 2021)
- **Swap Energy** (Undisclosed amount, 2022)
- **Hyundai and LG Energy Solution** ($1.1B, 2021)
- **VinGroup** (Multiple investments)

Source: AVCJ; CapIQ; Crunchbase; Preqin; Pitchbook; Industry participant interviews; Lit. search; Bain analysis.
## Attractive opportunity to manufacture 2Ws, with bulk of value in manufacturing

### Factbase

<table>
<thead>
<tr>
<th>Estimated SEA market size ($B, 2030)</th>
<th>6-9 (Majority from foreign OEMs)</th>
<th>25-30</th>
<th>2-4(^1)</th>
<th>4-6</th>
<th>1-3</th>
</tr>
</thead>
</table>

### Indicative EBIT

| 5-8\(^2\) | 10-12\(^2\) | 6-10\% | ~0\% | 4-8\(^2\) |

### Headwinds

- Supply-chain challenges, increasing commodity costs
- Rising battery/component costs (e.g., lithium)
- Pressure on dealer margins due to online OEM sales channels
- Lack of regulatory framework and government incentives (excluding Singapore)
- Reduced aftersales care required for EVs vs. ICE

### Tailwinds

- Rise in pro-domestic manufacturing targets and regulation
- Growing consumer EV demand and consumer subsidies by government
- Commercial operators building onsite charging to attract traffic
- Potential emergence for end-of-life battery mgmt. market/recycling

### Adoption readiness

- ✔

### Regulatory support

- ✔

### Scalability

- ✔

### Room for local player

- ✔

### Assessment

- **Attractive**
- **Opportunistically attractive**
- **Unattractive**

### Overall assessment for SEA

- **Limited opportunity** as battery and EV manufacturing are commoditized and dominated by foreign OEM
- **Limited opportunity for new players to deal major 4W brands, EV-only pure-plays are rare**
- **Opportunity for local corporates to scale and operate, smaller opportunity for battery swapping, dominated by OEMs**
- **Unattractive as EV requires less servicing (e.g., over-the-air services, lower servicing needs and cost), vs. ICE cars that require more technical expertise**

### Potential to scale e-2Ws manufacturing with foreign and local OEMs

- **Opportunity for 2Ws manufacturer to partner with fleet companies (e.g., ride-hailing) to develop EV ecosystem**

### Minimal opportunity as hardware/R&D limited in SEA

---

Note: 2W refers to two-wheelers (e.g., motorbike) and 4W refers to four-wheelers (e.g., car); (1) Does not include leasing/secondhand market; (2) Based on global players; (3) Battery recycling industry not expected to be sizeable by 2030 since EV industry is still nascent in SEA and the average battery life is 10 years | Source: Lt. search; Analyst reports; Industry participant interviews; Company annual reports; Euromonitor; Fitch; Bain analysis
Opportunity for local players to progressively install and operate charging infrastructure, given expected growth in demand as EVs penetration matures

WHERE TO INVEST

**Electric mobility**

**Hardware manufacturing and sales**
- Estimated SEA market size: 0.3-0.4 ($B, 2030)
  - (Mainly from foreign OEMs)

**Installation**
- 1-3

**Operator software**
- 2-3

**Charging point maintenance and ops**
- End-user application
  - 0.5-0.7

**Factbase**
- **Indicative margins** (EBIT, 2030)
  - 10-15%

**Headwinds**
- High upfront CAPEX to develop R&D and manufacturing capabilities
- Unclear regulatory framework
  - E.g., Thailand: installation may be conducted by local government – practice not standardized, unclear requirements for op. software security
- No visibility on profitability and payback period (~4-5 yrs.) – depends on EV adoption/scale
- Compatibility across operators – expect proliferation of apps over time

**Tailwinds**
- Foreign players increasingly interested and regulated by government to partner local/regional players
- Pro-infrastructure government targets
  - Singapore: 60k charging points by 2030
  - Indonesia: >31k charging stations by 2030
- Adoption driven by broader EV demand and charging infrastructure buildout

**Assessment**
- Adoption readiness
- Regulatory support
- Scalability
- Room for local player

**Overall assessment for SEA**
- Limited opportunity in production/R&D – imports from United States, Europe, China, small opportunity for distribution (Malaysia: local players doing this for MNCs)
- Emerging opportunity for local corporates/operators (e.g., Thailand: installation via local subcontractors); Local distribution network and government connections critical for scale
- Limited opportunity as international solutions faster to scale
- Opportunity for local infrastructure-focused corporation to drive scale, additional revenue for retail and commercial buildings, gas station asset owners
- Opportunity for local/regional players to build solution and scale (e.g., players who can utilize existing networks, such as charging operators)

**Note:** (1) Revenue split (based on United States market) across value chain; (2) No major players profitable today without subsidy, so Indicative margins are illustrative and based on 2030 expectations for Europe and United States mature markets; (3) Varies significantly based on scale, OEM partnership agreement, VAS (hardware distribution), etc.

Source: Industry participant interviews; Analyst reports; Lit. search; Bain analysis

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**Opportunity for local players to progressively install and operate charging infrastructure, given expected growth in demand as EVs penetration matures**

**Factbase**

**Estimated SEA market size**
- 0.3-0.4 ($B, 2030)
- (Mainly from foreign OEMs)

**Indicative margins**
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Source: Industry participant interviews; Analyst reports; Lit. search; Bain analysis
Indonesia, Thailand, Vietnam emerging as EV hotspots (especially in 2W manufacturing) in SEA, given strong vehicle-manufacturing expertise

% of SEA EV production\(^1\) and outlook
- **92%**
  - Existing auto manufacturing hub, thus expect strong growth with continued policy and government support to draw EV investments
- **4%**
  - Pro-EV policies have led to increased private investments, leveraging vast nickel resources for battery production
- **4%**
  - Slow to implement policies/subsidies and charging infra despite strong manufacturing base

Note: 2W refers to two-wheelers (e.g., motorbike), 3W refers to three-wheelers (e.g., tricycle) and 4W refers to four-wheelers (e.g., car); \(^1\) For 2020 and refers to mainly four-wheelers

Opportunities

1. **Auto R&D and manufacturing**
   - **25-30** Estimated SEA market size ($B, 2030)
   - **10-12%** Indicative EBIT

   **Potential to scale e-2W with foreign OEMs due to local expertise:**
   - In Vietnam, an emerging regional champion for e-2W (first e-2W in 2018) was created due to large local demand for e-2W
   - Skilled local 2W manufacturing can also support expansion by foreign OEMs

   **Emerging opportunity to support foreign OEMs to scale 4W manufacturing:**
   - Skilled local 4W manufacturing can support expansion by foreign OEMs
   - Large existing manufacturing scale (e.g., Thailand has largest 4W manufacturing sector in SEA)
   - Clear traction in OEM investment in SEA

2. **Charging infrastructure**
   - **4-6** Estimated SEA market size ($B, 2030)

   **Emerging opportunity led by private sector:**
   - Aggressive efforts from single local player to expedite growth
   - Low EV price differential to increase EV adoption
   - Potential strong use case for LCVs and passenger buses (~1 charge daily on avg.)
   - Path to profitability remains challenged
   - Need for more clear national targets/plans vs. others in SEA
   - 2W/3W prevalence to turn toward battery swapping instead

   **Emerging opportunity as supply chains localize with vast nickel resources for battery manufacturing:**
   - High penetration potential – government target 25K stations by 2030
   - High use case potential for passenger buses (~1 charge daily)
   - Led by foreign players
   - 2W/3W prevalence to turn toward battery swapping instead
   - Path to profitability remains challenged

   **Emerging opportunity with sizeable investments made and customer EV purchase inclinations:**
   - High penetration potential – government target 12K stations by 2030
   - High (43%) consumer inclination toward EV for next purchase
   - Use case for passenger buses (nearly one charge daily on avg.)
   - Path to profitability remains challenged
   - 2W/3W prevalence to turn toward battery swapping instead

WHERE TO INVEST

Electric mobility

Note: 2W refers to two-wheelers (e.g., motorbike), 3W refers to three-wheelers (e.g., tricycle) and 4W refers to four-wheelers (e.g., car); \(^1\) For 2020 and refers to mainly four-wheelers

Source: Statista; IEE; Industry participant interviews; Lit. search; Bain analysis
Challenges with regulatory frameworks and incentives hinder faster scaling; full potential can be unlocked with more actions from governments.

Key actions to accelerate trajectory to full potential

<table>
<thead>
<tr>
<th>Improve market accessibility</th>
<th>Confront transition costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incentivize local development</strong></td>
<td><strong>Promote EV adoption</strong></td>
</tr>
</tbody>
</table>
| Gov’t subsidies and incentives to spur local manufacturing to lower production costs  
  - E.g., Dept of Trade and Industry (Philippines) launched introductory zero-tariff packages for local EV manufacturing  
  - Local partnership requirements for foreign OEMs, set by government, will develop local manufacturing capabilities (e.g., Indonesia: partnership with state-owned battery firm required for foreign entry) | Gov’t bodies should lead the way in adoption  
  - Policy measures to include green public procurement practices, direct support to infrastructure development, setting effective pollutant emissions standards  
  - E.g., Land Transport Authority (Singapore) shifted procurement policy for public transport toward EVs  
  - E.g., Malaysia announced 200 low-carbon zones in its National Low Carbon Cities Plan 2030 |
| **Set up clear roadmap to motivate private investment** | **Subsidize car-sharing businesses that operate with an EV fleet** |
|  - E.g., Thailand government announced the plan to make the country an EV hub in SEA and achieve 250K EV sales by 2025 |  - E.g., BlueSG (EV car-sharing in Singapore), given multiple government grants |

<table>
<thead>
<tr>
<th>Address range anxiety</th>
<th>Lower adoption costs</th>
</tr>
</thead>
</table>
| Public-private partnerships to quickly build out charging infrastructure and subsidize home charging  
  - E.g., Chinese state-owned utility co. has collaborated with 46K companies to build out world’s largest EV battery charging network (108K stations) across country | Induce customer adoption of EVs through govt incentives  
  - Incentives for purchase of EVs – e.g., Indonesia consumers enjoy relaxed VAT and income taxes for EV purchases, Singapore Vehicular Emission Scheme gives rebates  
  - Long-term adoption will ultimately depend on maturity of overall technology – range performance extension |

| **Back innovative business models that lower costs** |
|  - Battery-swapping service allows removal of battery costs from the purchase price – prevalence of 2W in SEA makes battery swapping more feasible for adoption (easy handling) |

Source: Industry participant interviews; Lit. search; Bain analysis
These prioritized sectors offer a range of accessible thematic investment plays; Built environment, EVs, Forest conservation and Renewables are most attractive

<table>
<thead>
<tr>
<th>Opportunities for early-stage capital</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Forest conservation</strong></td>
</tr>
<tr>
<td>Carbon mgmt./credit exchange tech</td>
</tr>
<tr>
<td>Attractive potential for emerging local carbon credit trading platform to become regional/global hub</td>
</tr>
<tr>
<td><strong>Sustainable farming</strong></td>
</tr>
<tr>
<td>Digital platforms</td>
</tr>
<tr>
<td>Farmer services platforms by local start-ups to provide services across value chain</td>
</tr>
<tr>
<td><strong>Renewables (Solar)</strong></td>
</tr>
<tr>
<td>Small C&amp;I solar projects and hybrid players</td>
</tr>
<tr>
<td>Smaller companies developing C&amp;I solar projects across SEA (who may also develop utility-scale projects)</td>
</tr>
<tr>
<td><strong>Renewables (Wind)</strong></td>
</tr>
<tr>
<td>Wind project development</td>
</tr>
<tr>
<td>Attractive potential due to strong onshore and offshore technical wind potential, driven by high expected returns on investment</td>
</tr>
<tr>
<td><strong>Built environment</strong></td>
</tr>
<tr>
<td>Energy saving technologies and services</td>
</tr>
<tr>
<td>Energy saving technology and innovative solution (e.g., cooling as a service), driven by anticipated cost savings</td>
</tr>
<tr>
<td><strong>Electric mobility</strong></td>
</tr>
<tr>
<td>Electric two-wheelers</td>
</tr>
<tr>
<td>2-wheeler manufacturing due to strong demand from consumers and mobility giants (e.g., GoJek to transition 100% of its fleet to EVs by 2030)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities for mature capital</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Forest conservation project development</strong></td>
</tr>
<tr>
<td>Develop, own and invest in forestry projects, given significant potential for forestry assets</td>
</tr>
<tr>
<td><strong>Precision agriculture</strong></td>
</tr>
<tr>
<td>High-technology scale solutions by and for larger firms with potential to substantially improve crop yield; also driven by governmental support</td>
</tr>
<tr>
<td><strong>Utility-scale solar projects by large businesses</strong></td>
</tr>
<tr>
<td>Reliable returns from utility-scale projects developed by large businesses with established track record</td>
</tr>
<tr>
<td><strong>Operational onshore wind projects</strong></td>
</tr>
<tr>
<td>Acquisition or investments into less-risky operational projects or from developers with proven track record</td>
</tr>
<tr>
<td><strong>Green building products/district cooling</strong></td>
</tr>
<tr>
<td>Green building construction as regulation expected to evolve in this direction to hit targets or district cooling projects, especially in new builds</td>
</tr>
<tr>
<td><strong>EV charging infra</strong></td>
</tr>
<tr>
<td>Local infrastructure players/conglomerates to scale and operate technology (e.g., charging stations rolled out by VinGroup in Vietnam)</td>
</tr>
</tbody>
</table>
From

$15B green capital deployed since 2020

Large untapped potential even with proven solutions in priority sectors

What is holding back SEA green investment?

What does it take to unlock full potential?

To

$170B annual revenue from priority sectors by 2030

$1T annual economic opportunity by 2030

$3T cumulative investment needed by 2030
The current disconnect

Impediments to change
SEA’s path to 1.5°C: A material gap remains between reality and aspirations

- Investment required in SEA to be on track to 1.5°C by 2030: ~ $3 trillion
- 2021 SEA GDP: ~ $3.2 trillion
- 2021 SEA GDP cumulative GDP from 2022 to 2030: ~ $37 trillion
- Annual green economic opportunity by 2030: ~ $1 trillion
- Private sector investment (financial & corporate) in green economy since 2020: ~ $15 billion
- Private green investment from 2020 to date deployed against renewables: ~ 70%
- SEA primary energy supply forecasted to still come from fossil fuels by 2040 in different scenarios: ~ 71-84%

How to fund transition while ensuring growth & prosperity? • What is holding back private sector investment? • Is decarbonizing the “old” garnering sufficient attention?

Note: Gross domestic product (GDP) at constant market prices, rebased to 2010 constant prices and translated into $ using the LCU/$ exchange rate in 2010. Source: EIU (Economist Intelligent Unit); ASEAN Centre for Energy; 6th ASEAN Energy Outlook; Bain analysis.
Three critical disconnects impede greater investment and action across SEA

1. **Insufficient incentives to scale decarbonization quickly**
   - Decarbonization is top-of-mind for investors but limited by scale of opportunities and inconsistent returns.
   - Opportunities for private capital in many sectors limited to small scale.
   - Many new projects lack sufficient incentives to meet threshold return.

2. **Bias toward new solutions vs. proven, low-risk levers**
   - Greater attention on “revolutionary” decarbonization solutions vs. known “evolutionary” proven actions.
   - Proven solutions offer low-risk impact across SME and other segments of economy that are not engaged today.

3. **Lack of clarity on system costs for energy transition**
   - Renewable competitive on LCOE basis, but integration and system costs not fully reflected in discourse.
   - Genuine change requires serious plans to address who pays for the new (e.g., renewables, grid upgrades) and the phase out the old (e.g., coal assets).

Source: Interviews with senior executives and industry experts; Bain analysis.
Greater incentives and/or penalties are needed to promote adoption of solutions

<table>
<thead>
<tr>
<th>Net-zero target</th>
<th>Renewable Tariffs</th>
<th>EV Adoption</th>
<th>Built Environment</th>
<th>Sustainable Farming</th>
<th>Forest Conservation</th>
<th>Carbon Taxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes (2060)</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Yes (2050+)</td>
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<tr>
<td>Yes (2065)</td>
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<tr>
<td>Yes (2050)</td>
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<td>No</td>
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<tr>
<td>Yes (2050)</td>
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</tbody>
</table>

Government actions to drive green solution adoption often accompanied by incentives in other parts of the world

**EV Adoption**
State of New Jersey passed a law to provide financial incentives of up to $5,000 for EV purchases in order to meet target of 85% vehicles sold to be electric by 2040

**Built Environment**
Italy raised tax-deductible "eco-bonus" benefit for better building insulation and more efficient replacement of residential cooling system (from 50% to 110%)

**Sustainable Farming**
England piloted an SFI² scheme, aiming to subsidize agri operations (£20-58/ha) meeting standards on sustainable farming practice (e.g., organic matter in soil, no bare grounds)

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**Carrots & sticks**
"There is a lack of true incentives (penalties) from most governments causing companies to have little motivation to try to achieve Net Zero"

Chief Sustainability Officer, Malaysia Conglomerate

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**Clarity needed**
"The real roadblock in SEA is not financing, but lack of clarity from governments on how they will support net zero targets. Clarity on plans is critical to build private sector confidence to invest"

Senior Executive, ADB

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**Accountability needed**
"Many governments still don’t want specific sector (decarbonization) plans given cost implications (and no budgets to address) if targets are committed to"

Head of Investments, State Pension Fund (ASEAN)

---

Scale adoption is unlikely without greater incentives/disincentives to drive behavior change

Note: (1) Committed to carbon neutrality by 2050, no direct commitments on net-zero (expecting 2050+); (2) Sustainable Farming Incentive Policy Paper; Lit. search; Bain analysis

Source: Renewables Now 2021 Global Status Report; UK Sustainable Farming Incentive Policy Paper; Lit. search; Bain analysis
Many proven solutions merit greater attention given abatement potential, risk, cost

Decarbonization levers vary by abatement cost and impact

Illustrative SEA marginal carbon abatement curves

<table>
<thead>
<tr>
<th>Carbon Abatement cost (USD/tCO2e)</th>
<th>Carbon abatement potential (MtCO2e)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Proven 20–30% abatement</td>
</tr>
<tr>
<td></td>
<td>Market ready 30–50%</td>
</tr>
<tr>
<td></td>
<td>Emerging 25–40%</td>
</tr>
</tbody>
</table>

Proven levers available across sectors in SEA

<table>
<thead>
<tr>
<th>Mobility &amp; transport</th>
<th>Built environment</th>
<th>Power generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply chain optimization</td>
<td>Efficient cooling</td>
<td>Thermal plant process optimization</td>
</tr>
<tr>
<td>2 &amp; 4-wheeler EV</td>
<td>Energy-saving appliances (e.g., LED lamps)</td>
<td>Grid modernization</td>
</tr>
<tr>
<td>EV charging infrastructure</td>
<td>Green construction design</td>
<td></td>
</tr>
</tbody>
</table>

Key Takeaways

Proven levers offer high abatement potential through proven technologies; when implemented well, can deliver high payback

Proven levers estimated to be ~10% of total expected transition costs in SEA, but can deliver 20-30% of emissions reductions

Yet many countries lack incentives and focus to encourage adoption of proven levers, (e.g., incentives for energy efficient appliances, regenerative agriculture financing scheme for smallholder farmers)
Ready-to-deploy solutions exist today across multiple decarbonization levers

Selected “proven decarbonization solutions”

<table>
<thead>
<tr>
<th>Mobility &amp; transport</th>
<th>Built environment</th>
<th>Power generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abatement potential 2050¹</td>
<td>Technology readiness²</td>
<td>Public awareness /Sentiment³</td>
</tr>
<tr>
<td>Technology readiness²</td>
<td>Public awareness /Sentiment³</td>
<td>Economics⁴</td>
</tr>
<tr>
<td>Public awareness /Sentiment³</td>
<td>Economics⁴</td>
<td>Investor interest⁵</td>
</tr>
<tr>
<td>Economics⁴</td>
<td>Investor interest⁵</td>
<td>Regulatory incentives⁶</td>
</tr>
<tr>
<td>Investor interest⁵</td>
<td>Regulatory incentives⁶</td>
<td>Enabling infrastructure⁷</td>
</tr>
</tbody>
</table>

**Note:** Based on: (1) Project Drawdown numbers scaled to SEA; (2) Tech maturity for adoption; (3) Level of policy stability, policy execution efficiency, and socioeconomic context; (4) Revenue and growth potential; (5) Publicly available private investments from 2020, involving targets based in SEA; (6) Level of regulatory financing support including carbon tax, government subsidies, and financing incentives to support adoption; (7) Availability of existing and developing infrastructure to support adoption (e.g., EV charging stations) | Source: Lit. search; Industry participant interviews; Bain analysis; (*) IEA; (**) Statista, 2017.

Legend:
- High
- Low
- Criteria agnostic

**2. Levers**

**Disconnection**

**Abatement potential 2050¹**

- **Mobility & transport**
- **Built environment**
- **Power generation**

**Technology readiness²**

- **Mobility & transport**
- **Built environment**
- **Power generation**

**Public awareness /Sentiment³**

- **Mobility & transport**
- **Built environment**
- **Power generation**

**Economics⁴**

- **Mobility & transport**
- **Built environment**
- **Power generation**

**Investor interest⁵**

- **Mobility & transport**
- **Built environment**
- **Power generation**

**Regulatory incentives⁶**

- **Mobility & transport**
- **Built environment**
- **Power generation**

**Enabling infrastructure⁷**

- **Mobility & transport**
- **Built environment**
- **Power generation**

**DISCONNECT**

**2. Levers**

**Attractiveness assessment for 2030**

- **Mobility & transport**
- **Built environment**
- **Power generation**

**Selected “proven decarbonization solutions”**

**Mobility & transport:** Supply chain optimization

- **Freight industry inefficiencies** driven by fragmentation and manual processes result in suboptimal loads & empty backhauls
- Recent emergence of ventures in SEA developing logistics management platforms indicates rising investor interests

Combination of proven improvement levers could **reduce emissions with the industry by up to 30%** (e.g., supply chain optimization, intermodal switch)

**Built environment:** Cooling efficiency

- **Increasing energy demand for cooling** up to ~2X in SEA by 2030 highlights pressing need to push efficient solutions
- Existing inverter technology could provide ~30% energy efficiency improvement⁸; proven technology with ~90% adoption in Japan**⁹

Widespread adoption possible through minor retrofit projects from small local players like SMEs

**Power generation:** Plant process optimization

- Given most SEA government targets expect coal to remain a key part of the fuel mix for next 10-20 years, more actions are needed to optimize its efficiency and reduce carbon footprint as much as possible

Untapped opportunities exist to **improve thermal efficiency of coal fired power plants quickly and effectively** (e.g., feedstock drying, feedwater heater & condenser optimization) during transition
Proven solutions like supply chain optimization could reduce emissions from transport by nearly 30% - with positive related benefits in energy costs

Supply Chain Optimization: Digital freight booking platforms improve utilization & reduce empty backhaul

Freight industry is relatively **inefficient due to fragmentation and manual operations** by brokerages. Optimizing for freight efficiency to reduce “empty miles” – wasted trips with suboptimal loads – leads to both **lower costs** and **elimination of excess pollution** and fuel emissions.

Digital platforms serve to bridge information asymmetry through aggregating demand and supply, recommending a match between shippers and carriers.

There are **proven abatement solutions** today with potential cost savings.

<table>
<thead>
<tr>
<th>Sample solutions</th>
<th>Estimated emissions reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Chain Optimization</td>
<td>7 - 10%</td>
</tr>
<tr>
<td>Modal switch</td>
<td>2 - 4%</td>
</tr>
<tr>
<td>Fleet Upgrades</td>
<td>8 - 10%</td>
</tr>
<tr>
<td>Drop-in Biofuels¹</td>
<td>3 - 4%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20 - 28%</strong></td>
</tr>
</tbody>
</table>

Note: (1) Trucks and ships, not aviation
Source: (*) Bain expert analysis, 2020 Agility sustainability report

*Marginal Abatement Cost (MAC) curves illustrate potential decarbonization pathways, showing how technologies compare by cost (Y-axis) and abatement potential (X-axis)

**EZYHAUL**

A digital freight platform that optimizes routing and ‘right-sizing’ vehicle type, reducing fuel emissions up to 10%*.

Through advanced machine learning algorithms and IoT connectivity, the platform equips partners with scale and carrier type choices while providing intelligence on delivery schedules.
Cooling (which accounts for 15-20% of SEA electricity demand) could be more efficient via proven solutions and offers low-risk, high-gain abatement potential

Demand for residential ACs in SEA expected to ~2x in next 10 years...

Growing demand for space cooling across SEA driven by rising income, urbanization rate, and greater access to electricity

Residential sector in SEA forms about 15% of total final energy demand today and is expected to decrease to about 10% towards 2030

Most residential ACs used in SEA are not efficient, as most of the countries have <50% of ACs with inverter technology which is up to 30% more energy efficient*

Current adoption of AC (inverter) in SEA is estimated to be ~35%

“Most consumer are simply not educated on inverter technology. For e.g., payback period is 2-5 years for using inverter AC vs. non-inverter AC with 10-15 years usage life…”

Regional director of AC manufacturer

Opportunity to abate 10-15 MtCO2-e (~10% of 2030 BAU) from residential cooling sector in SEA, by doubling adoption of inverter technology (more energy-efficient ACs) by 2030

Higher adoption of AC (inverter) could be driven by financial incentives (e.g., cash rebates, grants), consumer education, and more stringent efficiency standards

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*Note: AC refers to air-conditioning units; (1) Analysis and forecast by 6th ASEAN energy outlook report (ASEAN); (2) Other sectors include Industry, Transport, Commercial, Agriculture and Others, and total final energy demand refers to the energy used directly by end-users, and not for production of another fuel, and is measured with million tonnes oil equivalent
Source: (*) IEA; IIFIR; Ipsos; Euromonitor; ASEAN Center for Energy; Green Cooling Initiative; Industry participant interviews; Bain analysis
Uncertainty about who will pay the system costs to allow scale integration of renewables across SEA is a further impediment to scale investment

EU: More renewables are accompanied by higher electricity prices to consumers

VALCOE reflects more holistically full costs of generation at system level; conventional wisdom about costs may be wrong

Example: Levelized cost of electricity (LCOE) and value-adjusted LCOE (VALCOE) for solar PV and coal-fired power plants in India; suggests high penetration may reduce returns as scale increases

“Structure of EU wholesale electricity markets...means that the savings generated by low-cost solar PV and wind power are not passed on to electricity customers...”

Climate Action Network Europe

“VALCOE builds on the LCOE metric by including three additional considerations of value in power systems, including energy, capacity, and flexibility”

IEA

Note: VALCOE = Value adjusted levelized costs
Source: HH electricity price from Eurostat; UK data from UK national statistics; 2021 installed solar + wind capacity from IRENA; population data from UN as of Jan 1 2020; IEA

DISCONNECT 3. System costs

EU market structure gives pricing power to fossil fuel power producers and consumers do not enjoy the savings from renewable costs

Renewable levies that serves to provide guaranteed revenues for suppliers result in higher prices for consumers

“Structure of EU wholesale electricity markets...means that the savings generated by low-cost solar PV and wind power are not passed on to electricity customers...”

Climate Action Network Europe
SEA needs to address these disconnects to unlock and accelerate investment

1. Insufficient incentives to scale decarbonization quickly
   - Greater incentives and penalties required to drive behaviour change and investment at needed scale

2. Bias toward new solutions vs. proven, low-risk levers
   - Many overlooked proven solutions are already here today, offering clear abatement and investment potential

3. Lack of clarity on system costs for energy transition
   - Unlocking investment at scale for green economy requires great clarity about system costs and who pays

How can the region develop a more holistic approach to meet 2030 interim decarbonization goals?
Recommendations

Actions to accelerate and scale the green economy
Four actions to drive acceleration of green investment and climate action

1. **Unlock opportunities in proven solutions**
   Adopt a more holistic decarbonization program with stronger framework and incentives to expand market access and enroll segments such as SMEs.

2. **Confront system costs for energy transition**
   Clarify full costs on renewables power transition and define funding sources and mechanisms to attract new investments.

3. **Strengthen green financing**
   Leverage financial services sector to develop abatement investment products that lower the cost of capital for businesses to transition.

4. **Drive creative regional collaboration**
   Scale up regional collaboration to unlock new potential and risk mitigation. Foster partnerships across value chain, industries, and public/private sectors.
Unlock opportunities in proven solutions

Market Challenge

Insufficient regulatory framework and market attention allocated towards ready solutions that can be implemented today across broader population to reduce emissions

Actions to accelerate transition

Countries should adopt more holistic decarbonization program by strengthening framework and incentives for proven solutions and enroll segments such as SMEs who are not fully engaged today

Government Support and Incentives

Promote zero-carbon mobility solutions

Set up regulations and incentives for public and private transport operators to convert into electric fleet to achieve scale decarb impact

Socialize benefits (e.g., via public campaigns) and raise awareness on zero-carbon transport solutions for mass market (e.g., two-wheeler users in SEA)

SMEs and Smallholders

Accelerate sustainable & regenerative farming

Smallholder farmers represent about ~10% of SEA’s overall carbon emissions (segment represent ~60% of the total agricultural emissions)

Scale promotion of more sustainable farming has potential to reduce emissions by up to ~40% versus today; a high potential lever to 2030

Power

Improve current capacity during energy transition

Heavy industry, thermal power generation, and O&G production account for material emissions under many SEA country NDCs with hydrocarbon use continuing well into 2040s

Parallel focus needed to vigilantly reduce (not ignore) current emissions from industry and thermal power in tandem with transition

Meeting 2030 targets for COP demands explicit focus on O&G, coal, and other industries where near term solutions can deliver impact and ROI while next generation solutions emerge (hydrogen)

Malaysia EV Tax Exemption

EVs in Malaysia will be exempted from road tax through Dec 2025. Owners of EVs also benefit from EV charging income tax reliefs of up to MYR 2,500

Opportunities in Precision Agriculture

The usage of precision irrigation solutions could increase yields by up to 25%, reduce water consumption by up to 50%, and reduce energy costs by up to 50%

Source: Aljazeera, World Bank, The Star; Lit. search
Confront system costs for the energy transition

Insufficient understanding and consideration of system costs of various renewables in both public discourse and in policies; lack of clarity on who pays what is hindering scale up of solar and wind.

Countries, with joint effort between regulators and investors, should gain clarity on full costs of Solar and Wind; define how costs will be funded (e.g., developmental funding, national budgets, incentives, carbon taxes) to attract investments.

### Transition costs

**Assess full system costs of renewable roll out**

- **Delineate costs** to countries’ electricity systems at varying level of Solar/Wind deployment, i.e. storage, grid stability management, peaking capacity, transmission.
- **Enable fully informed decision** on power generation technology mix decisions.

### Funding Options

**Explore public-private financing options**

- **Quantify funding needs** to deliver on country’s renewable commitments.
- **Launch joint taskforce between regulators and commercial investors** to develop funding levers balancing project risk and returns.

### Roadmap and actions

**Develop enabling regulation in detail**

- **Define market mechanism and policies** that govern “who pays” for shared infrastructure cost (e.g., transmission balancing, grid & connection).
- **Create regulatory incentives** (e.g., carbon tax, carbon credits, feed in tariff) that align with country’s climate commitment and economic realities.

### VALCOE Study

ACE launched “VALCOE” report on September 2021 – first regional study to quantify cost competitiveness of different power generation technologies in SEA.

### Blended Finance

“Blended finance, which combines concessional public funds with commercial funds, can be a powerful means to direct more commercial finance toward impactful investments that are unable to proceed on strictly commercial terms.”

Senior Economist, Global Development Bank

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**Source:** World Bank, EU RES, ASEAN Center for Energy

**Netherlands Electricity Act**

The Netherlands Competition Authority established a Fee Code, which determines the initial connection fee and subsequent annual maintenance fees borne by the Plant Operator.
Strengthen green financing for all solutions

**Market Challenge**

Existing gaps between abatement-ready opportunities and availability of capital needed to deliver carbon reduction

**Actions to accelerate transition**

Leverage financial services sector to develop abatement investment products that lower the cost of capital for businesses to make carbon transition

### Alternative Financing

**Improve financing access to smallholder farmers**

- Develop new microfinancing options with collateral-substitute schemes for smallholder farmers by developing suitable regulations, flexible yet properly governed lending mechanism, and enabling equity financing for retail investors

- Introduce ultra-low cost or interest-free government-backed loans for smallholder farmers facing challenges to secure formal financing due to limited credit history

**Energy Efficiency Fund**

- Energy Efficiency Fund (E2F) increased tech grant up to 70% of project cost. Lowers the barrier for industrial SMEs to adopt energy-efficient solutions that save money on energy and cut carbon emissions

**Government Incentives**

- Fiscal incentives to drive energy efficiency
  - SMEs account for ~50% of regional GDP but are not focused today on carbon reduction or energy efficiency due to lack of awareness and lack of access to capital to facilitate change
  - Providing greater access to financing needed to unlock the material high-probability/low-risk carbon reduction lever untapped today across SEA

**Public-Private Financing**

- Performance-based finance for green buildings
  - Most SEA countries are behind on mandating green building requirements. They also lack financing facilities for green building retrofits
  - Governments can fill the gap in financing availability by facilitating upfront capital required for costly green retrofits from local/regional financial institutions (through default-risk or credit-risk sharing agreements)

**Micro finance**

The ADB partners with local microfinance institutions (MFIs) and shares loan default risk (up to 50%) to increase MFI access to local currency funding, reducing the credit costs of SMEs (incl. smallholder farmers)

### Notes

1. ADB Microfinance Risk Participation and Guarantee Program
2. Building and Construction Authority
3. Asian Development Bank
4. Deal Street Asia
5. WWF

**RECOMMENDATIONS**

3. Green financing

---

Source: Building and Construction Authority (1); Building and Construction Authority (2); Asian Development Bank; Deal Street Asia; WWF
Drive greater collaboration through a regional, innovative mindset

 SEA decarbonization challenges transcend borders where there is often a disconnect with opportunities existing in one country, but capital and needs in another; opportunities need scale to be delivered at lower costs

Government and industry leaders should scaleup cross-border collaboration to unlock opportunities and know-how, and allow capital to better flow to where needed; foster partnerships across value chain, industries, and public/private sectors

Regional Transaction Markets

Regional carbon market development

Select countries have large natural carbon resources and need capital to better value and protect them as rich carbon sinks

Cross-regional investment of nature-based solutions and offsets connects capital to where it can help scale conservation and biodiversity

Singapore-Australia carbon trade

Layering on top of the existing FTA, Singapore and Australia converged on carbon regulations and standards to enable bilateral trade where Australia will supply carbon credits while Singapore aggregates demand.

Cross-Border Power Development

Accelerate regional power grid development

Expand the APG1 to build out cross-border connections and facilitate multilateral power trading for grid balancing and reducing system costs, e.g., export of Vietnam's solar power

Establish regional taskforce to align on regulatory/technical framework, e.g., PPA standardization to enable bilateral trading

Singapore-Indonesia Batam investment

Multiple projects under proposal in Riau Islands to provide location for large-scale solar projects and supply of power to Singapore and domestic local markets

Open Data Ecosystems

Data sharing to spur innovation & advancement

Provide farmers with access to digital connectivity and efficient farming data through infrastructure and grants

Set up a regional platform for stakeholders to share farming data – breaking past current modes of restricted sharing between local cooperatives – to better facilitate private sector innovation

IDEA2 platform

Sustainable farming is critical (~50% of employment) for India. Government-led, multi-stakeholder platform empower farmers to make well-informed planting decisions with data-driven insights to increase yields and income

Note: (1) ASEAN Power Grid; (2) India Digital Ecosystem of Agriculture; FTA = Free Trade Agreement

Source: IEA
Successful outcomes require key stakeholders to take unique roles & mobilize actions

**Governments**
- Lead with **clear direction** and specific **decarbonization roadmaps** to enable growth in green investments

**Investors**
- Champion progress and back needle-moving solutions by **unlocking greater transition financing**

**Corporates**
- Translate ambition into results by **decarbonizing own emissions** and capturing **commercial value** from sustainability levers

What are the critical activities needed from stakeholders to accelerate carbon transition?
Governments need to build visibility and actionable plans to realize COP26 ambitions

Priority action checklists to accelerate transition

- Define holistic decarbonization approach across time horizons, balancing focus on near-term solutions vs next-gen technologies
- Translate COP26 ambitions into clear transition roadmap and industry pathways with baseline measurement and science-based target setting
- Provide comprehensive fiscal and non-fiscal incentives across all commercially viable sectors to accelerate adoption

Unlock opportunities in Proven solutions

- Streamline project approval process and clarify regulatory framework (e.g., land access rights)
- Establish building efficiency and green construction mandates, while providing enabling policies (e.g., free building audits, tax levies)
- Develop fiscal and non-fiscal EV incentives (e.g., excise tax rebates) to induce consumer adoption & commercial fleet conversion
- Increase project size caps and foreign ownership threshold to enable participation from global / large players in renewables projects

Confront system costs for Energy transition

- Develop clear energy-transition roadmap (e.g., coal phase-out) as well as plan for distributing total shared infrastructure costs to stakeholders
- Modernize existing power grids and install energy storage solutions to improve load balancing and reduce curtailment of Variable Renewable Energy (VRE)
- Clarify total VRE system costs and delineate costs ownership to countries sharing grid network, i.e., storage, grid stability management, peaking capacity, transmission

Develop and strengthen Green financing

- Collaborate with multi-national platforms (e.g., Global Infrastructure Facility) to develop pipeline of bankable projects & mobilize private capital
- Facilitate upfront capital required for major capex projects from local/regional financial institutions (through default-risk or credit-risk sharing agreements)
- Develop co-investment schemes with green funds and angel investors investing in green start ups to de-risk green investments

Prioritize and drive Regional collaboration

- Develop and implement harmonized carbon pricing, measurement standards, and certification framework across SEA countries
- Develop regional ETS marketplace to enable cross-border trades & allow capital to better flow to where needed
- Expand ASEAN power grid to build out cross-border connections & facilitate multilateral power trading for grid balancing and reducing system costs
Investors hold a critical key to unlocking greater transition finance

Priority action checklists to accelerate transition

Unlock opportunities in Proven solutions

- Improve project bankability by leveraging network of experts to train project owners in building more robust business plans; increasing investment attractiveness
- Specify investment hurdle rates and risk-return requirements, collaborating with governments to identify possible risk-sharing arrangements and bridge gaps in project financing
- Track financial performance (value) of "green" investments over time and leverage performance data to showcase attractiveness to various investors

Confront system costs for Energy transition

- Evaluate capex investments on shorter lifetime value to mitigate stranded asset risks and build flexibility for renewables transition
- Support and back innovative business models that lower adoption barriers and costs, e.g., battery swapping service allows removal of battery costs from the overall EV purchase price

Develop and strengthen Green financing

- LPs\(^1\) to specify a “green mix” in portfolio decisions and extend preferential investment horizon for deployment of green capital
- GPs\(^2\) should actively seek out green trading/investment strategies to increase LP fundraising for deployment of green capital
- Launch loan financing products with green compliance guardrails, linking financing terms to sustainability performance – e.g., Singapore BCA BREEF\(^3\) scheme

Prioritize and drive Regional collaboration

- Advocate for common disclosure requirements in public-private industry forums, enabling ‘interoperability’ across SEA
- Setup collaboration platform with local microfinancing players to accelerate outreach to small-holder farmers / SMEs for loan disbursements

Note: (1) Limited Partners – investors providing capital but not responsible for daily operating activities; (2) General Partners – investment professionals responsible for managing portfolio performance and making operational decisions; (3) BCA = Building Construction Authority, BREEF = Building Retrofit Energy Efficiency Financing
Corporates should prioritize decarbonizing own emissions – start simple & evolve

Priority action checklists to accelerate transition

<table>
<thead>
<tr>
<th>Unlock opportunities in Proven solutions</th>
<th>Confront system costs for Energy transition</th>
<th>Develop and strengthen Green financing</th>
<th>Prioritize and drive Regional collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure baseline emission across all lines of business to set clear &amp; measurable decarbonization ambition</td>
<td>Assist government efforts in building out renewables power grid, advising on potential grid configurations to optimize for both system costs and energy security</td>
<td>Establish commitments and make regular, comprehensive carbon disclosures using international standards (e.g., SBTi, SASB, etc.) to improve transparency</td>
<td>Collaborate with upstream suppliers in the region to decarbonize supply chain (e.g., switch to lower carbon input, reduce logistics carbon footprint)</td>
</tr>
<tr>
<td>Evaluate abatement opportunities across businesses and prioritize short &amp; long-term decarbonization levers</td>
<td>Design assets with an emphasis on convertibility to low-carbon powered sources, e.g., modifying a gas-powered generating station to run on hydrogen</td>
<td>Foster partnerships with governments and multilateral development banks to broker agreement for transition finance</td>
<td>Improve availability and affordability of energy efficient products across the region by optimizing manufacturing and distribution processes</td>
</tr>
<tr>
<td>Optimize energy efficiency across internal operations to minimize Scope 1 and 2 emissions</td>
<td></td>
<td></td>
<td>Open up access to data and knowledge critical for sector innovation, e.g., India’s IDEA platform facilitate ecosystem-wide agriculture innovation through sharing of collected farming data</td>
</tr>
<tr>
<td>Embed sustainability into strategic agenda, translating decarbonization goals into measurable KPIs for various business units</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: (1) Science-based Targets initiative; (2) Sustainability Accounting Standards Board
Country insights
Indonesia has announced bold net zero ambitions; however, unclear path exists on how it will deliver results with inconsistencies on many market practices.

### Point of departure (Emission profile)

- **1,700 MtCO2e** of total GHG emissions in 2018
- **76%** energy from fossil fuel sources
- **$7B** spent in fossil fuel subsidies (2020), 8th highest in the world
- **Has 23% of world’s peatlands, largest tropical peat carbon stock (55% of the world), majority under deforestation threat**

### Key details

<table>
<thead>
<tr>
<th>Key</th>
<th>29%</th>
<th>12M &amp; 2M ha</th>
<th>$2</th>
</tr>
</thead>
<tbody>
<tr>
<td>emissions reduction</td>
<td>from BAU by 2030 (41% conditional)</td>
<td>of degraded lands and peatlands to be rehabilitated and restored</td>
<td>proposed price/tCO₂e of carbon tax, with ETS under consideration</td>
</tr>
</tbody>
</table>

### Challenges

- **~1,700 MtCO2e of total GHG emissions in 2018**
- **$7B** spent in fossil fuel subsidies (2020), 8th highest in the world
- **Has 23% of world’s peatlands, largest tropical peat carbon stock (55% of the world), majority under deforestation threat**

###Government commitments (2030)

- **29%** emissions reduction from BAU by 2030 (41% conditional)
- **12M & 2M ha** of degraded lands and peatlands to be rehabilitated and restored
- **$2** proposed price/tCO₂e of carbon tax, with ETS under consideration

### Recommended government actions

- Translate commitments into ministerial decrees and a national roadmap
- Establish standardized and clear PPAs and deregulate the domestic power industry
- Strengthen law enforcement on illegal deforestation and criminal indictments of illegal deforesters, to increase deterrence effect

### Ambiguity + conflicting incentives

**ENERGY**

- Commercial scaling of renewables challenged due to FIT, PLN control over grid.
- Regulatory incentives not aligned and still favoring fossil fuels

- Coal plants moratorium after 2023, yet 21 GW worth of coal plants remain in pipeline, raising transition concerns

- Government aims to sell only electric-powered cars, motorbikes by 2050 yet falling short on 2020s’ targets for charging stations. Incentives for EV ownership insufficient

- Government aims to transform forests into carbon sinks, yet needs to move beyond ‘carbon nationalism’ to participation in global voluntary carbon markets

### 2030 TRAJECTORY

- ![Positive outlook](#)
- ![Uncertain outlook](#)
- ![Challenging outlook](#)
Investment driven by private sector, with focus on Renewables

Investment flows¹

Value of deals in Indonesia by key themes (2020-Feb 2022, USD M)

<table>
<thead>
<tr>
<th>Renewable energy (Other)</th>
<th>Other</th>
<th>Mobility</th>
<th>Solar</th>
</tr>
</thead>
<tbody>
<tr>
<td>960</td>
<td>215</td>
<td>112</td>
<td>109</td>
</tr>
</tbody>
</table>

Total = 1,396

Top themes by investment types:

- **Corporate**
  - Geothermal
- **PE/VC**
  - Solar, Sustainable Farming
- **Climate Fund**
  - Solar
- **SWF**
  - Mobility

Deal example:

Corporate: Singapore-based Green Era acquired ~33% stake in Star Energy (a group owning controlling stakes in Indonesian geothermal energy assets) for ~$450M

Most active investors²:

- AC Ventures
- East Ventures

Note: (1) Non-exhaustive and only includes investments > $10m, excluding JVs due to data availability, includes deals with overlap across investor types; (2) Based on deal volume

Source: AVCJ; S&P Capital IQ; Preqin; Pitchbook
Significant forestry assets and government push for carbon market signals Forest Conservation as high-potential investment sector

**Tailwinds:**
- Significant assets (~70% of SEA’s investable carbon forestry stock, 2nd largest in world)
- Recent government push to launch pilot emissions trading scheme is encouraging
- Expect continued increase in carbon prices, driving demand across value chain

**Headwinds:**
- Inconsistent regulations on carbon trading driving investor uncertainty
- Lack of clear regulatory framework for project development (may take 3+ years to secure project licenses)
- Scalability, profitability of projects still unproven; potential projects competing with other higher return projects (e.g., agri)
- Fragmented farming landscape, with many small-scale farmers (75% of all farmers own farms smaller than 1 hectare) unable to independently afford the high costs of digitalization
- Less educated smallholder farmers (2/3 farmers did not advance beyond primary education) may not have sufficient technical knowledge to adopt digitalization solutions
- Connectivity challenges (especially in rural areas) compounded by lack of internet usage (only 10% farmers use the internet)
- Lack of supportive policies to develop projects (e.g., bureaucratic process to obtain permits, no FIT schemes in sight)
- State-owned PLN has strict requirements hampering adoption (e.g., extra technical requirements, installation permission)

**, Opportunity: Project origination, feasibility, development and design, carbon-credit sales and trading**

Increased awareness and availability of farmer service platforms due to COVID-19 impact to supply chains

**Digitalization increases productivity, addressing concerns around labor shortage (due to lack of participation from young generation)**

**Sustainable farming**

**Opportunity:** Farmer service platforms

Significant utility-scale pipeline with MOUs (estimated five large-scale projects) to build solar plant/floating solar to export power to Singapore

**Decent project IRR (utility-scale) of 8-10%**

**High technical solar potential of ~200GW**

**Substantial landmass ideal for utility-scale solar (especially in Kalimantan), with recent projects reporting high energy densities of 600–800 kWp/hectare**

**Built environment**

**Opportunity:** Green building products

Maturation of government regulation mandating green building requirements for new construction projects

**Implementation and enforcement challenging, as regulations are mostly voluntary in practice; lack of compliance monitoring system**

**Existence of green premium, as materials and equipment will be more expensive, discouraging adoption**

**Increased supply-chain unpredictability, as products or product components likely to be imported from outside of SEA**

**, Opportunity: Exported utility-scale solar**

**Electric mobility**

**Opportunity:** Auto R&D and manufacturing (especially 2W), and charging infrastructure

Strong government support on EV and battery manufacturing (fiscal and non-fiscal support) and charging infrastructure (25K units by 2030)

**Ambitious government targets, with 20% of auto manufacturing to be EV**

**Raw material advantage (rich in nickel, cobalt, and other rare earth metals)**

**Emerging local manufacturing and demand for 2W vehicles**

*, Opportunity: Green building products**

Source: S&P Global; FFTC, World Bank; Mercy Corps; ERIA; Industry participant interviews
Malaysia’s push for new carbon initiatives encouraging, but greater clarity on timeline and actionable goals needed to deliver results in line with ambitions

Point of departure (Emission profile)

- ~390 MtCO2e of total GHG emissions in 2018
- 93% energy mix from fossil fuels in 2019
- 7% energy mix from renewables in 2019
- 17% of terrestrial areas protected in 2020

Government commitments (2030)

<table>
<thead>
<tr>
<th>Key details</th>
<th>Recommended government actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>45%</td>
<td>Develop coal transition roadmap, renewables roadmap, and green-economy upskilling plan</td>
</tr>
<tr>
<td>40%</td>
<td>Develop co-investment initiative specific to climate tech start-ups</td>
</tr>
<tr>
<td>20% &amp; 10%</td>
<td>Eliminate project size caps to stimulate development of larger-scale projects</td>
</tr>
<tr>
<td>~390 MtCO2e of total GHG emissions in 2018</td>
<td></td>
</tr>
<tr>
<td>93% energy mix from fossil fuels in 2019</td>
<td></td>
</tr>
<tr>
<td>7% energy mix from renewables in 2019</td>
<td></td>
</tr>
<tr>
<td>17% of terrestrial areas protected in 2020</td>
<td></td>
</tr>
</tbody>
</table>

Challenges

- ~2 years behind 2025 renewables target (forecast)
- ~50% coal retirement by 2033 but facing natural gas shortage
- Negative green investment growth since 2016

Legend

Positive outlook
Uncertain outlook
Challenging outlook

Rollout of renewables slowest in the region (3% of added capacity in SEA in 2020). Cap of 50 MW/project limits investment potential and feasibility to reach 31% ‘green’ power capacity by 2025

2.8 GW of coal to be added after 2030, despite ambition to phase out coal power. Clarity on coal-transition action plan required

Budget 2022 proposal to exempt EVs from taxes a step in the right direction; electric mobility transition needs to be supported by ramp-up in infrastructure

Establishment of Energy Audit Conditional Grant encouraging; clear goals should be established on top of the incentives

Preservation of 20% of land area and conservation financing highlighted in 12th Malaysia Plan; continues to face challenges with illegal land clearing and hazardous waste dumping

2030 TRAJECTORY

Note: (1) Industrial & construction; (2) Target reduction of economy-wide carbon intensity (base year: 2005), 35% unconditional and 10% conditional target; (3) Compared with 30% in 2020

Source: Argus; IHS Markit; EIA; UNFCCC; CBD; Ministry of Energy and Natural Resources; Moody’s Analytics; New Straits Times; CNA; Yahoo Finance; SBTi; Company websites
Room to grow for green investment space in Malaysia, emerging Solar momentum

Investment flows

Value of deals in Malaysia by key themes (2020-Feb 2022, USD M)

- Solar
- Fuel substitution
- Food loss and waste
- Corporate: Tailworks invested $35M into the 19MW Kuala Lumpur International Airport Solar Power Portfolio
- Most active investors:
  - No green investor has substantial activity in Malaysia

Top themes by investment types:

Corporate: Solar, Fuel substitution
PE/VC: Food loss and waste
Infra Fund: Solar
SWF: Food loss and waste, Solar

Note: (1) Non-exhaustive and only includes investments > $10m, excluding JVs due to data availability, includes deals with overlap across investor types; (2) Based on deal volume
Source: AVCJ; S&P Capital IQ; Preqin; Pitchbook
Supportive policies and incentives drive higher attractiveness for Sustainable Farming & Solar investments

**Tailwinds:**

- **Forest conservation**
  - **Opportunity:** Project origination, feasibility, development & design, and carbon-credit sales and trading
  - Significant forestry assets (~20% of SEA total investible carbon forestry stock)

- **Sustainable farming**
  - **Opportunity:** Precision agriculture and farmer service platforms
  - Supportive government plans (e.g., government targets to expand the use of AgTech as part of 12th Malaysia Plan)
  - Generous fiscal and non-fiscal incentives for AgTech start-ups from regulators and GLCs
  - Intermittent acute labor shortages necessitate digitalization

- **Solar**
  - **Opportunity:** Commercial and industrial Solar
  - Government allocation of additional 300 MW of net-metering capacity quota from 2021 to 2023, which allows owners to sell excess energy to the grid or offset bills at other sites on a “one-on-one” basis
  - Supportive government policies to encourage solar (e.g., solar-leasing firms enjoy 70% income tax exemption for up to 10 years) and develop C&I solar sector (estimated project IRR of ~12%)
  - Ambitious renewables target of 40% of installed capacity by 2025 to be driven primarily by solar

- **Electric mobility**
  - **Opportunity:** Auto R&D and manufacturing (4W)
  - Strong four-wheeler manufacturing sector (3rd largest in SEA) (accelerates industry maturity due to existing knowledge pool)
  - Recently introduced EV tax rebates likely to stimulate EV demand

**Headwinds:**

- **Forest conservation**
  - Need for clearer government regulation and enabler ecosystems
  - Scalability, profitability of projects still unproven; potential projects competing with other higher return projects (e.g., agri)

- **Sustainable farming**
  - Low deal-flow availability
  - Fragmented farming landscape with many small-scale farmers (e.g., 40% of palm oil produced by small-scale farmers) unable to independently afford the high costs of precision agriculture technologies

- **Solar**
  - Foreign ownership caps for FIT eligibility (49% max) limits large-scale projects, disincentivizing foreign investor demand
  - Smaller ticket sizes in C&I projects present challenge to scale

- **Electric mobility**
  - Unclear charging infrastructure plans and lack of commitment (previously established targets of 125k public-private charging stations by 2020 not met)

Source: Malaysia Investment Development Authority; Malaysia 20 Year National Strategic Plan (2018 – 2037); Khalid and Dayyan (2012); New Straits Times; ISEASA; MGTC
Thailand need to raise its carbon ambition and add concrete measures to transition

Point of departure (Emission profile)

- ~430 MtCO2e of total GHG emissions in 2018
- 86% energy mix from fossil fuels in 2019
- 14% energy mix from renewables in 2019
- 58% of all agriculture GHG emissions generated from rice cultivation

Government commitments (2030)

<table>
<thead>
<tr>
<th>Key details</th>
<th>Emission reduction relative to business-as-usual by 2030 (25% conditional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>of power generation to be sourced from renewables by 2030; increase from 18% in 2020</td>
</tr>
<tr>
<td>ETS</td>
<td>under consideration</td>
</tr>
<tr>
<td>No</td>
<td>explicit NDC commitments for agricultural farming</td>
</tr>
<tr>
<td>Lack</td>
<td>of good electrical infrastructure, support by financial institutions, and technical resources</td>
</tr>
<tr>
<td></td>
<td>projected increase in GHG emissions by 2030 under current policies (23% under planned policies)</td>
</tr>
</tbody>
</table>

Recommended government actions

- Increase resources allocated to NAMA; develop comprehensive sustainable farming and agricultural emissions-reduction roadmap
- Introduce additional fiscal and non-fiscal incentives to accelerate green-finance ecosystem
- Develop coal-transition roadmap, including a green-economy upskilling plan for impacted workforce

Challenges

- Ambiguity + conflicting incentives

  - Commitment of 37% renewables on new added power capacity by 2037; Promising, but yet to translate into National Energy Plan and clear policies
  - Lack of clear coal transition plan; 2021 Power Development Plan still includes new coal pipeline. Proposed plan to remove fossil-fuel subsidies yet to be seen, as fossil fuel lock-in continues
  - Thailand aims to become an EV hub for ASEAN, with all domestic vehicles sold to be zero-emission and production of only EVs by 2035, domestic uptake will depend on to-be-revised incentives
  - Several sectors as part of Thailand 4.0 initiative to transform into a developed, low-carbon economy (e.g., automotive) but without clear targets

Legend: Positive outlook, Uncertain outlook, Challenging outlook

Note: (1) I&C: industrial and construction; (2) Good agricultural practices/sustainable rice platform

Source: CCAC, NAMA, Climate Action Tracker, World Bank, S&P Global, Bangkok Post, EIA, UNFCCC, SBTi, PR Newswire, Bloomberg, Company websites
Capital deployed mainly on Renewables and green infrastructure deals

Investment flows¹

Value of deals in Thailand by key themes (2020-Feb 2022, USD M)

<table>
<thead>
<tr>
<th>Theme</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate</td>
<td>4,111</td>
</tr>
<tr>
<td>Built environment</td>
<td>25215</td>
</tr>
<tr>
<td>Solar</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

Total = 4,378

Top themes by investment types:

- Corporate: Solar, Built Environment
- Infra Fund: Built Environment

Deal example:

Infrastructure Fund: $241M JV by Keppel, BCPG, and TEAM on the Sam Yan District Cooling System Project, a Bangkok-based DCS plant with 18K refrigeration tons of cooling load

Most active investors²:

- bcpg
- Keppel

Note: (1) Non-exhaustive and only includes investments > $10m, excluding JVs due to data availability, includes deals with overlap across investor types; (2) Based on deal volume

Source: AVCJ; S&P Capital IQ; Preqin; Pitchbook
Sustainable Farming and Electric Mobility increasingly attractive with strong government and financial support

**Forest conservation**

Opportunity: Project originations, feasibility, development, and design

Ambitious government reforestation plans (18 trees to be planted by 25, ~85% of which in urban and industrial zones)

**Sustainable farming**

Opportunity: Precision agriculture and farmer service platforms

Farmers are well trained to adopt advanced info-communication technologies for precision farming (e.g., Young Smart Farmers program launched in 2014 has increased farmer reception to new technologies)

20-year agriculture-development plan by government to push for digitization of agricultural sector

Developed rental markets and hired services for machinery and technologies available, allowing farmers to share costs

Easy access to financing for AgTech start-ups through the National Innovation Agency

**Solar**

Opportunity: Utility-scale solar

Government’s interest and push for large-scale floating solar

Estimated project IRR of 9-10%

Select pockets of land area with high power potential, with 14% of Thailand's landmass capable of generating a decent 19-20 MJ/er/day of solar energy

**Wind**

Opportunity: Small-scale onshore wind

Existing electrical grid is robust and able to support renewable additions until 2036

Attractive returns of estimated project IRRs ~10%

Decent onshore wind potential of 13-17GW

**Built environment**

Opportunity: Efficient cooling

Government-mandated cooling sector to be more climate friendly with available market support (domestic producers assistance, technician training facilities)

Emerging interest in district cooling projects (e.g., government complex in Bangkok)

Rising electricity costs will drive innovation in energy efficiency tech

**Electric mobility**

Opportunity: Auto R&D and manufacturing (especially 2W), and charging infrastructure

Strong government support for EV manufacturing (both fiscal and non-fiscal, e.g., exemption of import duties on key electrical components)

Strong government support for EV infrastructure (e.g., 12K charging stations by 2030)

Existing auto OEM presence (allows for OEM partnerships)

Strong four-wheeler manufacturing sector (largest in SEA) accelerates industry maturity due to existing knowledge pool

Stronger consumer purchase inclination toward EVs

Unclear guidelines on agency responsible for rollout of charging stations

Nascent charging market, with just ~1K charging stations in 2021

---

Tailwinds:

- Low quantity of forestry assets (~10% of SEA total), not as significant or scalable vs. Indonesia, Malaysia
- Government incentives for reforestation projects are still in early development phase
- Success of nascent carbon trading platform dependent on regulation and enforcement
- Slowest progress among SEA nations for carbon tax, with discussions last few years but no concrete decision and implementation plan

Source: GWEC, IEA, Ministry of Energy, USAID, TDRI, Industry participant interviews
Vietnam’s higher NDC target is modest in scale; greater clarity on coal phase-out and renewables phase-in plan needed to define how goals will be delivered

Point of departure (Emission profile)

- ~360 MtCO2e of total GHG emissions in 2018
- 84% energy mix from fossil fuels in 2019
- 14% energy mix from renewables (incl. hydropower) in 2019
- 42% of total land area is forest cover in 2020; hydropower continues to pose deforestation threat

Government commitments (2030)

- Emissions reduction\(^2\) relative to business-as-usual by 2030 (27% conditional)
- 32% of total installed capacity to be sourced from renewables (excl. hydropower) by 2030
- 42% of total area to be restored as forest cover by 2030

Recommended government actions

- Accelerate deployment of smart electrical grid to continue momentum in renewables
- Increase foreign direct investment by developing general law permitting choice of international arbitration and allowing partial foreign direct investment in foreign currency
- Develop government-funded joint investment programs to de-risk and accelerate AgTech investments

Challenges

- Key national-level entities responsible for resource allocation; lack of clarity on responsibilities

Ambiguity + conflicting incentives

- Govt plans to further incentivize investments in renewables (solar PV/wind), but no clear budget after feed-in tariffs cut. Grid upgrade is key to prevent disruptions and curtailment of RE projects by EVN\(^3\)
- 17 GW of coal power (same as wind) to be added by 2030, despite ambition to phase out coal by 2040. A consistent policy will be required for successful transition
- Plans to restrict motorbikes in major cities encouraging. Overall EV market largely driven by private sector but government stepping up with incentives. Ramp-up on infrastructure remains key
- Calls for no new deforestation by 2040 and 18 new trees planted by 2025. Launch of enabling policies yet to be seen to unlock participation in carbon markets
- Govt aims to make biotechnology a leading industry in the region, supported by incentives for AgTech of $4.4 billion. Mainstream uptake will hinge on capability building, infrastructure support and financing for smallholder farmers

2030 Trajectory

Note: (1) I&C: industrial & construction; (2) Target reduction (base year: 2014); (3) Vietnam Electricity
Source: Climate Transparency Report; Trung et al.; EU REDD; Climate Action Tracker; IHS Markit; Reuters; EIA; UNFCCC; SBTi; Viet Nam News; Pinsent Masons; Company websites

Legend

- Positive outlook
- Uncertain outlook
- Challenging outlook

Vietnam
Strong fiscal and non-fiscal government support drove capital deployment into Solar and Wind, emerging investment theme on Mobility

Investment flows

Value of deals in Vietnam by key themes (2020 - Feb 2022, USD M)

- Solar: 1,580
- Wind: 144
- Built Environment: 92
- Mobility: 29

Top themes by investment types:

- Corporate
  - Solar, Built Environment, Wind
- PE/VC
  - Mobility
- Climate Fund
  - Solar, Wind
- SWF
  - Solar, Mobility

Deal example:

**Corporate:** ~$190M investment by Truong Thanh Viet Nam Group into the Phu Yen Solar Project

Most active investors:

- Trungnam Group
- BCG
- Temasek

Note: (1) Non-exhaustive and only includes investments > $10m, excluding JVs due to data availability, includes deals with overlap across investor types; (2) Based on deal volume

Source: AVCJ; S&P Capital IQ; Preqin; Pitchbook
Wind power and Electric Mobility highly investable with favorable structural and environmental factors

<table>
<thead>
<tr>
<th><strong>Stream</strong></th>
<th><strong>Opportunities</strong></th>
<th><strong>Tailwinds</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest Conservation</td>
<td>Project origination, feasibility, development, and design</td>
<td>Ambitious government reforestation plans (18 trees to be planted by ‘25, ~85% in urban and industrial zones)</td>
</tr>
<tr>
<td>Sustainable Farming</td>
<td>Precision agriculture and farmer service platforms</td>
<td>Generous fiscal and non-fiscal incentives to support land access and farming contracts (e.g., tax exemption, preferential credits for investments to improve productivity)</td>
</tr>
<tr>
<td>Solar</td>
<td>Utility-scale Solar</td>
<td>Government support for Agri e-commerce, with approved e-commerce plan to boost sales of farm produce</td>
</tr>
<tr>
<td>Wind</td>
<td>Onshore Wind and offshore Wind across the South and Mekong Delta regions</td>
<td>Decent returns (est. project IRR at ~10%), with alleviation from margin compression due to pilot of direct purchase power agreement in 2022</td>
</tr>
<tr>
<td>Electric Mobility</td>
<td>Auto R&amp;D and manufacturing (esp 2W), and charging infrastructure</td>
<td>Country expects to be &gt;50% of wind capacity installed in SEA by 2030, with estimated project IRR at 14-15%</td>
</tr>
</tbody>
</table>

**Tailwinds:**
- Limited forestry assets (<5% of SEA total)
- Lukewarm government support, with domestic trading platform target only by ‘28
- Low supply and demand of carbon credits in the mid-term
- Start-up talent and funding crunch could limit growth of AgTech firms
- Underdeveloped grid hampering capacity additions
- Persistent curtailment issues (due to solar boom in ’19–’20) with no compensation by EVN
- Expired FIT schemes with no visibility of replacement and suspension of new utility-scale projects
- PPA terms not aligned with international standards
- Underdeveloped grid (e.g., frequent curtailment) hampering capacity additions
- Recent expiration of FITs with intention to implement lower FITs in the future or switch to auctions
- PPA terms not aligned with international standards
- Lack of road traffic infrastructure, stationary parking spots, and land set aside for charging stations
- Lack of regulatory plans vs. other nations in SEA (limited government support for EV infrastructure, unclear domestic EV manufacturing goals)

**Headwinds:**
- Start-up talent and funding crunch could limit growth of AgTech firms
- Limited forestry assets (<5% of SEA total)
- Lukewarm government support, with domestic trading platform target only by ‘28
- Low supply and demand of carbon credits in the mid-term
- High solar PV potential in Southern Vietnam with large landmass available for Solar use
- Decent returns (est. project IRR at ~10%), with alleviation from margin compression due to pilot of direct purchase power agreement in 2022
- Country expects to be >50% of wind capacity installed in SEA by 2030, with estimated project IRR at 14-15%
- International offshore developers have proposed GW-scale offshore projects for next few years
- Ambitious wind energy targets of 11 GW by 2025
- High offshore wind potential of up to 500 GW due to 3,000 km+ of coastlines
- Strong two-wheeler and four-wheeler manufacturing sector, likely to accelerate industry maturity due to existing knowledge pool
- Strong local demand for 2-wheelers
- Low price differential between EV & ICE in SEA, likely to lead to increased EV adoption and subsequent demand for charging infrastructure
- Strong corporate support for development of EV infrastructure
- Underdeveloped grid (e.g., frequent curtailment) hampering capacity additions
- Persistent curtailment issues (due to solar boom in ’19–’20) with no compensation by EVN
- Expired FIT schemes with no visibility of replacement and suspension of new utility-scale projects
- PPA terms not aligned with international standards
- Underdeveloped grid (e.g., frequent curtailment) hampering capacity additions
- Recent expiration of FITs with intention to implement lower FITs in the future or switch to auctions
- PPA terms not aligned with international standards
- Lack of road traffic infrastructure, stationary parking spots, and land set aside for charging stations
- Lack of regulatory plans vs. other nations in SEA (limited government support for EV infrastructure, unclear domestic EV manufacturing goals)
Philippines ambition lags behind ASEAN peers; few concrete plans or policies

**Point of departure (Emission profile)**

- ~240 MtCO2e of total GHG emissions in 2018
- 70% energy mix from fossil fuels in 2018
- 25% energy mix from renewables in 2018
- 26% of total land area is forested area in 2020; 2.3% of tree cover lost between 2015 and 2020

**Government commitments (2030)**

- 75% emissions reduction from BAU by 2030 (only 2.7% unconditional); Net Zero target not defined
- 35% of total installed capacity from renewables by 2030
- No net loss in natural forests, mangrove, seagrass, and coral cover by 2028
- ETS under consideration

**Recommended government actions**

- Establish carbon tax/emissions trading scheme
- Rapidly increase renewables sourcing requirements from 1% of total energy today
- Eliminate land restrictions for foreign firms to further facilitate foreign investment in renewables
- Remove contractual obligations to produce energy from coal
- Develop clear decarbonization targets and establish decarbonization roadmap

**Challenges**

- Emissions to continue to grow under current policies rather than decline to meet the conditional target

**Ambiguity + conflicting incentives**

- Renewables accounted for ~21% of gross electricity generation in 2019 and have declined in share since 2008; energy storage ramp-up essential to mitigate “duck-curve” phenomenon
- Recent implementation of coal power moratorium encouraging. However, essential to also enact moratorium on current pipeline, and phase out all coal by 2040
- Improved government policy support for EV manufacturers and infra providers (e.g., tax incentives, duty exemptions); but lack of incentives to spur local consumer demand
- Slowest progress among SEA nations for carbon tax; ongoing discussions over the last few years but no concrete decision and/or implementation plan

**2030 TRAJECTORY**

**Legend**

- Positive outlook
- Uncertain outlook
- Challenging outlook

**Note:** (1) I&C: industrial & construction; (2) Target reduction (base year: 2010). Unconditional reductions are not dependent on external support. Conditional targets dependent on availability of international support; (3) Department of Finance has considered implementing carbon taxes or emissions trading scheme (ETS) since 2019, but no bill has been passed.

**Source:** PNA; IHS Markit; Global Forest Watch; EIA; UNFCCC; EQ International; CBS; Reuters; Business World; SBTi; PGBC; Company websites
Growing capital flow into the green economy, with focus on Solar and Wind

Investment flows¹

Value of deals in Philippines by key themes (2020- Feb 2022, USD M)

<table>
<thead>
<tr>
<th>Theme</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar/Wind</td>
<td>2,454</td>
</tr>
<tr>
<td>Mobility</td>
<td>435</td>
</tr>
<tr>
<td>Wind</td>
<td>364</td>
</tr>
<tr>
<td>Solar</td>
<td>19</td>
</tr>
</tbody>
</table>

Total = 3,273

Top themes by investment types:

- **Corporate**: Solar, Wind, Mobility
- **PE/VC**: Mobility
- **Infra Fund**: Fuel substitution, Solar, Wind
- **SWF**: Solar, Wind, Mobility

Deal example:

**Corporate: $1.6B investment into Aboitiz Power** by JERA for 27% of all outstanding shares

Most active investors²:

- Ayala
- KKR

Note: (1) Non-exhaustive and only includes investments > $10m, excluding JVs due to data availability, includes deals with overlap across investor types; (2) Based on deal volume

Source: AVCJ; S&P Capital IQ; Preqin; Pitchbook
Attractive renewables sector driven by strong government support and large power potential

### Tailwinds:
- Digitalization increases productivity, addressing concerns in declining labor participation in agriculture
- Ambitious renewables roadmap, with solar target of ~20GW by 2030
- Strong government support, with RPS\(^1\) starting from 2023
- Attractive commercial and industrial solar projects with estimated project IRR of ~15%
- Relatively high land-solar potential, with certain southern areas able to produce an average of 5.0 – 5.5kWh/m\(^2\)/day

### Headwinds:
- Lack of government advocacy and support for digital agriculture solutions
- Lack of concrete governmental progress despite announced plans
- Unclear farmland ownership reduces incentive to adopt digitalization solutions
- Fragmented farming landscape with many small-scale farmers unable to afford the high costs of digitalization
- Less educated smallholder farmers (average age of ~60) may not have sufficient technical knowledge to adopt digitalization solutions
- Connectivity challenges (esp. in rural areas) compounded by lack of internet usage
- Lack of regulatory clarity as government yet to finalize details of green energy auction
- Some challenges to scale C&I due to smaller capital deployment
- Lengthy and complex procedures to get project permissions

Note: (1) Renewable portfolio standards require power distribution utilities to source a minimum proportion of energy from renewable energy sources (e.g., solar and wind) and is set to increase by 2.52% annually from 2023

Source: FAO, Philstar, Reuters, National Renewable Energy Laboratory, World Bank (1), World Bank (2), Greening the Grid, IHS Markit (1), IHS Markit (2), German Federal Ministry for Economic Affairs and Climate Action, Eco-Business

### Highest investment potential
- Wind: Ambitious renewables roadmap, with government targeting 50% renewable energy share by 2040
- Strong government support, with RPS\(^1\) starting from 2023
- Government co-created offshore roadmap with international entities to develop offshore wind potential in Philippines
- High onshore wind potential of 76GW and offshore wind potential of 178GW
Singapore leading SEA green transition journey; recent carbon tax increase strengthens forward trajectory

**Point of departure (Emission profile)**

- ~70 MtCO2e of total GHG emissions in 2018
- 99% energy mix from fossil fuels (95% natural gas) in 2019
- <1% energy mix from renewables in 2019
- 47% of land mass covered in green space in 2020

**Government commitments (2030)**

<table>
<thead>
<tr>
<th>Key details</th>
<th>Peak</th>
<th>emissions by 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3%</td>
<td>of total energy demand to be met by solar by 2030</td>
</tr>
<tr>
<td></td>
<td>80%</td>
<td>of green buildings by 2030</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Challenges</th>
<th>50%</th>
<th>emissions reduction by 2050 (vs. 2030 peak); faces space constraints for utility-scale renewables development</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lack</td>
<td>energy to be imported from low-carbon sources by 2035; posing implications for energy security; need to secure alternative options</td>
</tr>
</tbody>
</table>

**Recommended government actions**

- **Continue to charter** a clear direction and decarbonization roadmap for hard-to-abate sectors while providing support to maintain global competitiveness of the key hubs (e.g., petrochem).
- **Provide fiscal and non-fiscal incentives** to both local and foreign acquirors, and work with domestic exchanges to streamline early offerings of DeepTech companies.
- **Continue to de-risk** DeepTech and ClimateTech investments through preferential tax rebates to investors and dedicated co-investment schemes.

**Ambiguity + conflicting incentives**

**LIMITED OPTIONS**

- **Limited options** for power sector decarbonization due to geographical constraint on renewables. **Green H2 shows promise but takeoff expected only in mid 2030s**

**ENERGY**

- **All new car and taxi registrations to be cleaner-energy models by 2030**. Further ramp-up of EV charging infrastructure and accompanying policies planned
- **40% of buildings “greened” as of early 2021**. Rising awareness and government incentives give confidence to investors

**ENABLERS**

- **Carbon tax** to expedite decarbonization of hard-to-abate sectors (e.g., power, petrochemical)
- **Ambition to establish carbon services hub paired with market action**. Establishment of Climate Impact X with first auctions in 2022 to accelerate decarbonization
Green investments continue to grow across asset categories, with alternative proteins gaining spotlight

Investment flows

Value of deals in Singapore by key themes (2020-Feb 2022, USD M)

- Solar: 1,706
- Built environment: 729
- Alt. proteins: 377
- Infrastructure fund: 326
- Corporate: 216
- Other: 1,104

Top themes by investment types:

- Corporate: Solar, Built Environment
- PE/VC: Alternative Proteins
- Infra Fund: Built Environment, Solar
- SWF: Alternative Proteins
- Climate Fund: Alternative Proteins

Deal example:

Corporate: Sunseap, a leading clean-energy solutions provider in Singapore, was acquired by EDP Renewables for ~$0.8b. EDPR committed to invest additional ~$7.4B by 2030 to establish APAC HQ in Singapore

Most active investors:

- TEMASEK
- K3 Ventures

Note: (1) Non-exhaustive and only includes investments > $10m, excluding JVs due to data availability, includes deals with overlap across investor types; (2) Based on deal volume

Source: AVCJ; S&P Capital IQ; Preqin; Pitchbook
Built environment sector most attractive due to high population density

**Tailwinds:**
- Attractive hub for carbon trading due to government support for establishment of Singapore as a carbon-trading hub, as well as strong carbon services ecosystem development (70+ carbon services organizations)
- Forest conservation
  - **Opportunity:** Project origination, feasibility, development & design, and Carbon credit sales and trading
- Built environment
  - **Opportunity:** Efficient cooling and green building products
- Highly educated workforce with large talent pool for knowledge-based services
- Strong government targets, regulations, incentives (e.g., 80% “green” buildings by 2030, granting greater floor space for green buildings, co-investment support for DeepTech start-ups)
- Growth of cooling technologies (e.g., data center cooling start-up), with potential to scale regionally
- Rising demand for green building products (for both new and retrofits); green building regulation continue to evolves (likely market leader for SEA)
- Strong deal flows in district cooling projects
- Strong engineering and technology talent pool
- Rising electricity costs will drive innovation in energy efficiency tech

**Headwinds:**
- Carbon standards vary across programs & countries, making difficult to scale
- Lack of clear regulatory, accounting framework to measure offset assets
- Existence of green premium as materials and equipment will be more expensive, discouraging adoption
- Increased supply chain unpredictability as products or product components likely to be imported from outside of SEA

Source: MCCY Singapore; BCA Singapore; CNA; Industry participant interviews
### Glossary for acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
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<tbody>
<tr>
<td>1M5R</td>
<td>FTA</td>
<td>MoU</td>
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<tr>
<td>“1 must 5 reductions” – VN national policy to promote best practices in lowland rice cultivation</td>
<td>Free Trade Agreement</td>
<td>Memorandum of understanding</td>
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<tr>
<td>2W</td>
<td>GDP</td>
<td>MRV</td>
</tr>
<tr>
<td>Two-wheelers (e.g., motorbike)</td>
<td>Gross domestic product</td>
<td>Monitoring, reporting, and verification (of carbon credits)</td>
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<tr>
<td>3W</td>
<td>GE</td>
<td>Mt</td>
</tr>
<tr>
<td>Three-wheelers (e.g., tricycle)</td>
<td>Green Economy</td>
<td>Metric ton</td>
</tr>
<tr>
<td>4W</td>
<td>GHG</td>
<td>MtCO2e</td>
</tr>
<tr>
<td>Four-wheelers (e.g., car)</td>
<td>Greenhouse gases</td>
<td>Megatons of CO2 emissions</td>
</tr>
<tr>
<td>AC</td>
<td>GLC</td>
<td>MW</td>
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<tr>
<td>Air conditioning</td>
<td>Government-linked companies</td>
<td>Megawatt</td>
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<tr>
<td>ACE</td>
<td>GP</td>
<td>MWp</td>
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<tr>
<td>ADB</td>
<td>Gt</td>
<td>NAMA</td>
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<tr>
<td>ADB</td>
<td>ADB Asian Development Bank</td>
<td>Gigaton</td>
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<tr>
<td>AEDP</td>
<td>GtCO2e</td>
<td>NCCC</td>
</tr>
<tr>
<td>Alternative Energy Development Plan</td>
<td>Gigatons of CO2 emissions</td>
<td>National Climate Change Committee</td>
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<tr>
<td>Agtech</td>
<td>GW</td>
<td>NDC</td>
</tr>
<tr>
<td>Agriculture technology</td>
<td>Gigawatt</td>
<td>Nationally Determined Contributions</td>
</tr>
<tr>
<td>APAC</td>
<td>ha</td>
<td>NGO</td>
</tr>
<tr>
<td>Asia-Pacific</td>
<td>hectares</td>
<td>Non-governmental organization</td>
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<tr>
<td>APG</td>
<td>h</td>
<td>O&amp;BG</td>
</tr>
<tr>
<td>ASEAN</td>
<td>h</td>
<td>Oil and gas</td>
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<tr>
<td>Association of Southeast Asian Nations</td>
<td>hectares</td>
<td></td>
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<tr>
<td>BAU</td>
<td>HVAC</td>
<td>O&amp;M</td>
</tr>
<tr>
<td>Business-as-usual</td>
<td>Heating, ventilation, and air conditioning</td>
<td>Operations and maintenance</td>
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<tr>
<td>BCA</td>
<td>I&amp;C</td>
<td>OEM</td>
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<tr>
<td>Building and Construction Authority</td>
<td>Industrial and construction</td>
<td>Original equipment manufacturer</td>
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<tr>
<td>BEV</td>
<td>ICE</td>
<td>PE</td>
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<tr>
<td>Battery electric vehicle</td>
<td>Internal combustion engine</td>
<td>Private equity</td>
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<tr>
<td>BREEF</td>
<td>ICT</td>
<td>PPA</td>
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<tr>
<td>Building Retrofit Energy Efficiency Financing</td>
<td>Information and communications technology</td>
<td>Power purchase agreement</td>
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<tr>
<td>C&amp;I</td>
<td>IDEA</td>
<td>PV</td>
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<tr>
<td>Commercial and industrial</td>
<td>India Digital Ecosystem of Agriculture</td>
<td>Photovoltaic</td>
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<tr>
<td>CAPEX</td>
<td>IFC</td>
<td>R&amp;D</td>
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<tr>
<td>Capital expenditure</td>
<td>International financial corporation</td>
<td>Research and development</td>
</tr>
<tr>
<td>CCSU</td>
<td>IOT</td>
<td>RAC</td>
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<tr>
<td>Carbon capture, utilization, and storage</td>
<td>Internet of things</td>
<td>Refrigeration and air conditioning</td>
</tr>
<tr>
<td>CEA</td>
<td>IRR</td>
<td>RE</td>
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<tr>
<td>Controlled environment agriculture</td>
<td>Internal rate of return</td>
<td>Renewable energy</td>
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<tr>
<td>CO2</td>
<td>JV</td>
<td>REDD+</td>
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<tr>
<td>Carbon dioxide</td>
<td>Joint venture</td>
<td>Reducing emissions from deforestation and forest degradation</td>
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<tr>
<td>COP</td>
<td>KPI</td>
<td>RBIT</td>
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<tr>
<td>Conference of the Parties</td>
<td>Key performance indicator</td>
<td>Real Estate Investment Trust</td>
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<tr>
<td>CPG</td>
<td>kWh</td>
<td>ROI</td>
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<tr>
<td>Consumer packaged goods</td>
<td>Kilowatt-hour</td>
<td>Return on investment</td>
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<tr>
<td>DCS</td>
<td>LCORE</td>
<td>RPS</td>
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<tr>
<td>District cooling system</td>
<td>Leveraged cost of electricity</td>
<td>Renewable portfolio standards</td>
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<tr>
<td>E2E</td>
<td>LCU</td>
<td>SASB</td>
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<tr>
<td>End-to-end (from beginning to end)</td>
<td>Local currency unit</td>
<td>Sustainability Accounting Standards Board</td>
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<tr>
<td>E2F</td>
<td>LCV</td>
<td>SBTI</td>
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<tr>
<td>Energy Efficiency Fund</td>
<td>Light commercial vehicle</td>
<td>Science-Based Targets initiative</td>
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<tr>
<td>EBIT</td>
<td>LDV</td>
<td>SEA</td>
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<tr>
<td>Earnings before interest, and taxes</td>
<td>Light duty vehicle</td>
<td>Southeast Asian nations; Bain GE report scope includes Indonesia, Malaysia, Singapore, Thailand, Philippines, and Vietnam</td>
</tr>
<tr>
<td>EBITDA</td>
<td>LED</td>
<td>SME</td>
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<tr>
<td>Earnings before interest, taxes, depreciation, and amortization</td>
<td>Light-emitting diode</td>
<td>Small and medium enterprises</td>
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<tr>
<td>EDGE</td>
<td>LP</td>
<td>SWF</td>
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<tr>
<td>Excellence in Design for Greater Efficiencies</td>
<td>Limited partners</td>
<td>Sovereign wealth fund</td>
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<tr>
<td>EGY</td>
<td>LTV</td>
<td>tCO2e</td>
</tr>
<tr>
<td>End-of-year</td>
<td>Loan-to-value</td>
<td>Tons of CO2 emissions</td>
</tr>
<tr>
<td>EPC</td>
<td>m</td>
<td>UNFCCC</td>
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<tr>
<td>Engineering, procurement, and construction</td>
<td>Meter</td>
<td>United Nations Framework Convention on Climate Change</td>
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<tr>
<td>ESG</td>
<td>MAC</td>
<td>VALSE</td>
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<tr>
<td>Environmental, social, and governance</td>
<td>Marginal abatement cost</td>
<td>Value-added service</td>
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<td>ETS</td>
<td>MRI</td>
<td>VAT</td>
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<tr>
<td>Emissions trading scheme</td>
<td>Microfinance institution</td>
<td>Value-added tax</td>
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<tr>
<td>EV</td>
<td>MNC</td>
<td>VC</td>
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<tr>
<td>Electric vehicle</td>
<td>Multinational corporation</td>
<td>Venture capital</td>
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<tr>
<td>FT</td>
<td>MNO</td>
<td>Portfolio</td>
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</table>

Note: Additional explanations for some acronyms are provided in the text.