Southeast Asia's Green Economy 2022 Report

Investing behind new realities

With contributions from

BAIN & COMPANY TEMASEK Microsoft

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Reference

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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.

Foreword by Bain & Company

Satish Shankar
Regional Managing Partner
Bain & Company, Asia-Pacific

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[1] 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[2] 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[3] 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.

Note: (1) Science Based Targets initiative; (2) Return on investment; (3) Environmental, social, and governance

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 S$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.

Foreword by Microsoft

Sandy Gupta
President
Microsoft Asia Pacific

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.

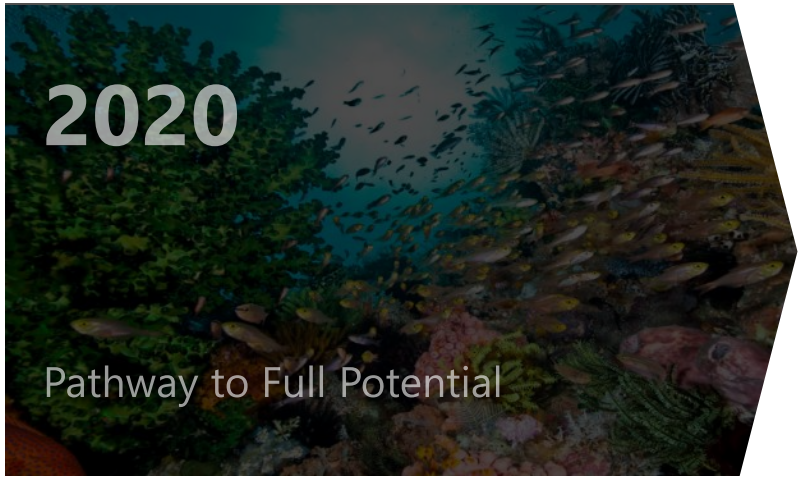
When it comes to future solutions, established businesses and MNCs should continue to pave the way for upcoming innovators to emerge in SEA. It is this drive towards co-innovation that will allow investment opportunities in the region to flourish, and is one of the reasons Microsoft created a $1 billion 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.

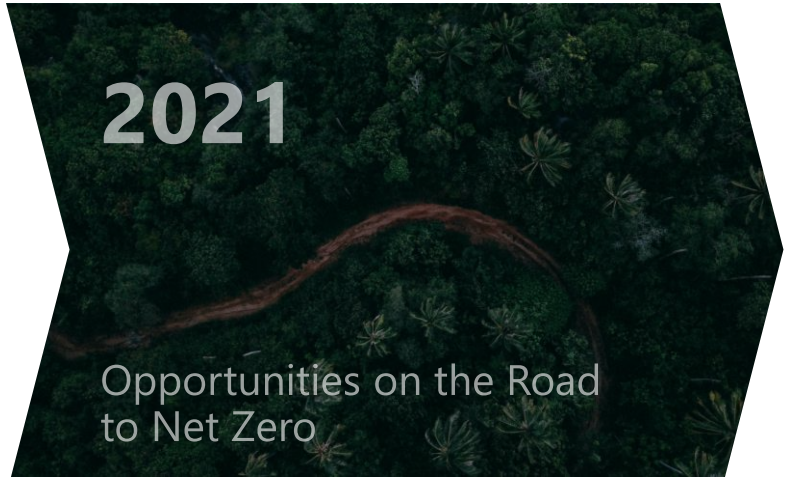
While these are ambitious enough goals, we cannot simply stop at decarbonization: we must also take action to become water positive, zero waste, and protect our planet's ecosystems and biodiversity.

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.

About Southeast Asia's Green Economy 2022 Report



Assess SEA's green economy potential and strategic pathways



Develop a collective action plan for SEA to capture economic opportunities

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

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

~30 | **decarbonization levers** screened for prioritization

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

Summary by the numbers

Rising commitments and material prize in SEA …

8 out of 10 — SEA countries committed to Net Zero targets

2-3x — estimated growth in number of new SBTi[1] commitments by corporate firms in SEA between 2021 and 2022

$1 trillion — annual green economic opportunities for SEA by 2030

… with increasing investment in last 2 years …

$15 billion — invested cumulatively by various investors in SEA since 2020, with ~45% deployed in last three quarters (Q3 2021 till Q1 2022)

$11 billion — deployed cumulatively by corporate firms in SEA since 2020, with a focus on Renewables and Built environment

~3x — more investment value on sustainability-focused start-ups by private equity/venture capital investors in SEA in 2021 than 2020

… but more can still be done to unlock full potential

~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

~50% — of SEA's GDP is contributed by SMEs[2] who need to be engaged for the green economy

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 $20B

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 opportunity[1] 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[2] 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 opportunity[1] 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 OEMs[3] 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

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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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

With contributions from

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COP26 raised SEA's climate ambition, with eight out of ten countries now having net zero targets and two new countries piloting carbon taxes

Updated from 2021 GE Report | No changes from 2021 GE Report | Does not exist

	Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Net Zero	2050	(2050+)[1]	2060	2050	(2050+)[1]	NA	NA	2050+[2]	2065	2050
Emissions reduction[3]										
NDC date of submission	**Dec 2020**	**Dec 2020**	**Jul 2021**	**May 2021**	**Jul 2021**	**Aug 2021**	**Apr 2021**	**Mar 2020**	**Oct 2020**	**Sep 2020**
Unconditional	**~20%**		**~29%**	**~60%**	**~45%[4]**	NA	**~3%**	**~36%**	**~20%**	**~9%**
Conditional		**~42%**	**~41%**	**~67%**			**~75%**		**~25%**	**~27%**
Carbon pricing (in USD)	**Carbon pricing** to be implemented by 2025	NA	**Carbon tax** (~\$2/tCO_2e) **for coal power,** full market by **2025**	NA	NA	NA	**Carbon tax** and **ETS** under consideration	**Carbon tax** (~\$4/tCO_2e) implemented, to increase to \$40-60 by 2030	**ETS** under consideration	**ETS** legalized – Pilot Carbon Exchange from 2025
Renewables capacity	**30%** by **2035**	**25%** by **2030**	**~48%** by **2030**	**30%** by **2025[5]**	**~40%** by **2035**	**11%** by **2030[6]** (non-hydro)	**~35%** by **2030**	**~15%** by **2030[7]**	**30%** by **2030**	**~32%** by **2030**
	← Regional target of **35%** by 2025 (from ~24% in 2018) →									
Nature	Increase **forest reserves** from **41% to 55%** by 2035	Increase **forest** cover to **60%** of total area by 2030	Protect **5.8m** ha of **forests** and **1.9m ha** of **peatlands** by 2030	Increase **forest** cover to **70%** of total area (conditional) by 2030	**Protect** >**20%** of terrestrial and **10%** of coastal areas by 2025	Increase **forest** under public protection to **30%** of total area by 2030	**Eliminate net loss** in natural forests, mangrove, seagrass, coral cover by 2028	**Plant 1m** more **trees** and add **130ha** of new **parks** by 2030	Increase **forest** cover to **55%** of total area by 2037	Increase **forest** cover to **42%** of total area by 2030

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 dependent 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; UOB

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**[1] to cover the investment gap by 2030.

✔ In place/updated since COP 26 ✔ In place but insufficient/ incomplete/outdated ✘ Not in place

	Net-zero target by 2050	Decarbonization Action Plan	Reporting & Governance	Climate Financing (e.g., green bonds[5])	Overall assessment
	✘ (2060)	✔ 10Y electricity supply plan, moratorium on new forest clearance, **carbon tax** (only applicable for coal)	✘ **Need to improve coordination across key ministries** to define joint governance and reporting mechanism	✔ $6.25B of green sukuks	**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 NDC**
	✔[2]	✘ **Need for more explicit climate policies** beyond 12th Malaysia Plan	✘ **Need for formal regulations** and **a governing body** to oversee climate policies/goals	✔ $4B of green sukuks	Need for more **clarity** on **concrete steps and financing**; **at risk** of not achieving **NDC targets** by 2030
	✘ (2065)	✘ Most **climate-specific policies drafting still underway**, AEDP[4], national EV roadmap	✘ **Need for more consistent policies** (Energy Conservation Promotion Act); governing body (NCCC) set up to oversee national climate policies	✔ $2.85B of green bonds	**Need for more concrete execution and financing plans**; **at risk** of not achieving **NDC targets** by 2030
	✔	✔ ETS, pilot carbon exchange in '25, development strategy on renewable energy but **no carbon tax yet**	✔ Presence of **inter-ministerial governing body**, but **no carbon tax to enforce** and **regulations** (e.g., environmental protection) only applicable to **biggest emitters**	✘ Green bond financing **roadmap uncertain**	**Fossil fuels** still play **a big part in latest plans** though infra. to support goals are in place – **economic development** remains a **priority**; likely to **achieve NDC** targets
	✘ (no target)	✘ **Need for more explicit climate policies** – only mentioned in Philippine Development Plan, carbon tax yet under consideration	✘ **Need for a governing body and reporting enforcements** though **some regulations** enacted (e.g., Energy Efficiency and Conservation Act)	✔ $2.85B of global sustainability bonds	Need for **stronger ambition, implementation; able to achieve NDC** targets by 2030 (unconditional target far below region average)
	✔[3]	✔ $4 industrial **carbon tax** since '19 ($40-60 by '30), Energy Conservation Act, Climate Action Plan, power sector roadmap	✔ Presence of **inter-ministerial governing bodies and regulations that mandate reporting** for private companies (e.g., Carbon Pricing Act)	✔ $3B of green bonds ($25B planned by 2030)	**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**

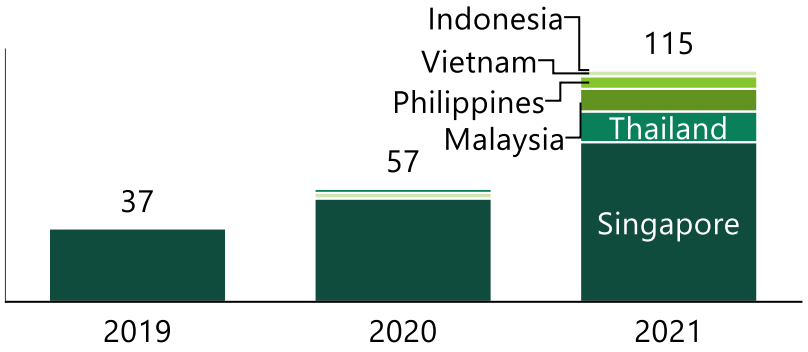
Note: (1) Total of $23.6B out of $350-450B investment need by 2030 for the 6 countries; 2) Committed to carbon neutrality by 2050, no direct commitments on net-zero (expecting 2050+); 3) By or around 2050; 4) Alternative Energy Development Plan; 5) Green bonds issues in 2021; All amounts in USD
Source: Straits Times; Business Times; Lit. search; Climate Analytics; Climate Action Tracker

All stakeholders across SEA are advocating for greater change in climate action

Corporates

2 – 3x[1]
estimated growth in number of new SBTi commitments between 2021 and 2022

Valuation of firms with SBTi commitments (US$B)[2]



*"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

Investors

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**

Consumers

46%
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**

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

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

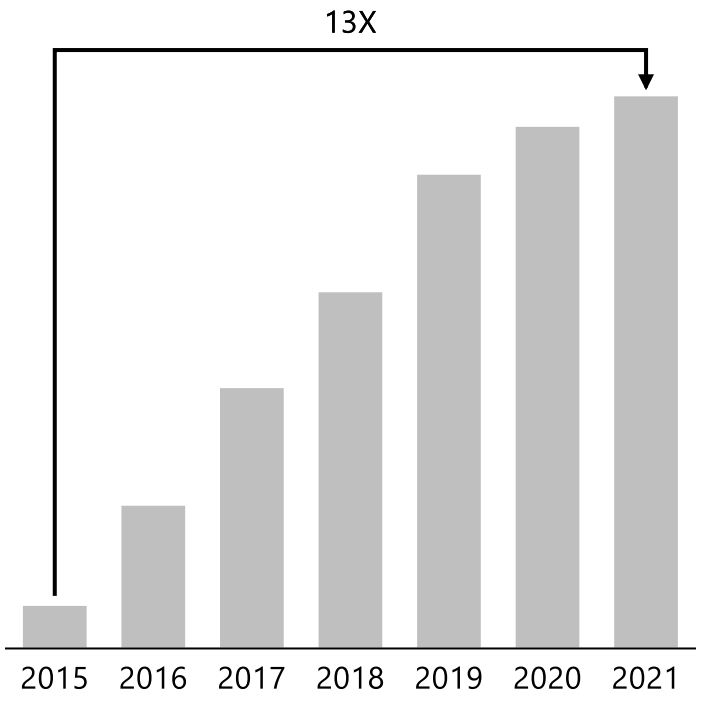
- **Installed 500 EV charging stations** across Vietnam in 2021
- Signed **MOU with PetroViet** to install **EV charging stations across PetroViet's service stations**
- Delivered **42K electric bikes in 2021**
- Achieved **~60K EV 4-wheeler pre-orders** as of Apr 2022

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

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

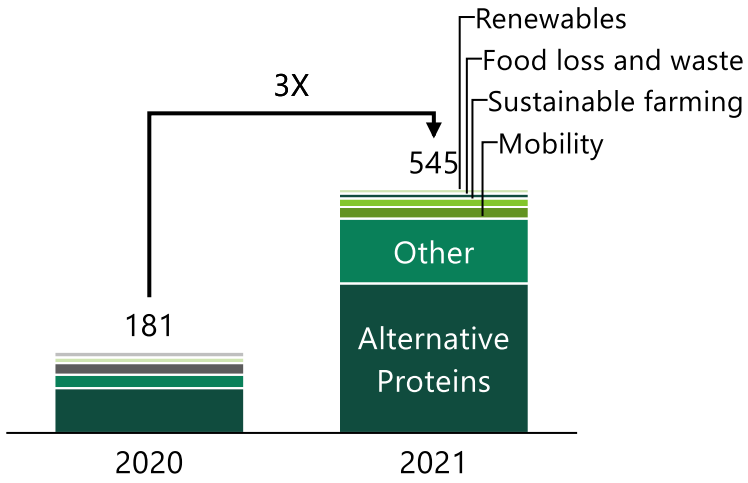
Start-ups on sustainability are emerging

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



Investor demand observes rapid increase

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



*"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 revolutionizing energy
SUN CABLE

Mobility

ION MOBILITY
beam

Sustainable farming

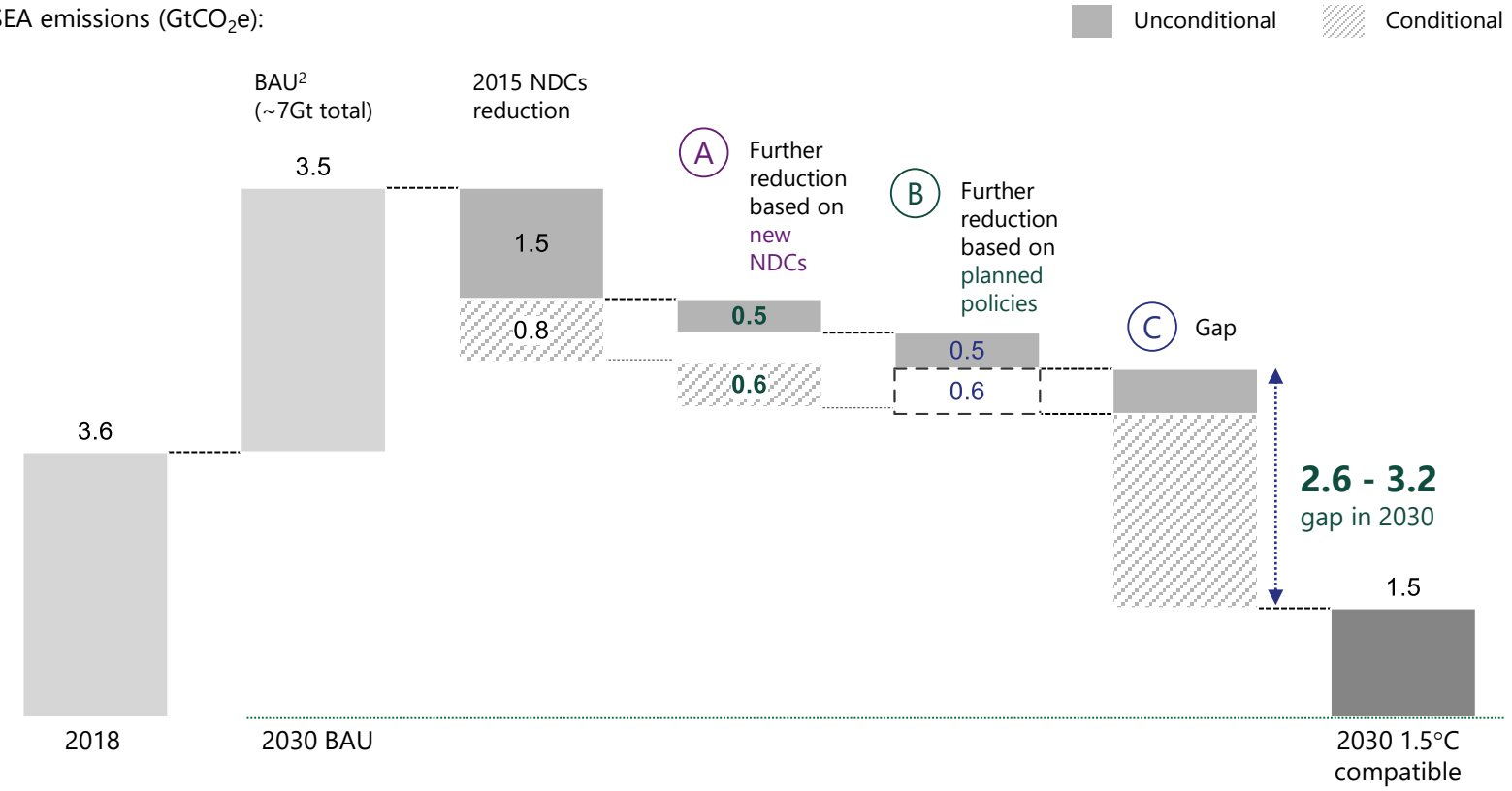
sayurbox
TaniHub Food Solutions

Note: (1) Only includes publicly known and funded operating start-ups that are sustainability-related; (2) Only includes publicly available deals, excludes deal 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 2030[1]

SEA emissions ($GtCO_2e$):

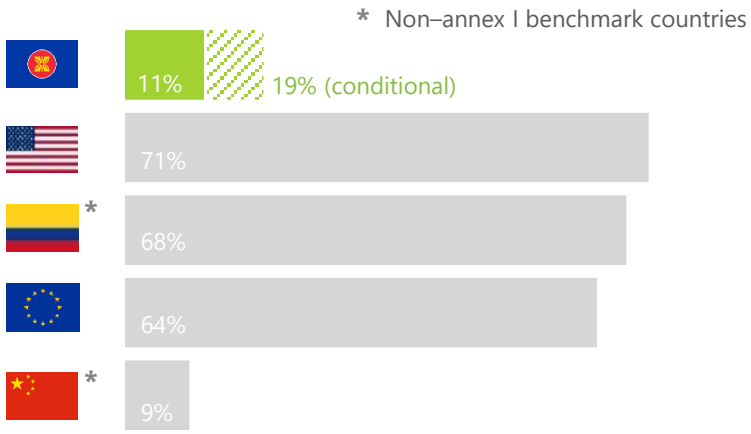


(A) SEA's latest NDCs predict a **marginal improvement of 0.5–0.6 $GtCO_2e$** from previous, which leaves projected emissions levels at **>4-5$GtCO_2e$ in 2030**

(B) Emissions based on planned policies projects an **improvement of ~0.5-1.1 $GtCO_2e$ emissions** from latest unconditional NDC targets*

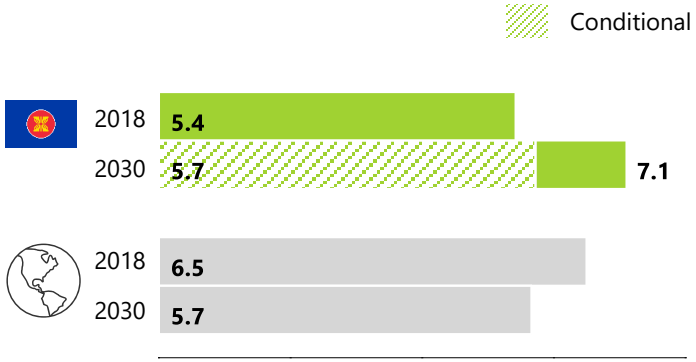
(C) **~2.6–3.2 $GtCO_2e$ gap** to 1.5°C pathway compatible scenario remains in 2030

2030 emissions gap closed in latest NDCs (vs. 2015 NDCs – almost all countries rise)



SEA emissions per capita is set to overtake global emissions average by 2030

Emissions per capita (tCO_2e per capita):

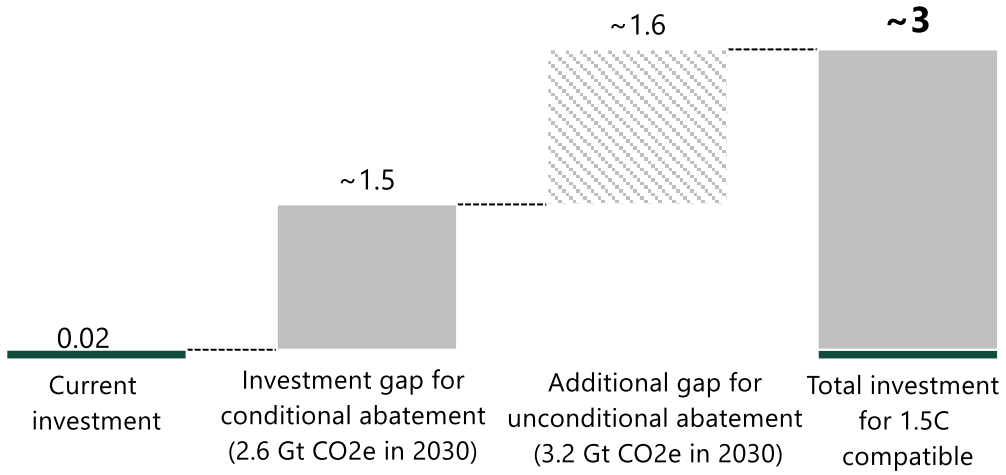


Note: (1) Assumes 9% - 21% of unconditional NDC target emissions abated due to planned policies, range extrapolated from existing planned policies for MY, SG, ID, TH, VN, and PH;
Source: Climate Watch; Climate Action Tracker; Climate Analytics; UNFCCC; CAIT historical emissions (ret. Apr 2022); Lit.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

Material investments needed to decarbonize vs. the 1.5°C pathway by 2030

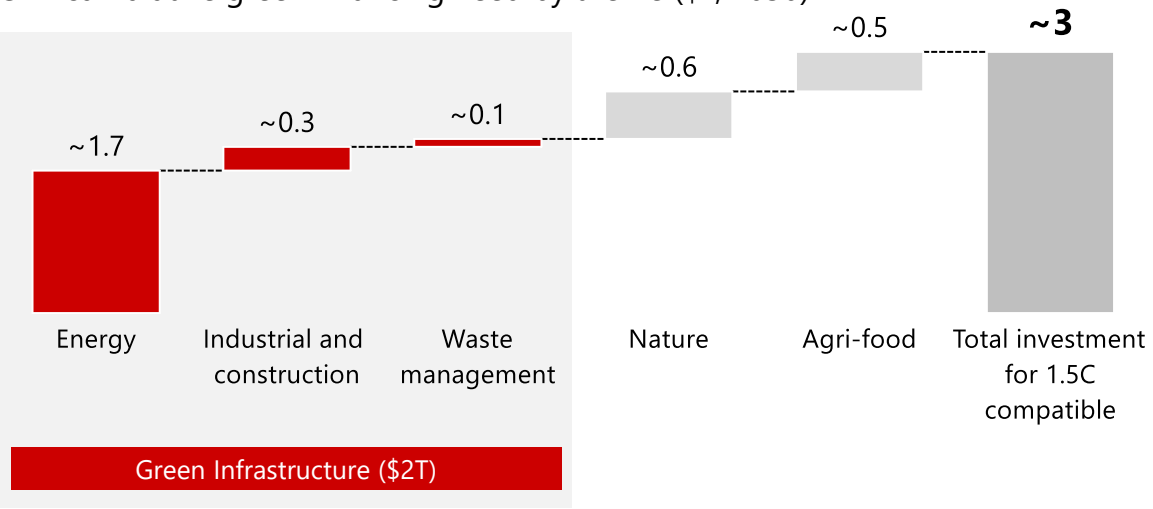
Large financing gap remains for SEA to be on track to close the emission gap for 1.5˚C[1]

SEA cumulative green financing requirements ($T, 2030)[2]



Majority investments needed to build sustainable infrastructure

SEA cumulative green financing need by theme ($T, 2030)[3]



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

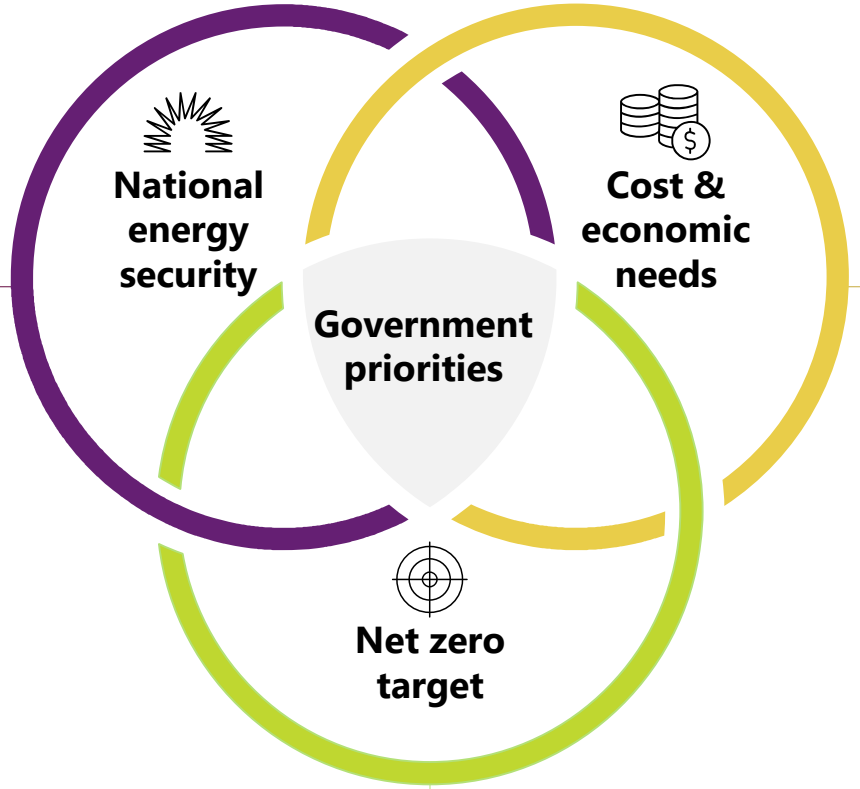
$3T of cumulative investment needed by 2030 for SEA to transition to a green economy; **~$2T needed to build sustainable infrastructure** across energy, waste, and industrial and construction sectors

Note: (1) Derived from 2030 planned policy projections for MY, SG, ID, 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

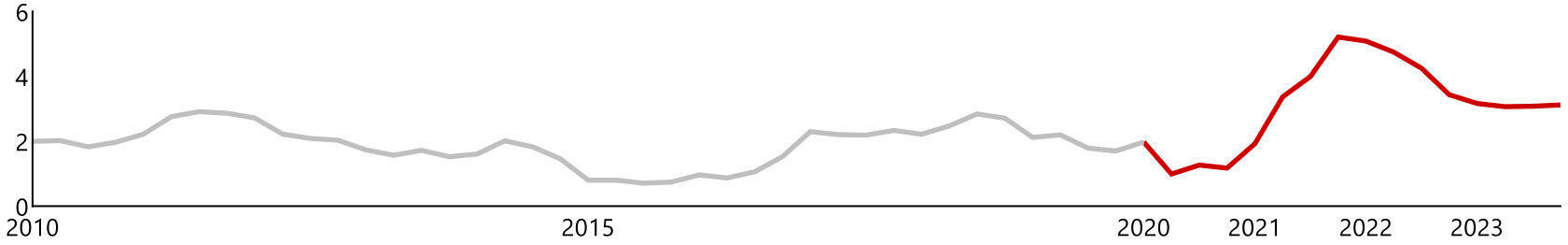
Global pressure exists to accelerate Net Zero ambitions and **start delivering carbon commitments** to meet 1.5°C targets

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

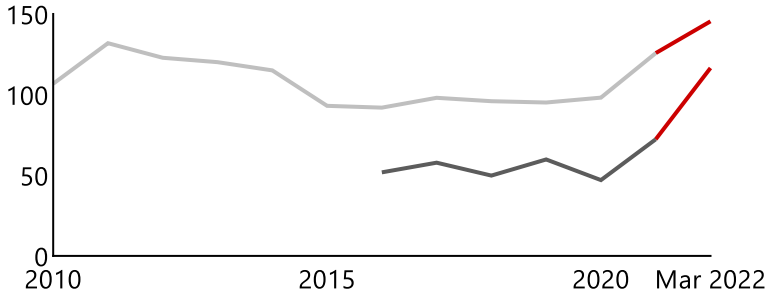
The global economy is facing inflation disruption, now at a 10-year high

OECD historical and forecast inflation (%)



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

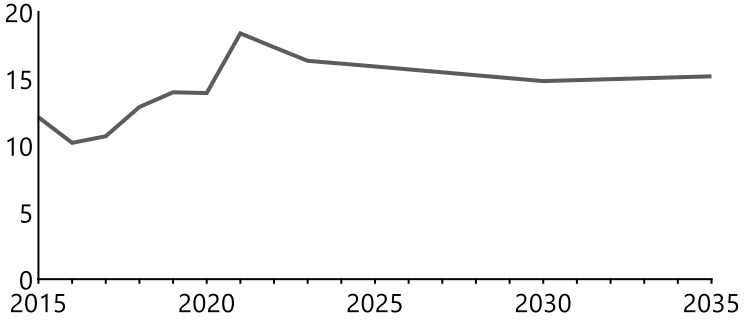
Commodity Prices (2010-present day)



US Spot Prices Crude Oil (USD/bbl)
FAQ Food Prices Index (2014-2016=100)

Raw material prices for critical green economy mineral inputs to remain high

World Bank forecast per mt of nickel ($K)[1]



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

Short-term cost volatility due to the war in Ukraine has resulted in **increased energy costs**, slowing down the Coal to Natural Gas transition. This, coupled with SEA's abundance of coal, has contributed to **continued coal power generation**

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**

"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

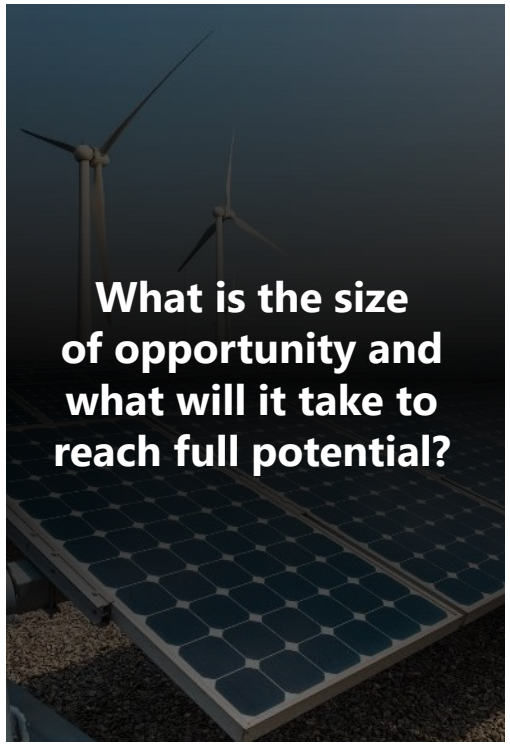
The region is facing **challenges**

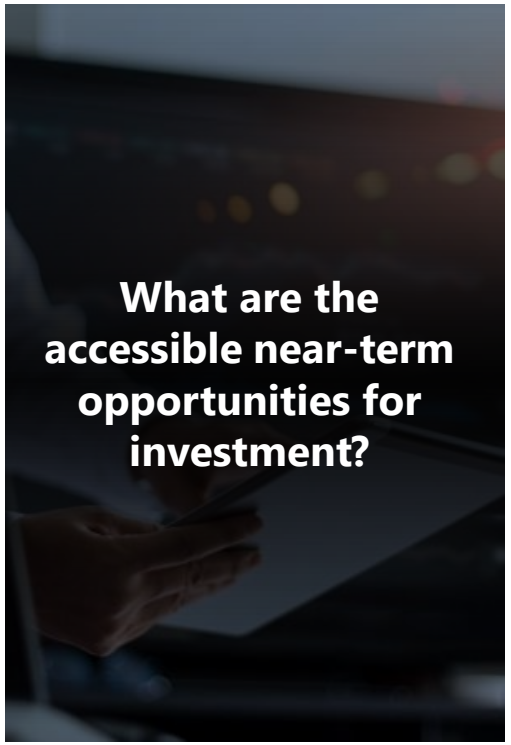
~3 Gt
emission gap for SEA
to 1.5°C aligned levels in 2030

$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**





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

Sectors

Energy

Solar, Wind, Hydropower, Geothermal, Marine energy, 4th gen nuclear, Sustainable biomass/biogas/biofuel, Green hydrogen, Carbon capture and storage, Fuel substitution[1], etc.

Agri-food & Forestry

Sustainable farming, Alternative proteins, Food loss and waste, Forest conservation[2], Peatland protection, etc.

Industrial

Recycling, Industrial electrification, Compostable bioplastics, and other recyclable plastic alts., etc.

Cities

Built environment, Mobility & transport[3], Green cement, Waste-to-energy, etc.

Others

Healthcare, Education, Retail, etc.

Enablers

Green financing

Financing, Investment, Rating/measurement/risk assessment

Voluntary carbon market

Green data revolution

SEA is uniquely positioned to expand green economy

SEA makes up ...

20% of the **world's biodiversity**

10% of the **world's population**

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

~60% **projected increase in SEA CO_2 emissions** to ~2400 $MtCO_2$ by 2040

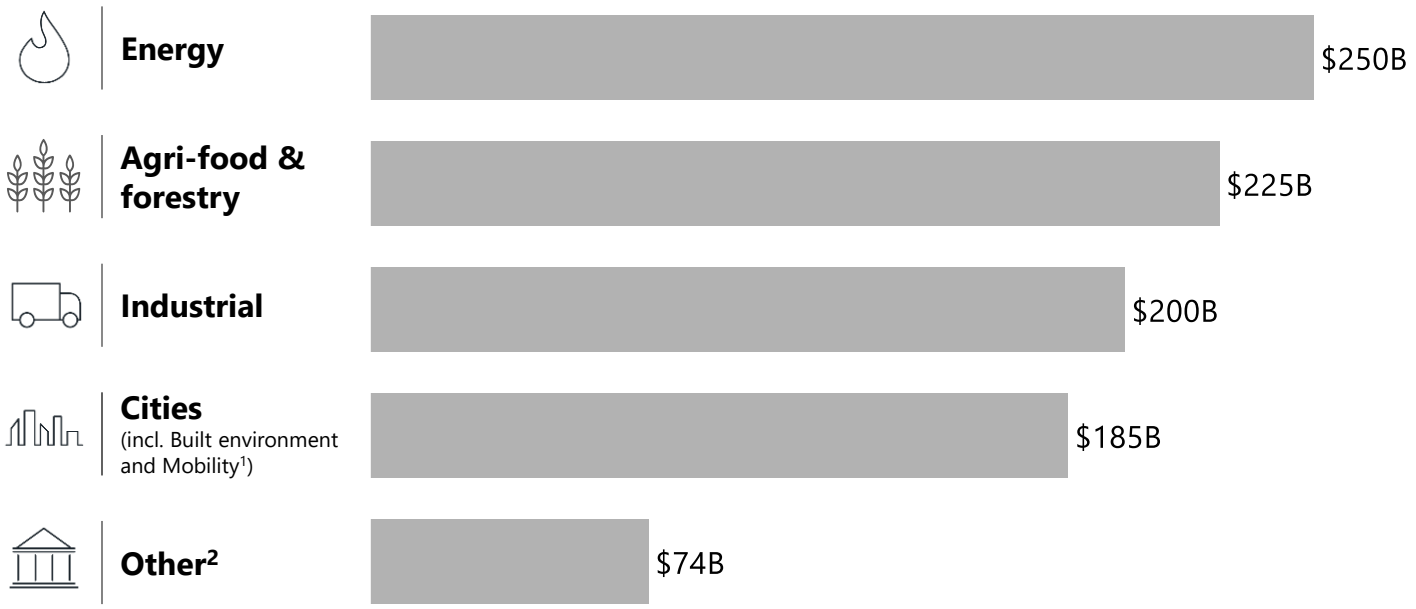
~85% of total primary energy supply in SEA comes from **non-renewable sources**

~1.2% **annual rate of deforestation**, highest of any major tropical region globally

Note: (1) Refers to substituting coal to natural gas; (2) Includes reforestation and afforestation, and forest protection only; (3) Includes Public transportation and Electric mobility
Source: UN University; IEA; Our World in Data; Asia Water; NTU

A material economic and climate prize exists regionally in SEA if fully pursued

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



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**

! 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

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*

13

prioritized decarbonization levers for further screening

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

D Deep dive analysis on subset of select levers

~5

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

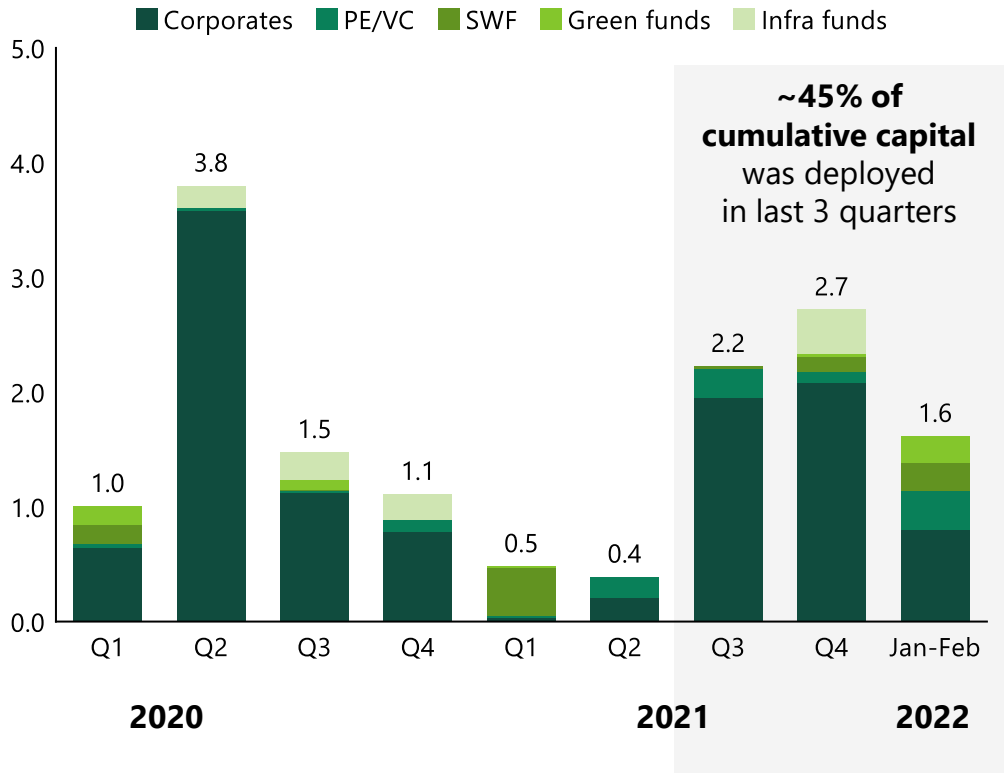
*...to conduct **in-depth analysis on value chain** and extract **specific investment opportunities** in SEA towards 2030*

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

SEA's potential is attracting greater green investment: $15B since 2020

Green capital deployment accelerated in SEA

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



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

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."*

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

Investment in the green economy cuts across multiple asset classes, deployed by a broad range of investors, with corporates being the largest

	Corporates	PE/VC	Infrastructure funds	Sovereign wealth funds	Pure-play green funds
	Drive **majority of investment** (~75% of total green capital) in region, big **infrastructure** focus	Focused on **next-gen** solutions, start-ups **scaling hot topics** from mature markets (e.g., e-scooters)	Focused on **next-gen** solutions, start-ups **scaling hot topics** from mature markets (e.g., e-scooters)	**Undersized in SEA:** large funding gap in infra needed for green transition (e.g., est. ~$2T in SEA investment by 2030)[2]	**Still a niche investor segment** in region, strategically targeting opportunities to scale in **Renewables, Alt. proteins**
Capital deployed[1] *Cumulative, '20- Feb'22*	**$11B** deployed over **86 deals**	**$1B** deployed over **23 deals**	**$1B** deployed over **6 deals**	**$1B** deployed over **12 deals**	**$0.5B** deployed over **9 deals**
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 renewables**[3] (e.g., Hydro, Geothermal) **$1.1B** in **Built environment** (e.g., HVAC, data center energy efficiency)	**$0.6B** in **Alternative proteins** **$0.1B** in **Mobility** (e.g., e-scooters)	**$0.5B** in **Built environment** (e.g., district cooling system) **$0.2B** in **Solar/Wind renewable energy**	**$0.6B** in **Solar/Wind renewable energy** **$0.1B** in **Alternative proteins**	**$0.3B** in **Solar/Wind renewable energy** **$0.1B** in **Alternative proteins**
Capital deployed[1] *Cumulative, '20- Feb'22*	**37%** of value in **Thailand-based targets** **22%** in **Philippines-based targets**	**70%** of value in **Singapore-based targets** **21%** in **Indonesia-based targets**	**36%** of value in **Singapore-based targets** **35%** in **Philippines-based targets**	**43%** of value in **Philippines-based targets** **32%** in **Singapore-based targets**	**44%** of value in **Singapore-based targets** **29%** in **Vietnam-based targets**
Example investors *Non-exhaustive*	edp renewables, Ayala	jungle, TPG	SUSI PARTNERS, Keppel Infrastructure Trust	GIC, TEMASEK	abc IMPACT, BlackRock | TEMASEK Decarbonization Partners

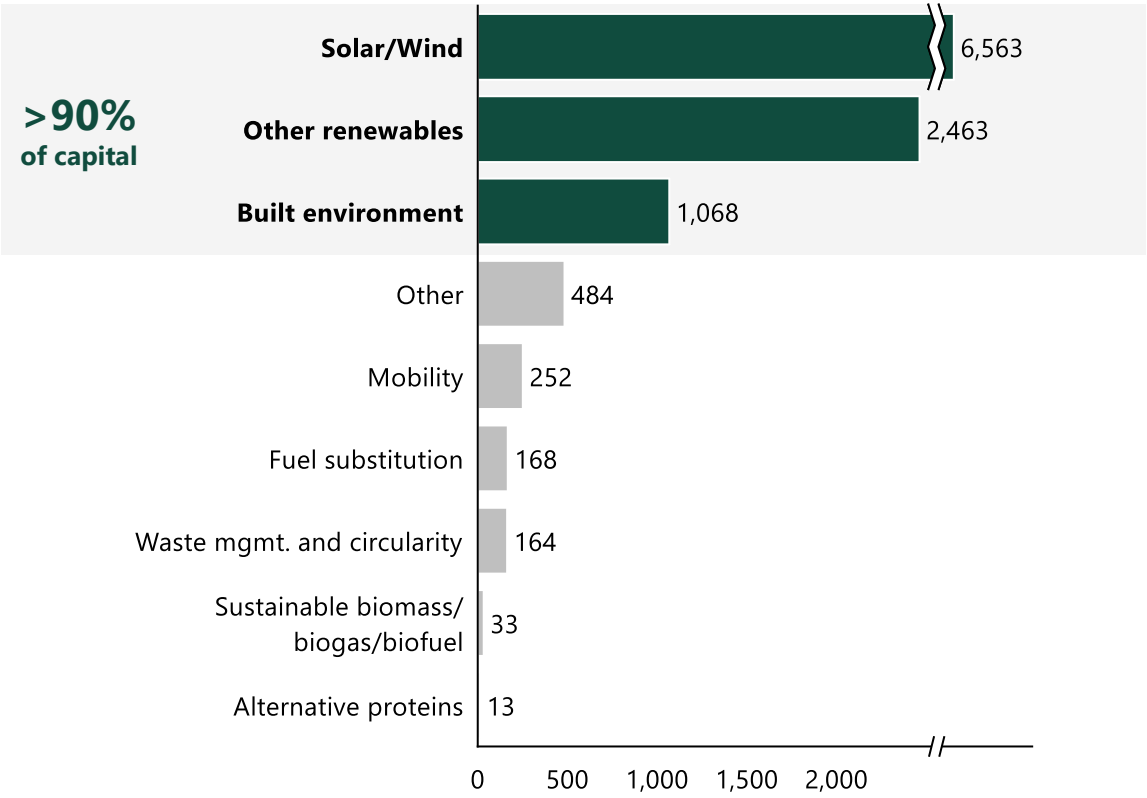
Note: Geographic focus is tagged according to deal details. If data is unavailable, estimates were based on target company's reported portfolios in different countries; (1) ~$2B worth of deals involve more than one investor category and are counted under each investor type, only including deals >$10M 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

Source: AVCJ; CapIQ; Crunchbase; Preqin; Pitchbook

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)



Solar/Wind energy[1]: ~$6.6B cumulatively deployed

- 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

Other renewables: ~$2.5B cumulatively deployed

- Includes investments in target companies with portfolios primarily in non-solar/wind renewables (e.g., hydro) and enablers such as energy storage systems

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

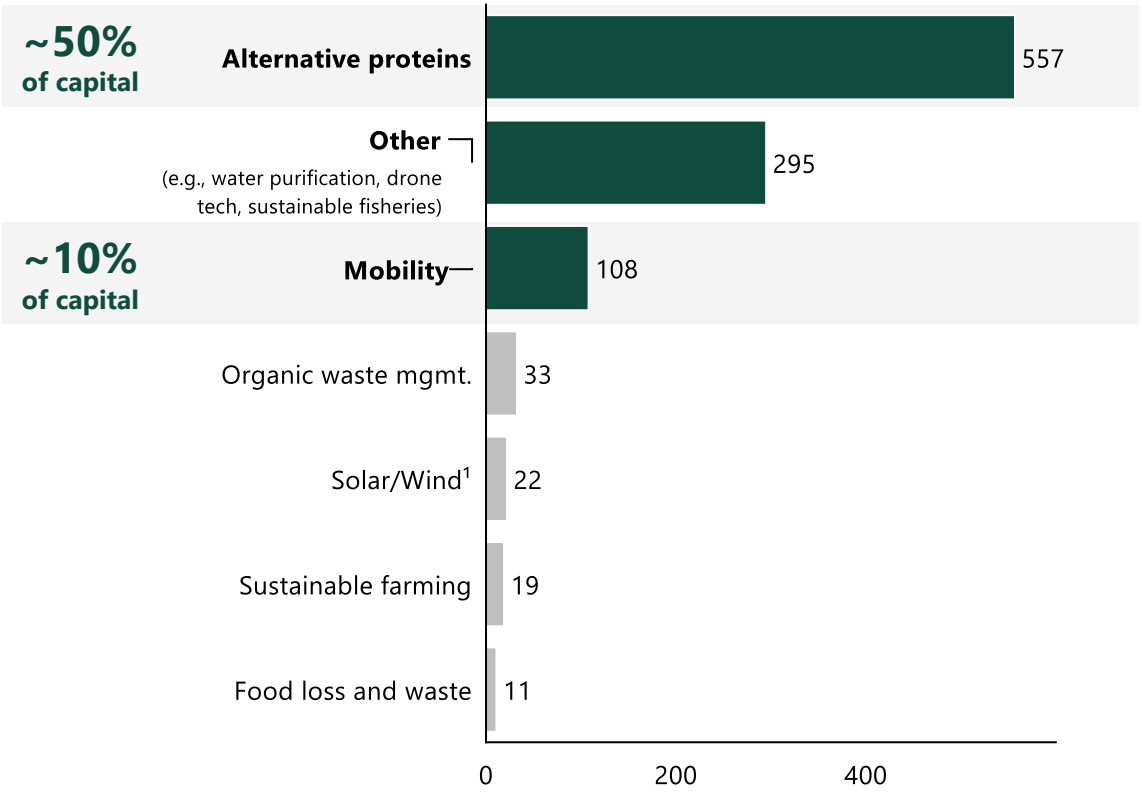
PCI Private Limited ($326M deal, 2021)
Singapore-based company providing smart home appliances

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

PE/VC green capital deployed in SEA ($M, cumulative, 2020 – Feb 2022)



Alternative proteins: ~$600M cumulatively deployed

- Investors are optimistic, piggybacking on **mature market trend** on **Alternative proteins**
- Mostly **Singapore-based R&D/manufacturing start-ups** targeting **APAC/global markets**

NextGen Foods ($100M deal, 2022)
Singapore-based alternative protein start-up targeting US market

Mobility: ~$100M cumulatively deployed

- Within **broader trend of electric mobility**, investors are bullish on **two-wheeler electrification** in SEA given consumers' cost considerations, high urban density
- 3 of 4 deals in **Singapore-based e-scooter start-ups** looking at **regional expansion**

Beam ($93M deal, 2022)
Singapore-based electric scooter firm operating across 35 cities in APAC

- Fewer investment opportunities in **underlying tech**: Only 1 deal in the air mobility tech space, as most **R&D-type opportunities** based in mature markets

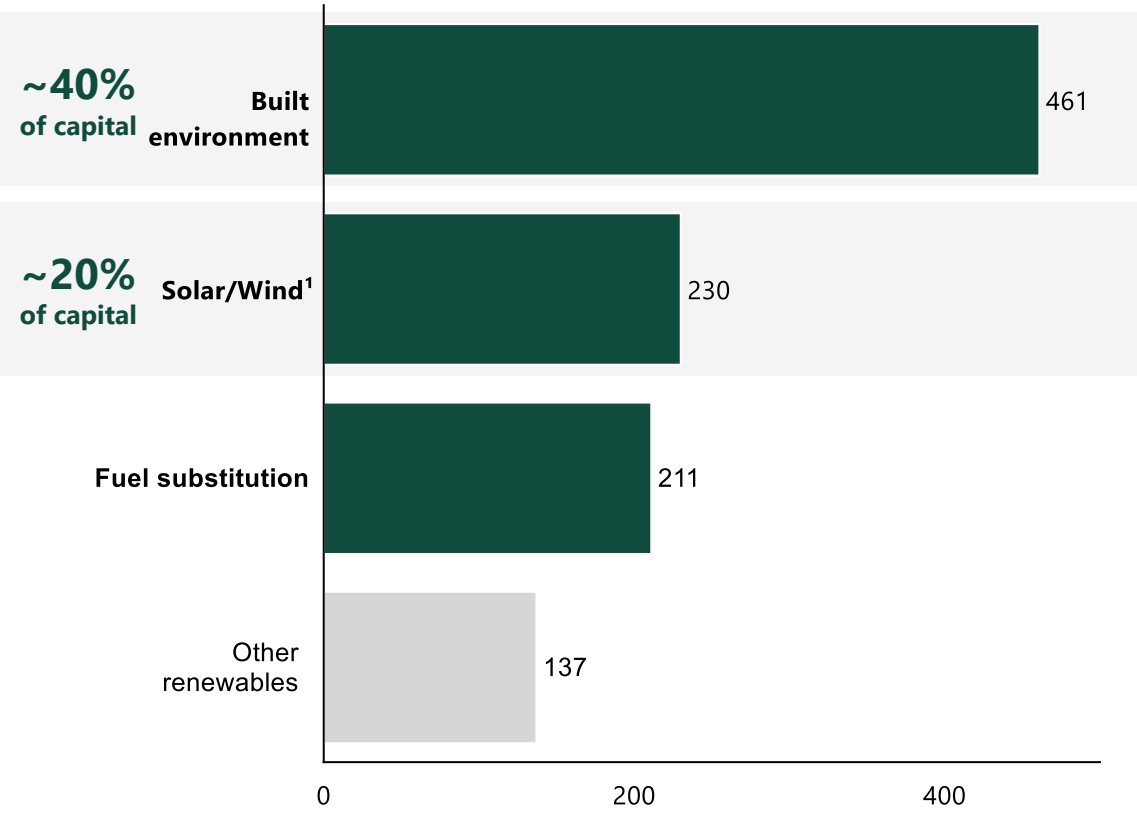
H3 Dynamics ($26M deal, 2021)
Singapore-based tech firm focused on decarbonizing air mobility (e.g., drones, hydrogen-based propulsion, etc.)

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

Bulim District Cooling System Plant ($220M deal, 2020)

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

Solar/Wind energy[1]: ~$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

Cleantech Solar ($150M deal, 2020)

Singapore-based solar integrated developer with projects (large C&I) across SEA and Asia; received investments from Singapore's Keppel

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-corns" 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

Diverse range of decarbonization levers exist with varying degrees of tech maturity; this report considers 30 key levers for potential impact and invest-ability in SEA

Compiled 30 levers with decarbonization potential; each has varying technology maturity

Proven

Competitive commercial solutions or solutions with established proof of stability

- Hydropower
- Solar
- Organic waste mgmt.
- Forest conservation (Re-/afforestation and forest protection)
- Onshore wind
- Efficient power gen. & trans.
- Landfill mgmt.
- Refrigerant mgmt.
- Waste-to-energy
- Biochar production
- Fuel substitution (Coal to natural gas)
- Sustainable farming
- Built environment (Energy efficiency solutions for buildings)

Market ready

Solutions that are commercially available, but not competitive yet or solutions with demonstrations in final operating conditions

- Alternative proteins (plant-based and food tech alts.)
- Food loss and waste
- Geothermal
- Mobility & transport
- Recycling
- Offshore wind
- Sustainable biogas/ biomass/biofuel
- Alternative refrigerants
- 4th gen nuclear
- Compostable bioplastics and other recyclable plastic alts.
- Peatland protection

Emerging

Solutions with pre-commercial demonstrations

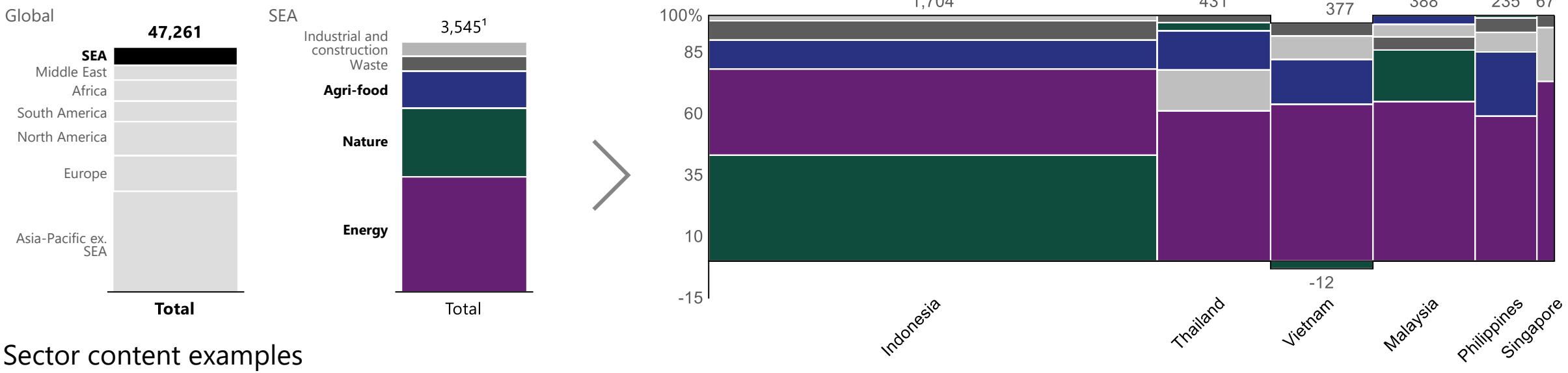
- Green hydrogen
- CCUS
- Marine energy
- Blue carbon ecosystem protection
- Industrial electrification
- Green cement

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 ($MtCO_2e$)

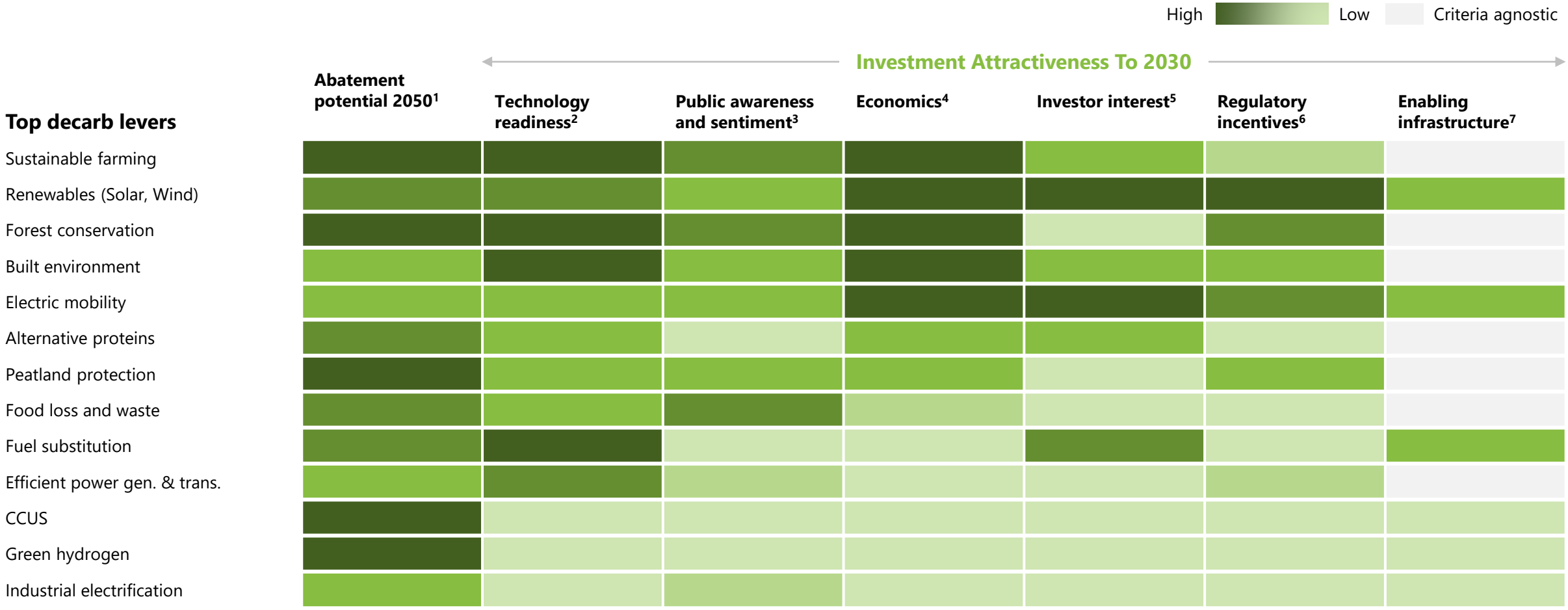


Sector content examples

- **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

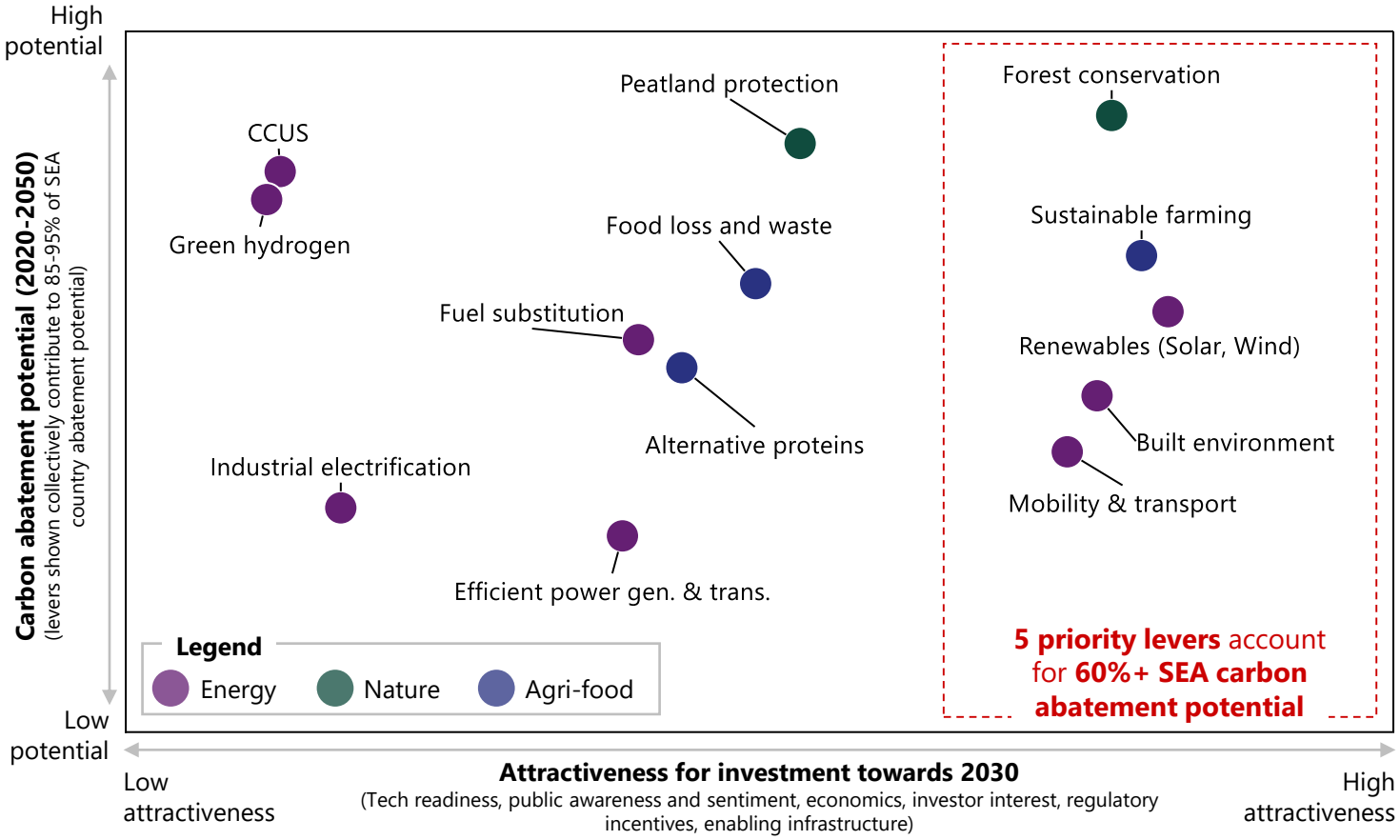


Note: Based on: (1) Project Drawdown numbers scaled to SEA; (2) Tech maturity for adoption; (3) Level of policy stability, policy execution efficiency, and socioeconomic context; (4) Revenue and growth potential; (5) Publicly available private-sector investments from 2020, involving targets based in 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

Only top abatement levers[1] shown on chart

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

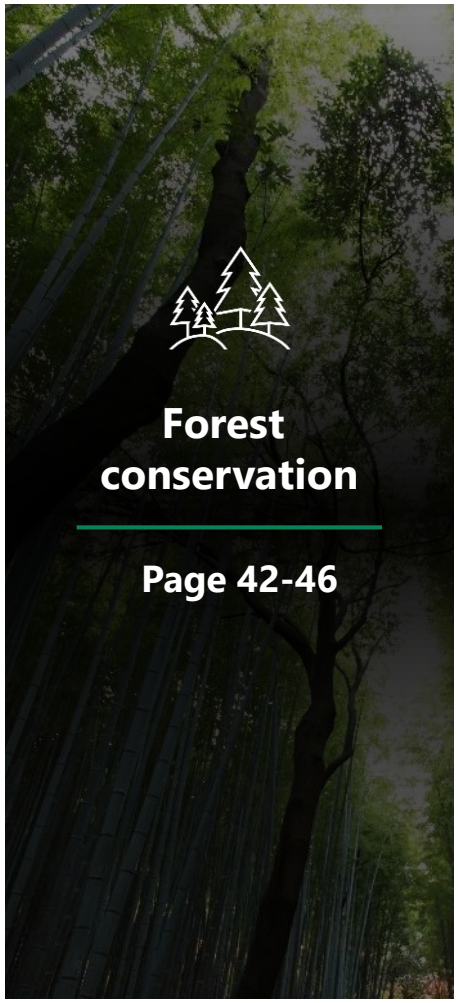
Wind presents a significant opportunity in specific countries, e.g., Vietnam and Philippines

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

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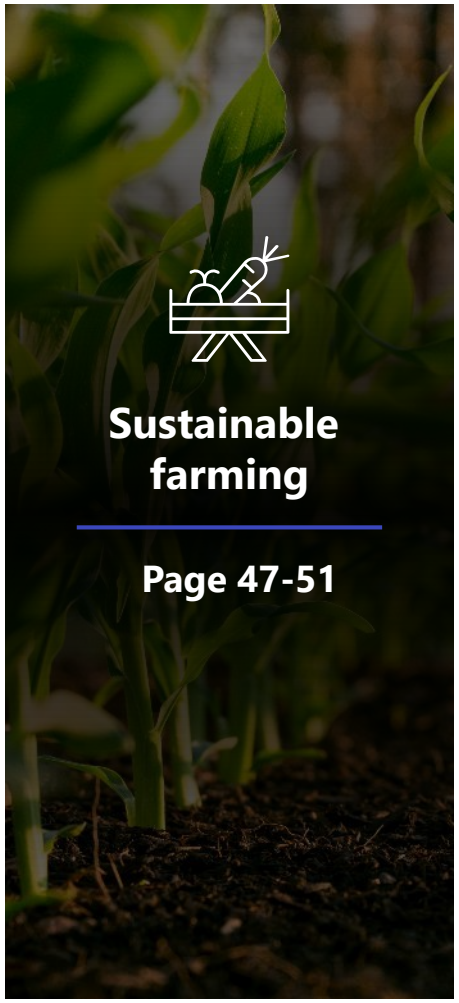

Sustainable farming

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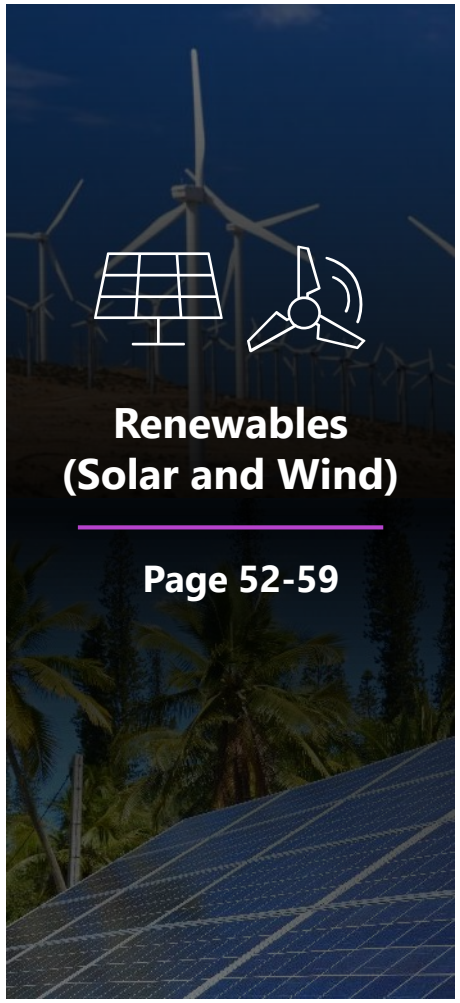

Renewables (Solar and Wind)

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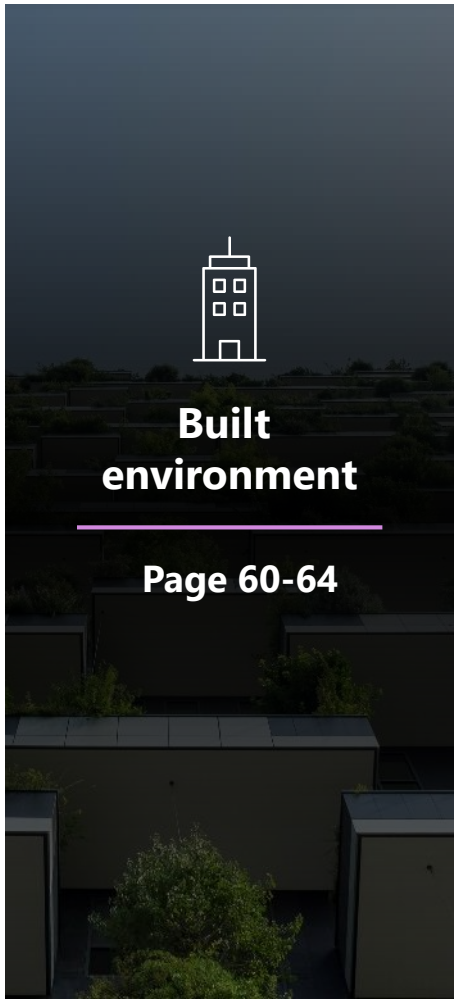

Built environment

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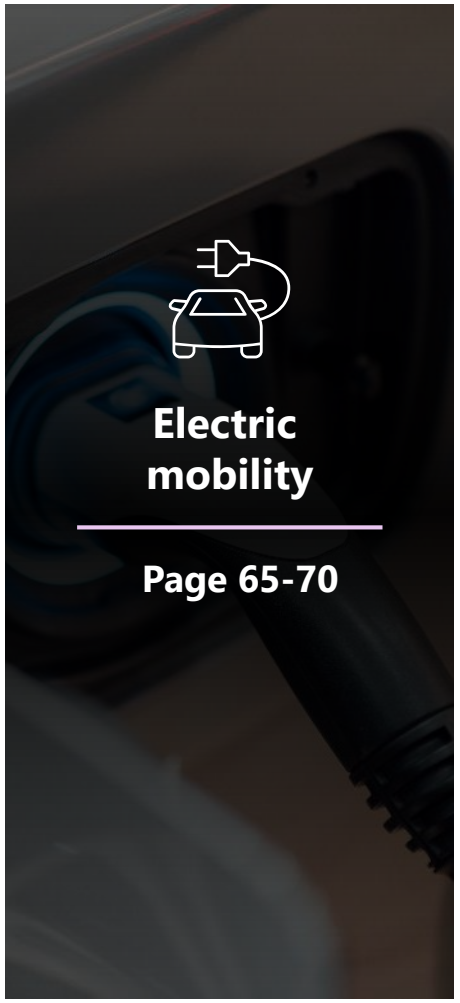

Electric mobility

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What are the **specific investment opportunities** within these prioritized sectors and **actions required to accelerate the trajectory** to full potential?

Forest conservation

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Sustainable farming

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Renewables (Solar and Wind)

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Built environment

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Electric mobility

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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 ~**$20B** opportunity by 2030

Investment opportunities

Recent developments (not exhaustive)

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

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

Climate Impact X

Singapore-based global carbon exchange and marketplace

Sylvera

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

Mature capital looking for high CAPEX project development

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

NewForests

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

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

*"There is nobody out there, **people are looking for consultants** as simple as mapping out their footprint, enabling training of certifiers"*

Commissioner, Forest conservation project

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

	Project origination, feasibility, development and design	Implementation	Monitoring and carbon measurement	Credit verification, registry and issuance	Carbon credit sales and trading
Factbase					
Estimated SEA market size *($B, 2030)*	**~1** (PDD consultants may charge equivalent of 10-20% of carbon sales revenue)	**~1-2**	**<1**	~1 *(Majority will go to foreign players)*	**~15-17** (Including $6-8B in derivative sales)
Indicative profit margins	**~15%**[1]	**~30%**[2]	**15-20%**[3]	**15-20%**[1] *for verification, registry and issuance typically non-profit*	**3-5%** for reseller, Up to **50%**[4] for exchange
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					
Adoption readiness	✓	✓	✓	✓	✓
Regulatory support	✓	✓	✓	✓	✓
Scalability	✓	✓	✓	✓	✓
Room for local player	✓	✓	✓	✓	✓
Overall assessment for SEA	***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.***	***Opp. to support emerging local players,*** *however,* ***limited due to unclear regulation***

Attractive | Opportunistically attractive | Unattractive

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

Investment opportunities focus on project development in Indonesia & Malaysia, with potential to build out carbon credit trading in SEA

% of SEA investable forestry carbon stock[1]

66%
Largest potential given significant forestry assets

16%
Large potential, 2nd to Indonesia given significant forestry assets

9%

6%

Smaller forestry assets, however, foresee **some potential** given growing government support

3%
Insignificant potential due to small forestry assets and lack of regulatory clarity

~0%
Insignificant potential due to small forestry assets, however, may be headquarter for regional players

Opportunities

Attractive | Opportunistically attractive

1 Project origination, feasibility, development and design

1
Estimated SEA market size ($B, 2030)

15%
Indicative profit margins

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

Strategic development opp. when sector matures given:

- (+) **Ambitious government targets** (e.g., Thailand plans to increase forest cover to 55% of total country area, Vietnam plans to plant 1B trees by '25)
- (−) Lack incentives to drive more actions

2 Carbon credit sales and trading

15-17
Estimated SEA market size ($B, 2030)

>50%[2]
Indicative profit margins

Opp. for adjacent corps. (e.g., banks) given:

- (+) **Large carbon credit potential volumes**
- (−) However, platforms' 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

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

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

Improve market accessibility

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

Closer collaboration/partnerships

Strengthen collaboration

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?

Forest conservation

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Sustainable farming

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Renewables (Solar and Wind)

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Built environment

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Electric mobility

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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[1] by 2030

Investment opportunities

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		Production and harvesting			
	Higher-yield inputs	**Greener nutrient management**	**Precision agriculture**	**Regenerative agriculture and lower-impact farming[1]**	**Farmer service platforms**	**Controlled environment agriculture**
Factbase						
Estimated SEA market size *($B, 2030)*	~4 *(Majority will go to global players)*	~3-9[2]	~2-3	~2-4[3]	~3-4	~1-3
	Solutions can drive **additional ~8-16B** revenue from yield improvement[8]					
Indicative profit margins	15-25%[4]	5-10%[4]	~10%[5]	*N/A – typically doesn't exist as profitable standalone business*	*Majority free for farmers to promote adoption of other products*	30-50%[6]
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[7])
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	Opportunistically attractive	Unattractive	Attractive	Unattractive	Opportunistically attractive	Opportunistically attractive
Regulatory support	Unattractive	Opportunistically attractive	Attractive	Opportunistically attractive	Attractive	Opportunistically attractive
Scalability	Opportunistically attractive	Opportunistically attractive	Opportunistically attractive	Opportunistically attractive	Opportunistically attractive	Unattractive
Room for local player	Unattractive	Unattractive	Opportunistically attractive	Opportunistically attractive	Attractive	Opportunistically attractive
Overall assessment for SEA	***Commoditized**, 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***
	*Potential opportunity to invest in 1) **integrated players** as they possess **strong distribution networks** (scaling potential), and 2) **advisory services***					

Attractive | Opportunistically attractive | Unattractive

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

Within precision agriculture and platforms, Malaysia, Thailand and Vietnam are most attractive due to infrastructure readiness and strong regulatory support

% of SEA agriculture production[1] and outlook

21%

Expect fast growth due to strong government advocacy

5% **10%**

Strong infrastructure, adoption readiness (tech/network, financing), and **regulatory support to increase production share**

54% **10%**

Less government focus on agriculture sector (industrialization focus), and adoption **challenged by poor tech and infra**

~0%

Other than CEA space, **lack of scale agriculture opportunities**

Opportunities

Attractive | Opportunistically attractive

1 Precision agriculture

2-3
Estimated SEA market size
($B, 2030)

10%
Indicative profit margins

Overall sector adoption readiness and government policy support makes markets attractive:

- **Good infrastructure and ICT connectivity among SEA countries**
- **Farmers receive training** by government (e.g., Thailand's Young Smart Farmers program)
- **Access to financing** (e.g., venture funding in Malaysia and National Innovation Agency in Thailand)

Supportive government plans

- 12th Malaysia Plan: targets to expand the use of AgTech
- Thailand 4.0: 20Y agri development plan push for digitization of agri sector

Favorable market conditions bolstered by government support:

- **Farmers trained** through government programs and are **convinced of tech feasibility** ("1M5R" program saved ~18-25% of costs)
- **Government offering financial incentives to investors** (tax exemption, preferential credits, etc.) to support land access and farming contracts or to reduce losses

2 Farmer service platforms

3-4
Estimated SEA market size
($B, 2030)

Strong public support to push adoption alongside well-established rural connectivity networks:

- Ministry of Information & Communications approved an e-commerce plan to boost sale of farm produce

PPP initiatives (e.g., smart-farming programs) to lend support to growth, but little visibility on any traction gained

Though there has been some private sector participation, limited regulatory support slows adoption and scaling:

- Private players competing for a piece of the e-commerce pie
- Private players emerged through COVID-19 due to restricted supply chain movement (e.g., Indonesia: TaniHub, Thailand: DHL's 'MySupplyChain')
- Need for more visible government policy support

Need actions to reflect supportive government plans:

- Gov't has preliminary plans to equip agriculture sector with ICT capabilities (Gul.AI Project) but little action thus far

Note: (1) Turnover forecast for 2030 based on manufacturer selling price
Source: Euromonitor; Industry participant interviews; Lit. search; Bain analysis

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

Improve market accessibility

Support innovative models to monetize

Increase growth-stage financing to develop **innovative business models** with clear monetization potential

- Back AgTech start-ups with clear potential for scale
- Develop, scale carbon credit market for regenerative agri
- Issue certifications for sustainable produce that may command consumer premium

Confront transition costs

Improve farmer connectivity

Increase **investment/support** for **farmer connectivity**

- Deploying rural connectivity infrastructure not commercially sustainable for MNOs today, requires more government subsidy

Connectivity **critical to drive scale adoption of digital solutions** (especially, for smallholders) and make them financially viable

- E.g., facilitate payments, lending, trading, automation hardware (e.g., drones), and advisory services
- Carbon market enablement will rely on digital connectivity for measurability and verification

Strengthen green financing

Increase volume, improve access to green financing

Boost investment momentum through **government support**

- E.g., Singapore equity program: government co-funding early-stage Sustainable farming with private investors

Improve economics for AgTech funds by **reducing farm ownership fragmentation**

- E.g., Nepal and India: farming cooperatives enable members' crops to be machine-sown and harvested

Support **farmer financing**

- E.g., regenerative agri: farmers require capital to survive past breakeven

Closer collaboration/partnerships

Facilitate public-private partnerships

Establish partnerships between motivated agribusinesses to continue connecting with growers

- E.g., government of India's platform (multi-stakeholder agri ecosystem) opens up data, infrastructure, research expertise to private players

Accelerate adoption via **government agencies serving as flagship adopters** for new tech (that serve to benefit smallholders)

Corporate partnerships to provide **stipends** and **training**

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

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Sustainable farming

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Renewables (Solar and Wind)

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Built environment

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Electric mobility

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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**

Investment opportunities

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)

Recent developments (not exhaustive)

CONSTANT ENERGY

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

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

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

AC Energy
An Ayala Company

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; Preqin; 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

	Manufacturing[1]	Project development	Installation/EPC	Ongoing operations and maintenance
Factbase				
Estimated SEA market size *($B, 2030)*	~6-8 *(Majority will go to foreign players, especially China)*	~1-3	~1-3	~8-10
		Integrated developer captures bulk of revenue across value chain: ~8-13[2]		
Est. project IRR *(current)*	6-8% (Projects deployed with battery storage today estimated to have low project IRR)	Residential: <8% C&I: 12-15% Utility: 8-10%		
Headwinds	• **High competitiveness in PV manufacturing**, eroding margin due to scale from China (~60% of global share)	• **Lack of supportive policies** (e.g., no renewal of FiT, unbankable PPAs) • **Unstable grid** that results in curtailment, often with no compensation	• **Frequent "race to the bottom"** for bidding due to commoditized services (especially in EPC)	• **PV equipment is more prone to damage** due to tropical climate in SEA
Tailwinds	• High potential for battery storage given ability to **resolve curtailment** that is enabled with lower battery storage CAPEX, expected to happen by 2030	• **Robust demand for solar energy,** to provide significant share of SEA's renewable energy by 2030 • **High quality offtakers in solar** (e.g., Electricity Generation Authority of Thailand)		
Assessment				
Adoption readiness	✓	✓	✓	✓
Regulatory support	✓	✓	✓	✓
Scalability	✓	✓	✓	✓
Room for local player	✓	✓	✓	✓
Overall assessment for SEA	***Minimal opportunity*** *due to commoditized offerings and leadership from foreign players, but expect battery manufacturing opportunities to emerge in coming years*	***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)*	***Minimal opportunity*** *due to high competitiveness from undifferentiated solutions and low margins (as turnkey pricing is heavily exposed to volatility in PV components)*	

Attractive | Opportunistically attractive | Unattractive

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 interview; 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

71% **Expect strong growth with** largest capacity addition in SEA by 2030 but watch out on grid curtailment and pricing schemes

15% Expect strong **growth driven** by utility scale floating solar projects

7% Expect **moderate growth,** given highly competitive market with increasing margin compression

4% **Expect solar to lead renewable energy**, given large pipeline of proposed projects

2% Expect **moderate growth** given lack of space for large scale projects

1% Expect **strong growth due to exports** in the coming years (e.g., to Singapore)

Opportunities

Attractive | Opportunistically attractive

1 C&I

5-7 **Estimated SEA market size** ($B, 2030)

12-15% **Est. project IRR**

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

2 Utility

11-13 **Estimated SEA market size** ($B, 2030)

8-10% **Est. project IRR**

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**

Investment opportunities

Earlier-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)

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

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

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

	Manufacturing[1]	Project development	Installation/EPC	Ongoing operations and maintenance
Factbase				
Estimated SEA market size *($B, 2030)*	~2-4 (Majority will go to foreign players, especially China, Europe, United States)	~1	~1-3	~3-5
		Integrated developer captures bulk of revenue across value chain: ~4-7[2]		
Est. project IRR *(current)*	6-7% (Projects deployed with battery storage today estimated to have low project IRR)	Onshore: **8-14%**		
		Offshore: **12-15%**		
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				
Adoption readiness	Opportunistically attractive	Opportunistically attractive	Attractive	Opportunistically attractive
Regulatory support	Unattractive	Unattractive	Unattractive	Unattractive
Scalability	Unattractive	Opportunistically attractive	Unattractive	Unattractive
Room for local player	Unattractive	Attractive	Opportunistically attractive	Opportunistically attractive
Overall assessment for SEA	***Minimal opportunity in wind turbine manufacturing for*** *SEA due to consolidation from manufacturers in China, Europe and United States*	***Opportunity for offshore wind project development,*** *given capacity requirement, favorable geography potential, and attractive returns (12-15%)* ***Some opportunity in operational onshore wind projects*** *(especially those which secured FiT prices)*	***Low opportunity*** *in SEA for pure-play providers due to immediate lack of talent pool (e.g., know-how on offshore maintenance) and technology providers for O&M but will have more potential in next years given need to reduce operational complexity and fulfill market demand (e.g., offshore installation)*	

Attractive | Opportunistically attractive | Unattractive

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

% of SEA total installed capacity for Wind[1] and outlook

23% >3 GW of capacity added in 2021 (highest in SEA), expect **strong growth and market leadership**, with increasing share of offshore

16% Expect **strong growth** in the long term, especially in offshore due to government interest

55% Expect minimal **growth in new capacity addition**

6% Expect **minimal growth in new capacity addition**

n.a *Lack of favorable geography to capture wind energy*

Opportunities

Attractive | Opportunistically attractive

1 Offshore

2-4 **Estimated SEA market size** ($B, 2030)

12-15% **Est. project IRR**

Large potential for offshore wind project development to unlock:

- (+) **Favorable geography** (long coastlines with strong winds)
- (+) International offshore developers (e.g., Orsted) have **proposed GW-scale offshore projects** for next few years
- (+) **Required to fulfill installed capacity target** (onshore is not enough), with expected project IRR at 14-15%
- (−) Wind FiT expired and government likely to lower future FiT or switch to auction, but pilot of direct PPA can promote growth
- (−) Non-bankable PPA for financiers (does not comply with international standards)

Attractive opportunity for offshore wind project development, with signs of traction:

- (+) **Huge potential:** estimated 178GW of potential offshore wind development for the island geography
- (+) **Gov't and World Bank co-created offshore roadmap** to develop offshore wind potential in Philippine
- (−) No agreed prices (FiT), as pricing scheme may be replaced by upcoming green energy auction program or PPA (with utilities)

2 Onshore

4-6 **Estimated SEA market size** ($B, 2030)

8-14% **Est. project IRR**

Attractive for onshore operational projects and **large potential for project development to hit ambitious target:**

- (+) **Country expects to be >50% of wind capacity installed in SEA by 2030**, with estimated project IRR at ~14%
- (−) Wind FiT expired and government likely to lower future FiT or switch to auction, but pilot of Direct PPA can promote growth

Strong push from government which acts as main driver of growth:

- (+) **Tailwind from RPS[2] (from 2023) to boost capacity needed for wind**, with estimated project IRR at ~13%
- (−) No agreed prices (FiT) as it may be replaced by upcoming green energy auction program or PPA (with utilities)

Opportunistically attractive for small-scale onshore project development:

- (+) **Reliable grid network** that can support renewable energy addition through 2036
- (−) Suspension of FiT scheme (in 2018), though returns remain attractive (project IRR at ~10%)

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

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Sustainable farming

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Renewables (Solar and Wind)

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Built environment

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Electric mobility

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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

Investment opportunities

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

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

Mature capital looking for high CAPEX project development

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

Recent developments (not exhaustive)

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

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

	Design and planning	Building construction		Building operations	
	Green architectural and engineering services	**Substitute for raw material** (e.g., green cement and steel)	**Green building products** (e.g., framing and insulation)	**Efficient cooling** (e.g., district cooling, efficient HVAC systems)	**Building Automation Systems**
Factbase					
Estimated SEA market size *($B, 2030)*	2-4 *(dominated by international players)*	1-2[1] *(majority will go to foreign players, especially Europe and United States)*	20-25	7-10[2]	4-7
Indicative EBIT	4-8%	10-15%	5-15%	15-20%[3]	10-20%[4]
Headwinds	• **Lack of technical capabilities** outside of Singapore	• **Higher CAPEX vs. conventional construction**, excluding Singapore (e.g., ~5-10% cost premium for green building development, where not subsidized) • **Siloed thinking in construction** (vis-à-vis design and operations) that results in inaccurate costings and redundancies in capacity		• **Loose monitoring of** and **lack of incentives** for sustainable building operations, excluding Singapore • **Challenging to implement green interventions for retrofits**	
Tailwinds	• Increasing prevalence of **building information modeling** (e.g., in Singapore), facilitating easier sustainable building design, retrofits	• **Ambitious government targets in SEA** (e.g., Singapore to have 80% of buildings to be green by 2030) • **Support from IFC** to promote green building construction		• **Demand from corporates/end-users** to achieve cost-savings benefit via tech solutions (e.g., cooling optimization), amidst rising energy costs • **Increasing need for data monitoring and reporting** that can only be fulfilled with integrated infrastructures	
Assessment					
Adoption readiness	Unattractive	Unattractive	Opportunistically attractive	Attractive	Attractive
Regulatory support	Unattractive	Opportunistically attractive	Opportunistically attractive	Opportunistically attractive	Opportunistically attractive
Scalability	Unattractive	Unattractive	Unattractive	Attractive	Attractive
Room for local player	Unattractive	Unattractive	Opportunistically attractive	Attractive	Attractive
Overall assessment for SEA	***Limited opportunity*** *as international players with technical expertise dominate the market, very nascent in SEA*	***Clear potential*** *for green building products as more building certification systems (e.g., Singapore's BCA Greenmark) are mandated and government targets are enforced* ***However, market is fragmented*** *(e.g., foresee substitute materials dominated by global players) and thus may be challenging to find scalable player to invest in*		***Opportunity to scale innovative solutions*** *(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)*** *Growing interest for* ***corporates to scale district cooling****, though it requires master planning and buy-in from both public and private sector* *Some opportunity to* ***provide E2E energy advisory*** *(incl. reporting tools), given infancy of green building and need to still achieve emission targets*	

Attractive | Opportunistically attractive | Unattractive

Note: (1) Driven largely by green cement; green steel is relatively nascent; (2) District cooling has $1-2B, and efficient HVAC systems has $6-8B; (3) District cooling has estimated >20% EBIT, and efficient HVAC to have 15-20% EBIT; (4) Estimated based on global players

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

Most attractive opportunity in efficient cooling solutions, with large potential for green building materials and product

"Green building" targets and expectations across SEA

- **80% of buildings (by gross floor area) by 2030**
- Estimated **30% of buildings** by 2025[1]
- Estimated **20-25% of buildings** by 2025[1]
- Estimated **20-25% of buildings** by 2025[1]
- **1,750 green buildings by 2030** (vs. 550 in 2020)
- *No published government targets or estimates by third-party organization*

Opportunities

Attractive | Opportunistically attractive

1 Efficient cooling

7-10 **Estimated SEA market size** ($B, 2030)

15-20% **Indicative EBIT**

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 widescale adoption
- (+) Smaller-sized opportunities in **cooling tech (e.g., data center cooling startup),** with potential to scale regionally

Imperative 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)

2 Green building products

20-25 **Estimated SEA market size** ($B, 2030)

5-15% **Indicative EBIT**

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

Some opportunity in construction as space matures in action in med term:

- (+) **Maturing of government regulation** such as mandating green building requirements for new construction and development of rating tools (e.g., Green building rating tool)
- (+) **Favorable green financing (e.g., lower down payment) by Indonesian state banks** to encourage green construction
- (−) 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

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

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

Key actions to accelerate trajectory to full potential

Improve market accessibility

Develop enabling policies
(to achieve standards compliance)

Set standards and promote compliance (e.g., established certifications like EDGE, green building codes) for new and existing buildings

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

Strengthen green financing

Enhance financing

Create financial products with favorable terms to provide liftoff for developers

- E.g., increased LTV ratio for green building development, thereby lowering down payment

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)

Closer collaboration/partnerships

Strengthen awareness and collaboration

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

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)

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

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Electric mobility

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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

Investment opportunities

Recent developments (not exhaustive)

Earlier-stage capital looking for start-ups to scale

2W electrification – given cost, urban density, existing usage, opportunity in SEA's mass e-2W ecosystem (e.g., local manufacturing, battery swapping)

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

Mature capital looking for high CAPEX project development

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)

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

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

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

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

Attractive opportunity to manufacture 2Ws, with bulk of value in manufacturing

	Cell manufacturing and battery mgmt. system	Auto R&D and manufacturing	Vehicle sales and dealership	Charging infrastructure	Service, maintenance and battery recycling[3]
Factbase					
Estimated SEA market size *($B, 2030)*	6-9 (Majority from foreign OEMs)	25-30	2-4[1]	4-6 More details in subsequent page	1-3
Indicative EBIT	5-8%[2]	10-12%[2]	**6-10%** depends on OEM partnership, agreements, discounts, etc.	**~0%** profitability not proven without subsidy (United States market)	4-8%[2]
Headwinds	• **Supply-chain challenges,** increasing commodity costs	• Rising **battery/component costs** (e.g., lithium)	• Pressure on **dealer margins** due to higher EV costs and rise of 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 **e-2W** demand, given lower cost and denser urbanization in SEA	• 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**
Assessment					
Adoption readiness					
Regulatory support					
Scalability					
Room for local player					
Overall assessment for SEA	***Limited opportunity*** *as battery and EV manufacturing are* ***commoditized*** *and dominated by foreign OEM*	***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*	***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* ***Minimal opportunity*** *as hardware/R&D limited in SEA*	***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*

Attractive | Opportunistically attractive | Unattractive

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: Lit. 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

	Hardware manufacturing and sales	Installation	Operator software	Charging point maintenance and ops	End-user application
Factbase					
Estimated SEA market size[1] *($B, 2030)*	0.3-0.4 (Mainly from foreign OEMs)	1-3	2-3		0.5-0.7
Indicative margins[2] *(EBIT, 2030)*	10-15%	10-15%[3]	10-14%	Maintenance: 10-14% Operations: 4-8%	15-20%
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	Opportunistically attractive	Opportunistically attractive	Opportunistically attractive	Opportunistically attractive	Opportunistically attractive
Regulatory support	Opportunistically attractive	Opportunistically attractive	Opportunistically attractive	Opportunistically attractive	Opportunistically attractive
Scalability	Unattractive	Unattractive	Opportunistically attractive	Opportunistically attractive	Opportunistically attractive
Room for local player	Unattractive	Opportunistically attractive	Unattractive	Opportunistically attractive	Opportunistically attractive
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)*

Attractive | Opportunistically attractive | Unattractive

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

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**

Little government support/push for BEV but **championed by single Vietnam player**

Lack of government ambitions to build out charging infra. reflects sector focus (<1K stations by 2036 vs. 10-60K in rest of SEA)

Lack of scale compared to rest of region

Opportunities

Attractive | Opportunistically attractive

1 Auto R&D and manufacturing

25-30 Estimated SEA market size ($B, 2030)

10-12% Indicative EBIT

2W | 4W

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

Pro-domestic targets by government signals growth potential

- 20% of local auto manufacturing to be EV
- Local super-app to enter 2W EV manufacturing

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

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; IEA; 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

Improve market accessibility

Incentivize local development

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)

Set up clear roadmap to motivate private investment

- E.g., Thailand government announced the plan to make the country an EV hub in SEA and achieve 250K EV sales by 2025

Promote EV adoption

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

Subsidize car-sharing businesses that operate with an EV fleet

- E.g., BlueSG (EV car-sharing in Singapore), given multiple government grants

Confront transition costs

Address range anxiety

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

Lower adoption costs

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

	Forest conservation	Sustainable farming	Renewables (Solar)	Renewables (Wind)	Built environment	Electric mobility
Opportunities for early-stage capital	**Carbon mgmt./credit exchange tech** Attractive potential for emerging local carbon credit trading platform to become regional/ global hub	**Digital platforms** Farmer services platforms by local start-ups to provide services across value chain	**Small C&I solar projects and hybrid players** Smaller companies developing C&I solar projects across SEA (who may also develop utility-scale projects)	**Wind project development** Attractive potential due to strong onshore and offshore technical wind potential, driven by high expected returns on investment	**Energy saving technologies and services** Energy saving technology and innovative solution (e.g., cooling as a service), driven by anticipated cost savings	**Electric two-wheelers** 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)
Opportunities for mature capital	**Forest conservation project development** Develop, own and invest in forestry projects, given significant potential for forestry assets	**Precision agriculture** High-technology scale solutions by and for larger firms with potential to substantially improve crop yield; also driven by governmental support	**Utility-scale solar projects by large businesses** Reliable returns from utility-scale projects developed by large businesses with established track record	**Operational onshore wind projects** Acquisition or investments into less-risky operational projects or from developers with proven track record	**Green building products/district cooling** Green building construction as regulation expected to evolve in this direction to hit targets or district cooling projects, especially in new builds	**EV charging infra** Local infrastructure players/conglomerates to scale and operate technology (e.g., charging stations rolled out by VinGroup in Vietnam)

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

~ $3 trillion

Investment required in SEA to be on track to 1.5˚C by 2030

~ $3.2 trillion

2021 SEA GDP
~ $37 trillion cumulative GDP from 2022 to 2030

~ $1 trillion

Annual green economic opportunity by 2030

~ $15 billion

Private sector investment (financial & corporate) in green economy since 2020

~ 70%

Private green investment from 2020 to date deployed against renewables

~ 71-84%

SEA primary energy supply forecasted to still come from fossil fuels by 2040 in different scenarios

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

✔ Presence of gov't-aided financial incentives ✔ Existence of regulatory support but weak financial incentives ✘ No clear regulatory support or incentive

	Net-zero target	Financial Incentives for Investment: Renewable Tariffs	EV Adoption	Built Environment	Sustainable Farming	Forest Conservation	Disincentives: Carbon Taxes
	Yes (2060)	✘	✔	✘	✘	✔	✔ ($2 for coal; full market by 2025)
	Yes (2050+[1])	✔	✔	✔	✘	✔	✘
	Yes (2065)	✔	✔	✔	✘	✘	✘
	Yes (2050)	✔	✔	✘	✘	✘	✔ (ETS legalized; pilot in 2025)
	No	✔	✔	✔	✔	✔	✘
	Yes (2050)	✔	✔	✔	✔	✘	✔ ($4 today; increase to $40-60 by 2030)

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 SFI[2] scheme, aiming to subsidize agri operations (£20-58/ha) meeting standards on sustainable farming practice (e.g., organic matter in soil, no bare grounds)

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

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

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)

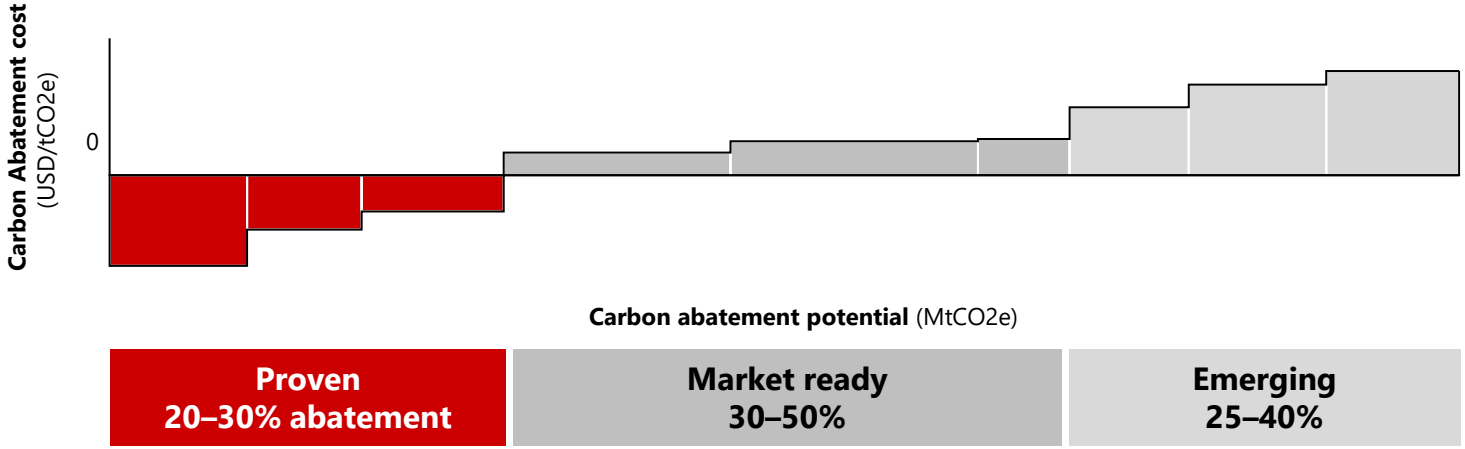
Scale adoption is unlikely without greater incentives/disincentives to drive behavior change

Note: (1) Committed to carbon neutrality by 2050, no direct commitments on net-zero (expecting 2050+); (2) Sustainable Farming Incentive
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



Proven levers available across sectors in SEA

	Mobility & transport	Built environment	Power generation
Sample levers	Supply chain optimization 2 & 4-wheeler EV EV charging infrastructure	Efficient cooling Energy-saving appliances (e.g., LED lamps) Green construction design	Thermal plant process optimization Grid modernization

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)

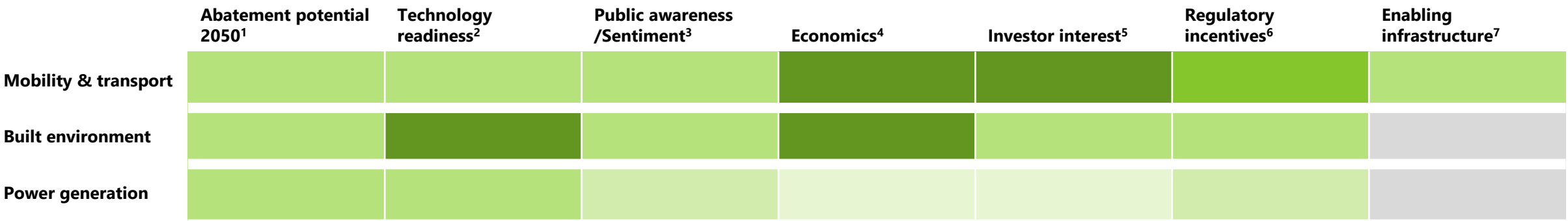
Note: Aggregate carbon abatement curves represents decarbonization technologies sorted by abatement unit cost in y-axis (negative value implies cost savings) and total abatement potential in x-axis
Source: Bain analysis

Ready-to-deploy solutions exist today across multiple decarbonization levers

Selected "proven decarbonization solutions"

High Low Criteria agnostic

Attractiveness assessment for 2030



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 improvement***; proven technology with ~90% adoption in Japan**

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

Power generation: Plant process optimization

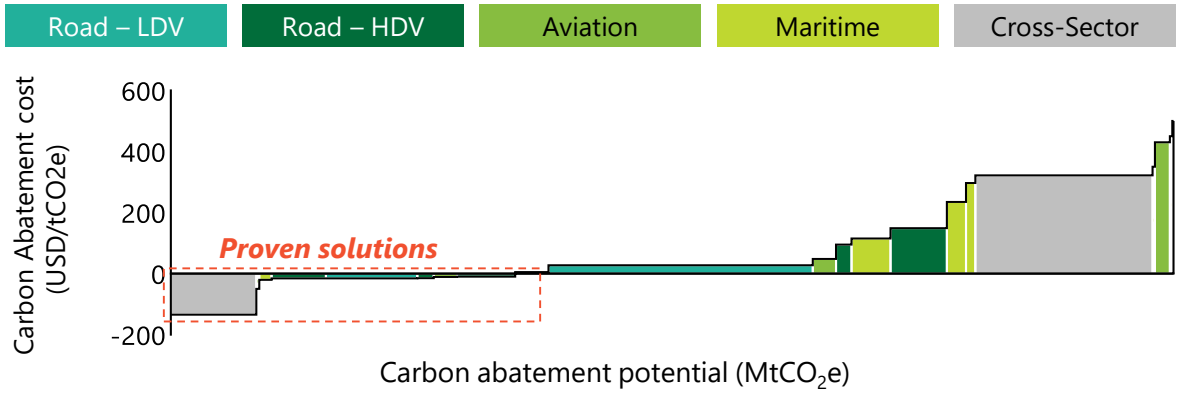
Given most SEA government targets expect coal to remain a key part of the fuel mix for next 10-20 years, more actions are needed to **optimize its efficiency** and **reduce carbon footprint** as much as possible

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

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

Proven solutions like supply chain optimization could reduce emissions from transport by nearly 30% - with positive related benefits in energy costs

Illustrative transportation marginal abatement cost curve



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

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

Sample solutions	Estimated emissions reduction
Supply Chain Optimization	7 - 10%
Modal switch	2 - 4%
Fleet Upgrades	8 -10%
Drop-in Biofuels[1]	3 - 4%
Total	**20 – 28%**

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

EZYHAUL

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

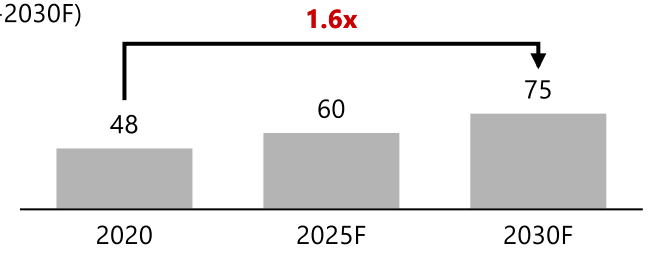
Through advanced machine learning algorithms and IoT connectivity, the platform equips partners with scale and carrier type choices while providing intelligence on delivery schedules

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

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…

Residential electricity demand for ACs in SEA[1], (TWh, 2020-2030F)



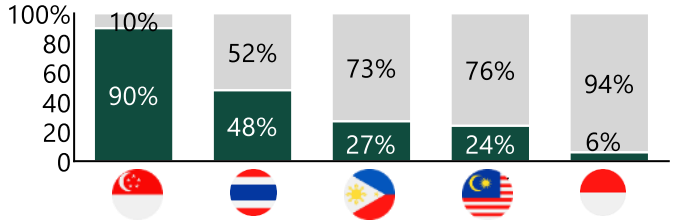
	2020	2025F	2030F
% of AC demand in total residential electricity demand	**15%**	18%	**20%**

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[2] today** and is expected to decrease to about 10% towards 2030

…but adoption for proven/efficient cooling option is still low today in SEA…

% of AC (inverter) in total ACs (2020/21)



Total residential electricity demand for ACs, TWh	2	12	5	7	7

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*

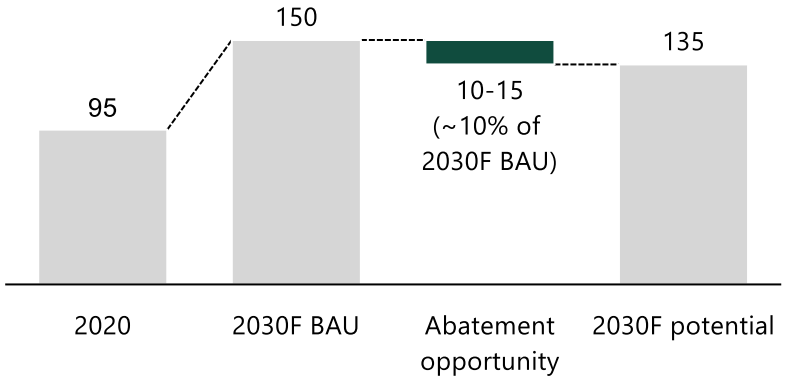
Current adoption of AC (inverter) in SEA is estimated to be **~35%**

*"We have more technology than people realize and that includes inverters, heat pumps; **when you get to SEA, there are hardly any inverters**…"*

CEO of leading AC manufacturer

…and this presents an opportunity to reduce ~10% of carbon emissions by 2030

Est. emissions from residential AC ($MtCO_2e$, 2020-2030F)



Opportunity to abate 10-15 MtCO2-eq (~10% of 2030F 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**

*"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…"*

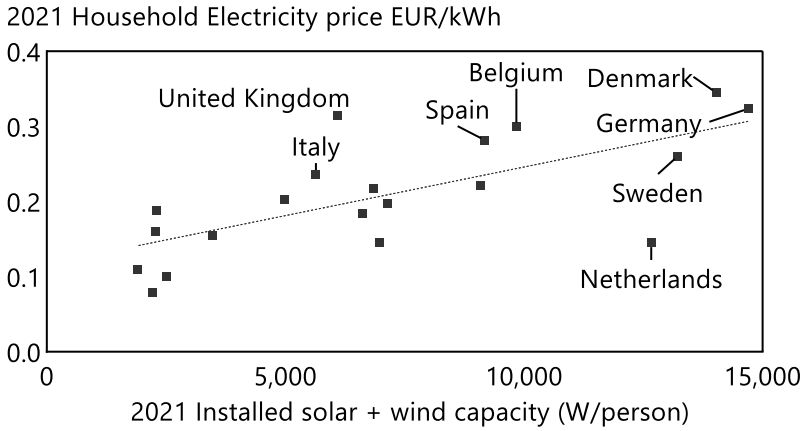
Regional director of AC manufacturer

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; IIFIIR; 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



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

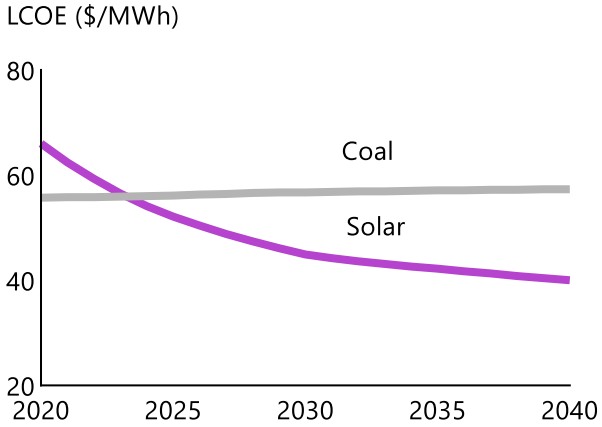
Renewable levies that serves to provide guaranteed revenues for suppliers result in **higher prices for consumers**

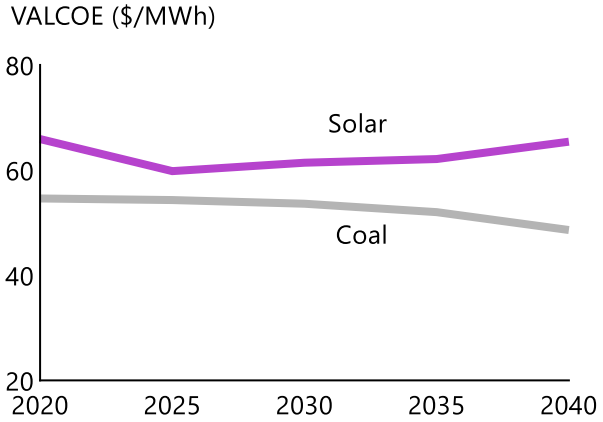
"Structure of EU wholesale electricity markets…means that the savings generated by low-cost solar PV and wind power are not passed on to electricity customers…"

Climate Action Network Europe

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[2]; suggests high penetration may reduce returns as scale increases





New solar PV LCOE projected to be more cost-efficient before 2025 in India

However, **VALCOE of solar PV is expected to increase** as share of solar PV energy increases over time and remains **more expensive than coal due to increased flexibility costs**, surpassing daytime production savings

"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

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)

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

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

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%

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

Pragmatic Transitions

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)

Source: Aljazeera; World Bank; The Star; Lit. search

Confront system costs for the energy transition

Market Challenge

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

Actions to accelerate transition

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

VALCOE Study

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

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**

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

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**

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

Source: World Bank; EU RES; ASEAN Center for Energy

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

Micro finance[1]

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)

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

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

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)

Singapore Government BREEF Scheme

The Building Retrofit Energy Efficiency Financing (BREEF) scheme facilitates private-sector financing of up to S$4M for green retrofits through an energy performance contract arrangement

Notes: (1) ADB Microfinance Risk Participation and Guarantee Program
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

Market Challenge

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

Actions to accelerate transition

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 APG[1] 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

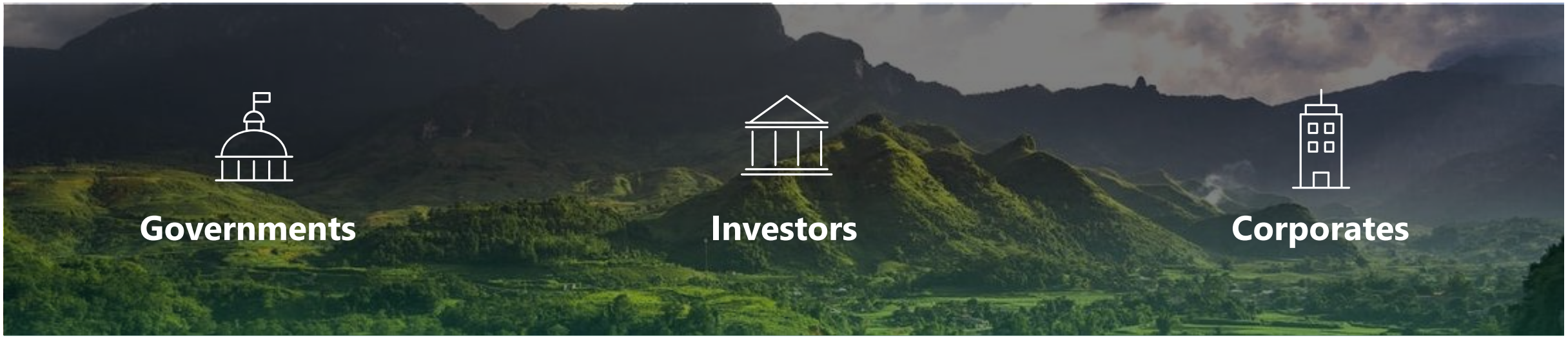
Set up a **regional platform** for stakeholders to **share farming data** – breaking past current modes of restricted sharing between local cooperatives – to better facilitate **private sector innovation**

IDEA[2] 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



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

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

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

Unlock opportunities in **Proven solutions**

- [ ] **Measure baseline emission** across all lines of business to set clear & measurable decarbonization ambition
- [ ] **Evaluate abatement opportunities** across businesses and prioritize short & long-term decarbonization levers
- [ ] **Optimize energy efficiency** across internal operations to minimize Scope 1 and 2 emissions
- [ ] **Embed sustainability into strategic agenda**, translating decarbonization goals into measurable KPIs for various business units

Confront system costs for **Energy transition**

- [ ] **Assist government efforts** in building out renewables power grid, advising on **potential grid configurations to optimize for both system costs and energy security**
- [ ] **Design assets with an emphasis on convertibility** to low-carbon powered sources, e.g., modifying a gas-powered generating station to run on hydrogen

Develop and strengthen **Green financing**

- [ ] **Establish commitments and make regular, comprehensive carbon disclosures** using international standards (e.g., SBTi[1], SASB[2], etc.) to improve transparency
- [ ] **Foster partnerships** with governments and multilateral development banks to broker agreement for transition finance

Prioritize and drive **Regional collaboration**

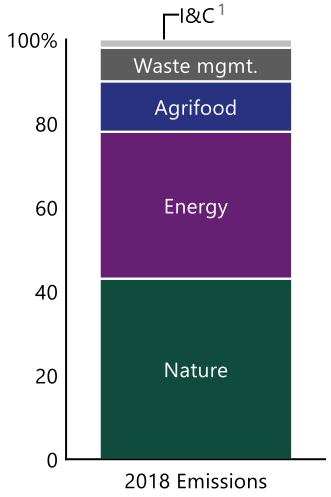
- [ ] **Collaborate with upstream suppliers in the region** to decarbonize supply chain (e.g., switch to lower carbon input, reduce logistics carbon footprint)
- [ ] **Improve availability and affordability of energy efficient products across the region** by optimizing manufacturing and distribution processes
- [ ] **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

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**

Government commitments (2030)

Key details	**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/tCO_2e of **carbon tax,** with ETS[2] under consideration
Challenges	**34%**	coal capacity added; **policies** and **investment climate** still favor large-scale, fossil-fuel power
	7.5%	of natural forest allowed to be cleared by 2050; existing long-term strategy only calls for limiting deforestation

Recommended government actions

Translate commitments into **ministerial decrees and a national roadmap**

Establish **standardized and clear** PPAs and deregulate the domestic power industry

Develop **coal transition roadmap**, including a green-economy upskilling plan for laid-off workforce

Strengthen law **enforcement on illegal deforestation and criminal indictments** of illegal deforesters, to increase deterrence effect

Ambiguity + conflicting incentives

Legend: Positive outlook | Uncertain outlook | Challenging outlook

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**

NATURE

Government aims to **transform forests into carbon sinks**, yet needs to move beyond 'carbon nationalism' to participation in global **voluntary carbon markets**

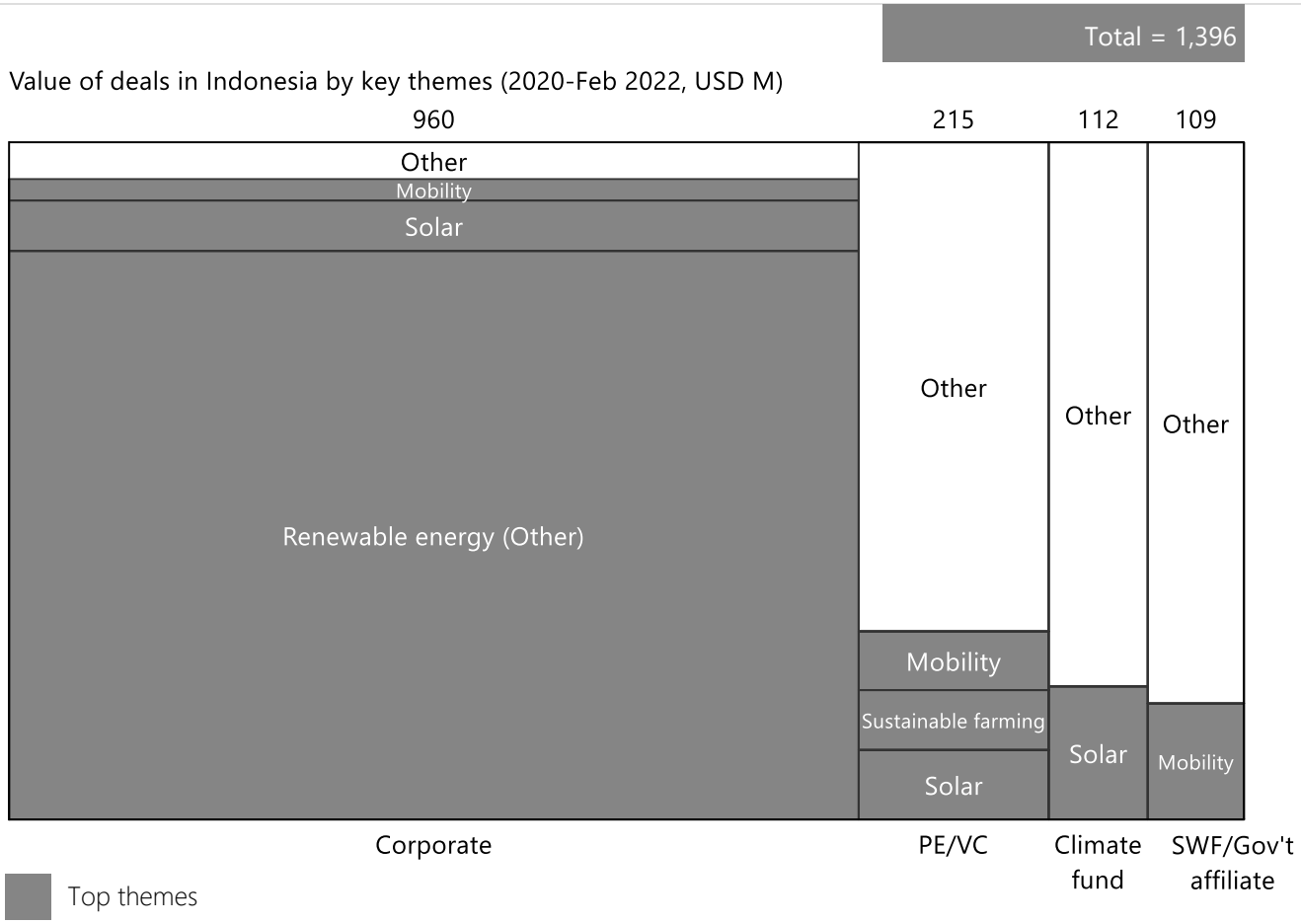
2030 TRAJECTORY

ENERGY			NATURE
↘	?	?	?

Note: (1) I&C: industrial & construction; (2) ETS emissions trading scheme
Source: EIA; UNFCCC; Reuters; Mongabay (1); Mongabay (2); Straits Times; Reuters; Jakarta Post; SBTi; Climate Transparency; Eco-Business; Jakarta Post (2); Company websites

Investment driven by private sector, with focus on Renewables

Investment flows[1]



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 investors[2]:

ACVENTURES EastVentures

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

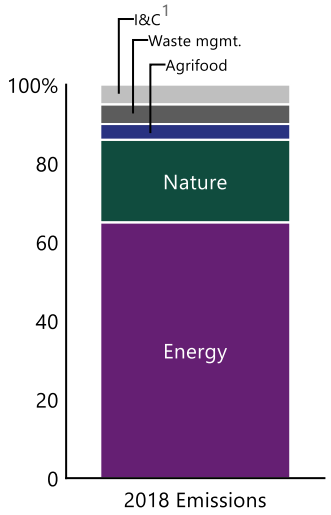
Highest investment potential

	Forest conservation	Sustainable farming	Solar	Built environment	Electric mobility
	Opportunity: Project origination, feasibility, development and design, carbon-credit sales and trading	**Opportunity:** Farmer service platforms	**Opportunity:** Exported utility-scale solar	**Opportunity:** Green building products	**Opportunity:** Auto R&D and manufacturing (especially 2W), and charging infrastructure
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	**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)	**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	**Maturation of government regulation** mandating green building requirements for new construction projects **Presence of green financing** (e.g., lower down payments) **by Indonesian state banks** to encourage green construction Partnership between local professional organizations and **IFC to promote awareness**	**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**
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)	**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	**High upfront CAPEX** to develop R&D expertise and manufacturing capabilities **Unclear regulatory framework** and government falling behind **on infrastructure development targets** Need a **new source of green electricity for EV manufacturing and charging**, especially due to existing coal power generation

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)

Key details	**45%**	**emission intensity reduction** from business-as-usual[2]
	40%	of total installed capacity **to be sourced from renewables** by 2035[3]
	20% & 10%	**of terrestrial and coastal areas to be protected,** respectively, by 2025
Challenges	**~2**	years behind 2025 renewables target (forecast)
	~50%	**coal retirement** by 2033 but facing natural gas shortage
	Negative	**green investment** growth since 2016

Recommended government actions

Develop **coal transition roadmap, renewables roadmap**, and green-economy upskilling plan

Develop **co-investment initiative specific to climate tech start-ups**

Eliminate project size caps to stimulate development of larger-scale projects

Ambiguity + conflicting incentives

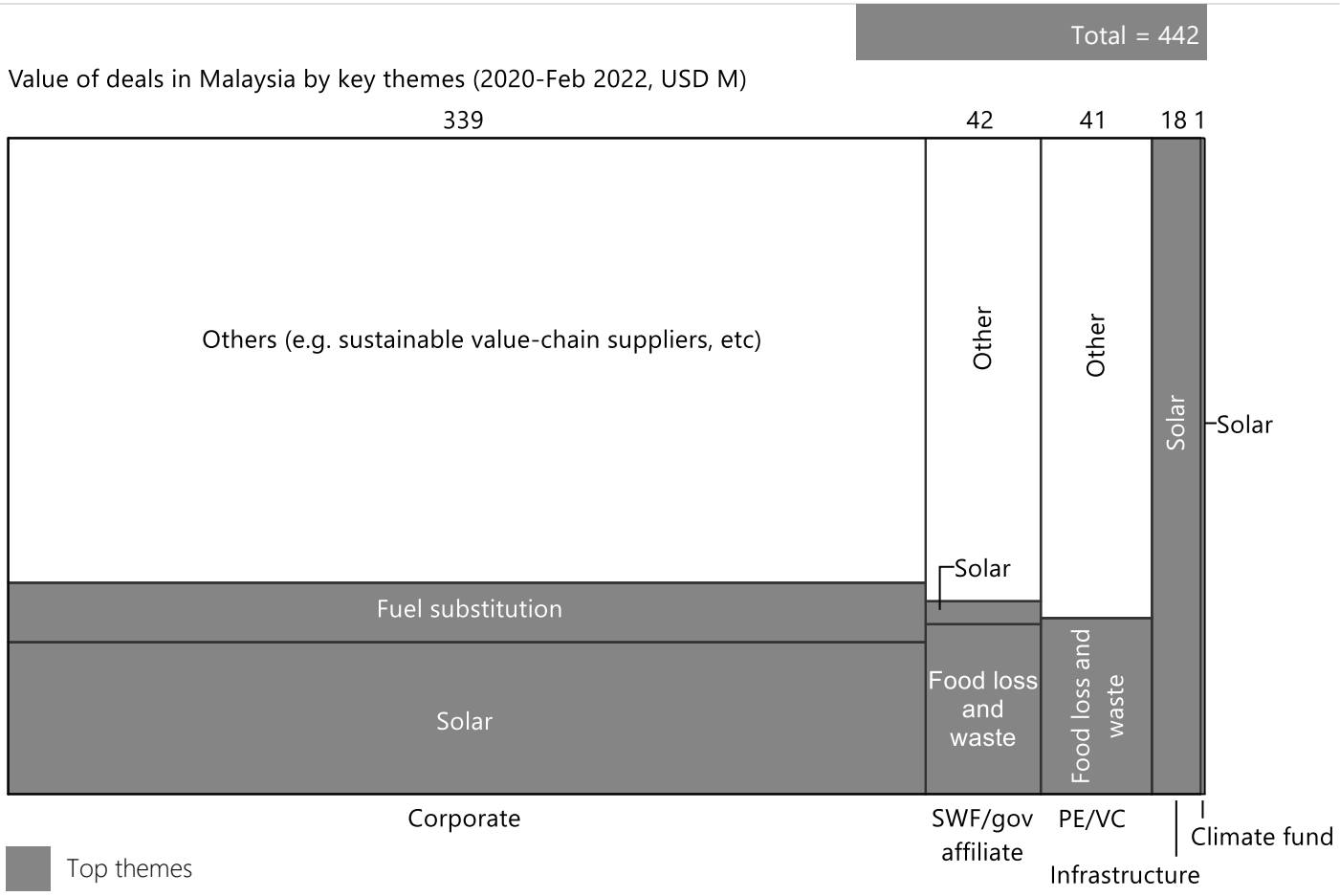
Legend: Positive outlook | Uncertain outlook | Challenging outlook

ENERGY	**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	NATURE 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[1]



Top themes by investment types:

Corporate
Solar, Fuel substitution

PE/VC
Food loss and waste

Infra Fund
Solar

SWF
Food loss and waste, Solar

Deal example:

Corporate: Tailworks invested $35M into the **19MW Kuala Lumpur International Airport Solar Power Portfolio**

Most active investors[2]:

No green investor has substantial activity in Malaysia

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

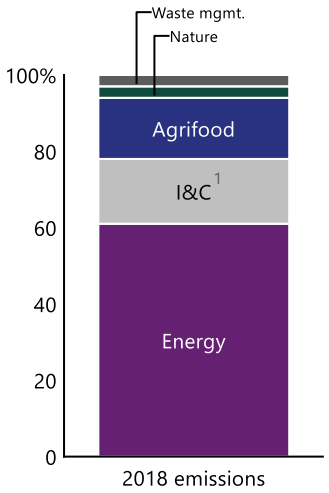
Highest investment potential

	Forest conservation	Sustainable farming	Solar	Electric mobility
	Opportunity: Project origination, feasibility, development & design, and carbon-credit sales and trading	**Opportunity:** Precision agriculture and farmer service platforms	**Opportunity:** Commercial and industrial Solar	**Opportunity:** Auto R&D and manufacturing (4W)
Tailwinds:	**Significant forestry assets** (~20% of SEA total investible carbon forestry stock) **Growing MNCs, conglomerate interest** Expect **continued increase in carbon prices,** driving demand across value chain Renewed government interest in carbon trading; **aims to start carbon-trading platform by late 2022**	**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	**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	**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:	**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)	**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**	**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	**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)

Key details	**20%**	**emissions reduction** relative to business-as-usual by 2030 (25% conditional)
	20%	of power generation **to be sourced from renewables** by 2030; increase from 18% in 2020
	ETS	under consideration
Challenges	**No**	explicit NDC commitments for agricultural farming
	Lack	of **good electrical infrastructure**, support by **financial institutions**, and **technical resources**
	41%	**projected increase** in GHG emissions by 2030 under current policies (23% under planned policies)

Recommended government actions

Increase resources allocated to NAMA[2]; develop comprehensive **sustainable farming and agricultural emissions-reduction roadmap**

Develop **coal-transition roadmap,** including a green-economy upskilling plan for impacted workforce

Introduce additional fiscal and non-fiscal incentives to **accelerate green-finance ecosystem**

Ambiguity + conflicting incentives

Legend: Positive outlook | Uncertain outlook | Challenging outlook

ENERGY

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

I&C

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**

AGRI

Goal to **reduce rice emissions by 26%** through capacity building, education, and establishment of GAP/SRP[1]; however **no explicit commitment** made and **standards remain voluntary**

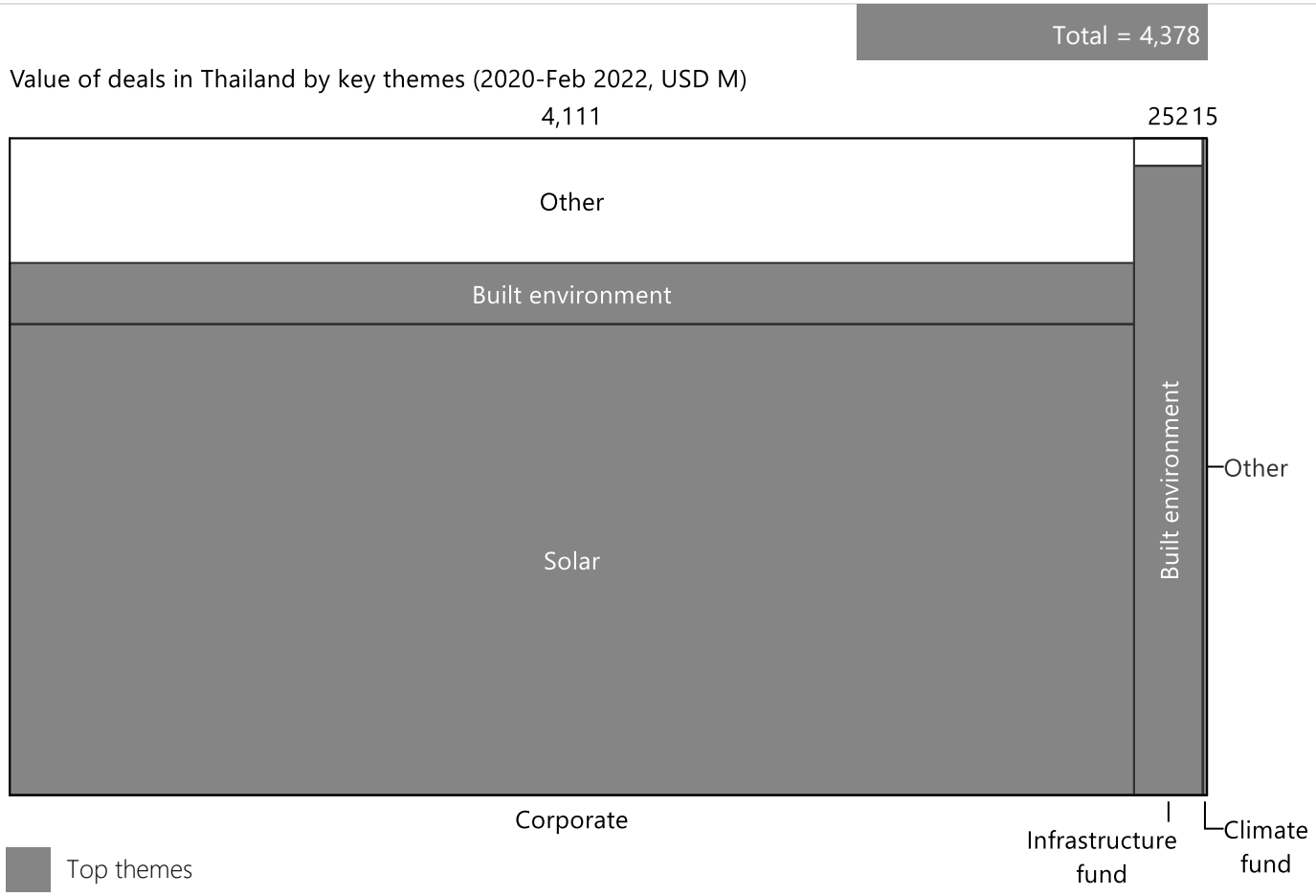
2030 TRAJECTORY

ENERGY	I&C	AGRI
?	?	?	?	↘

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; Bangkok Post; Bloomberg; Company websites

Capital deployed mainly on Renewables and green infrastructure deals

Investment flows[1]



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 investors[2]:

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

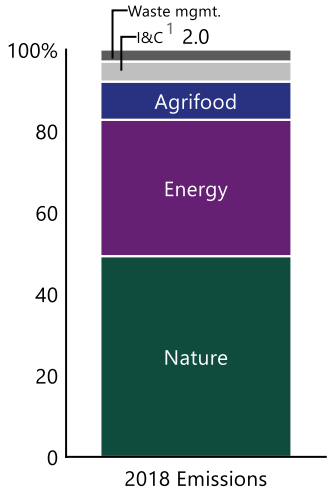
☆ Highest investment potential

	Forest conservation	★ Sustainable farming	Solar	Wind	★ Built environment	★ Electric mobility
	Opportunity: Project origination, feasibility, development and design	**Opportunity:** Precision agriculture and farmer service platforms	**Opportunity:** Utility-scale solar	**Opportunity:** Small-scale onshore wind	**Opportunity:** Efficient cooling	**Opportunity:** Auto R&D and manufacturing (especially 2W), and charging infrastructure
Tailwinds:	**Ambitious government reforestation plans** (1B trees to be planted by '25, ~85% of which in urban and industrial zones)	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	**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/m²/day of solar energy**	**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**	**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	**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
Headwinds:	**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**	Fragmented farming landscape with **many small-scale farmers** (43% smaller than 16,000 sqm) **unable to independently afford high costs of precision AgTech**	Government **no longer accepts large scale projects under FiT** **Unclear and lengthy PPA application processes** and procurement framework	**Suspension of FiTs in 2018** **Challenging and unclear regulations** in 2015 reduced land availability for wind deployment, especially given limited land areas with wind energy potential 3GW target of wind energy by 2036 **could be more ambitious**	**Lack strong enforcement of regulations by government** **Lack of incentives** for sustainable building operations	**Unclear guidelines** on agency responsible for rollout of charging stations Nascent charging market, with just ~1K charging stations in 2021

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)

Key details	9%	**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
Challenges	3	key national-level entities responsible for resource allocation; **lack of clarity on responsibilities**

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

Ambiguity + conflicting incentives

Legend: Positive outlook | Uncertain outlook | Challenging outlook

ENERGY

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**

NATURE

Calls for **no new deforestation by 2040** and **1B new trees planted by 2025**. Launch of enabling policies yet to be seen to unlock participation in carbon markets

AGRI

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

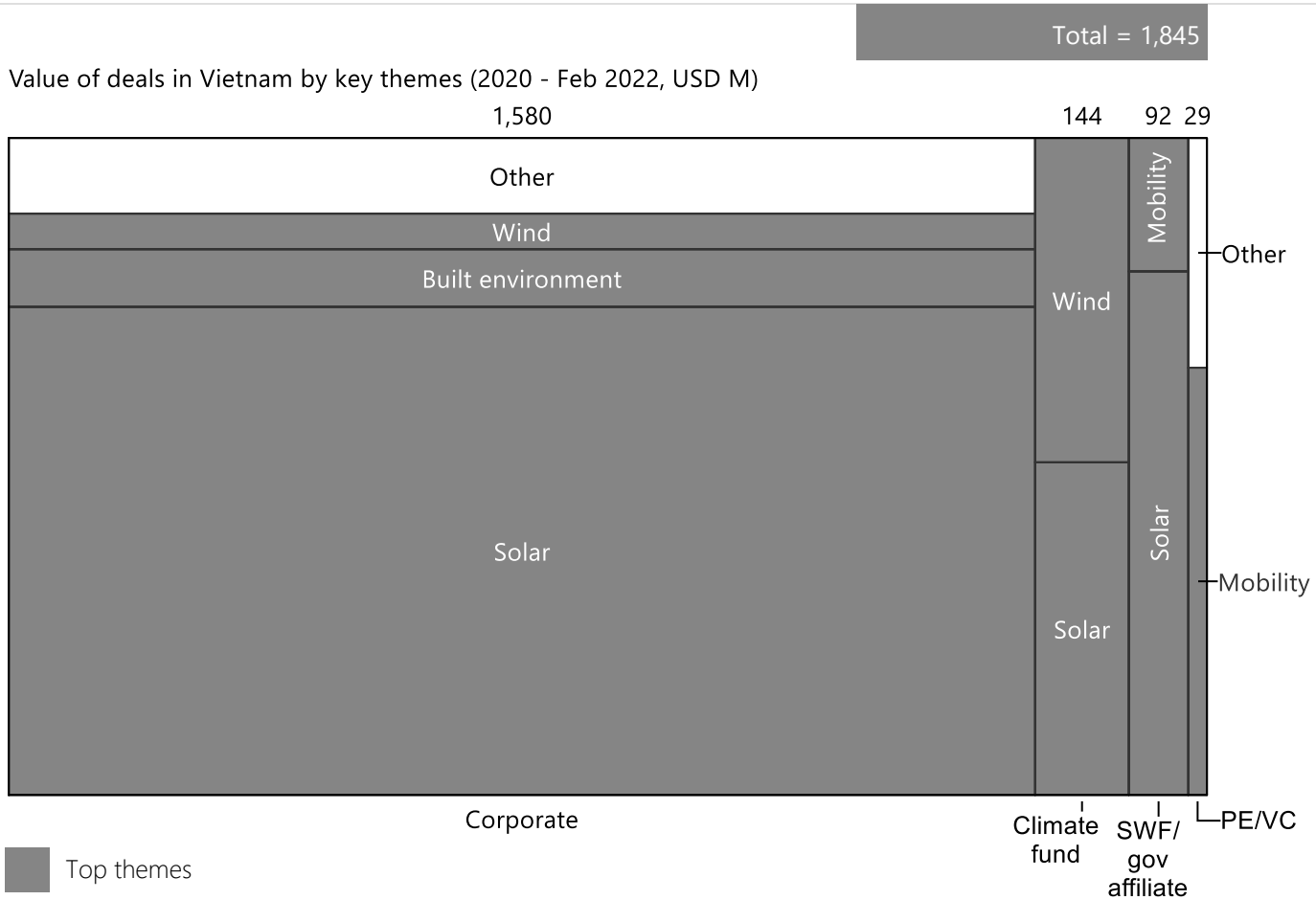
Energy	Nature	Agri
?	?	↗

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

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

Investment flows[1]



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[2]:

TRUNGNAM Group

BCG BAMBOO CAPITAL

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

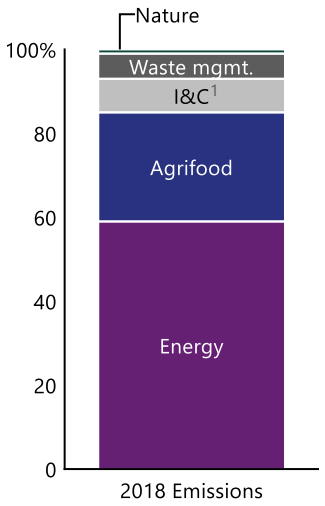
Highest investment potential

	Forest Conservation	Sustainable Farming	Solar	Wind	Electric Mobility
	Opportunity: Project origination, feasibility, development, and design	**Opportunity:** Precision agriculture and farmer service platforms	**Opportunity:** Utility-scale Solar	**Opportunity:** Onshore Wind and offshore Wind across the South and Mekong Delta regions	**Opportunity:** Auto R&D and manufacturing (esp 2W), and charging infrastructure
Tailwinds:	**Ambitious government reforestation plans** (1B trees to be planted by '25, ~85% in urban and industrial zones)	**Generous fiscal and non-fiscal incentives** to support land access and farming contracts (e.g., tax exemption, preferential credits for investments to improve productivity) **Government support for Agri e-commerce**, with approved e-commerce plan to boost sales of farm produce **Farmers trained through government programs**, and **convinced of tech success** ("1M5R" saved ~18-25% of costs)	**Largest capacity addition in SEA by 2030** **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** I n SEA, likely to lead to increased EV adoption and subsequent demand for charging infrastructure **Strong corporate support for development of EV infrastructure**
Headwinds:	**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)

Source: EU REDD; Nikkei Asia; Vietnam Plus; Bloomberg; CGIAR; World Bank; IHS Markit; Global Solar Atlas; Industry participant interviews

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)

Key details	**75%**	**emissions reduction**[2] 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[3]	under consideration
Challenges	**4GW**	**additional coal power** in pipeline despite announcement to stop constructing new coal power
	Total	**emissions to continue to grow** under current policies rather than decline to meet the conditional target

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**

Ambiguity + conflicting incentives

Legend: Positive outlook | Uncertain outlook | Challenging outlook

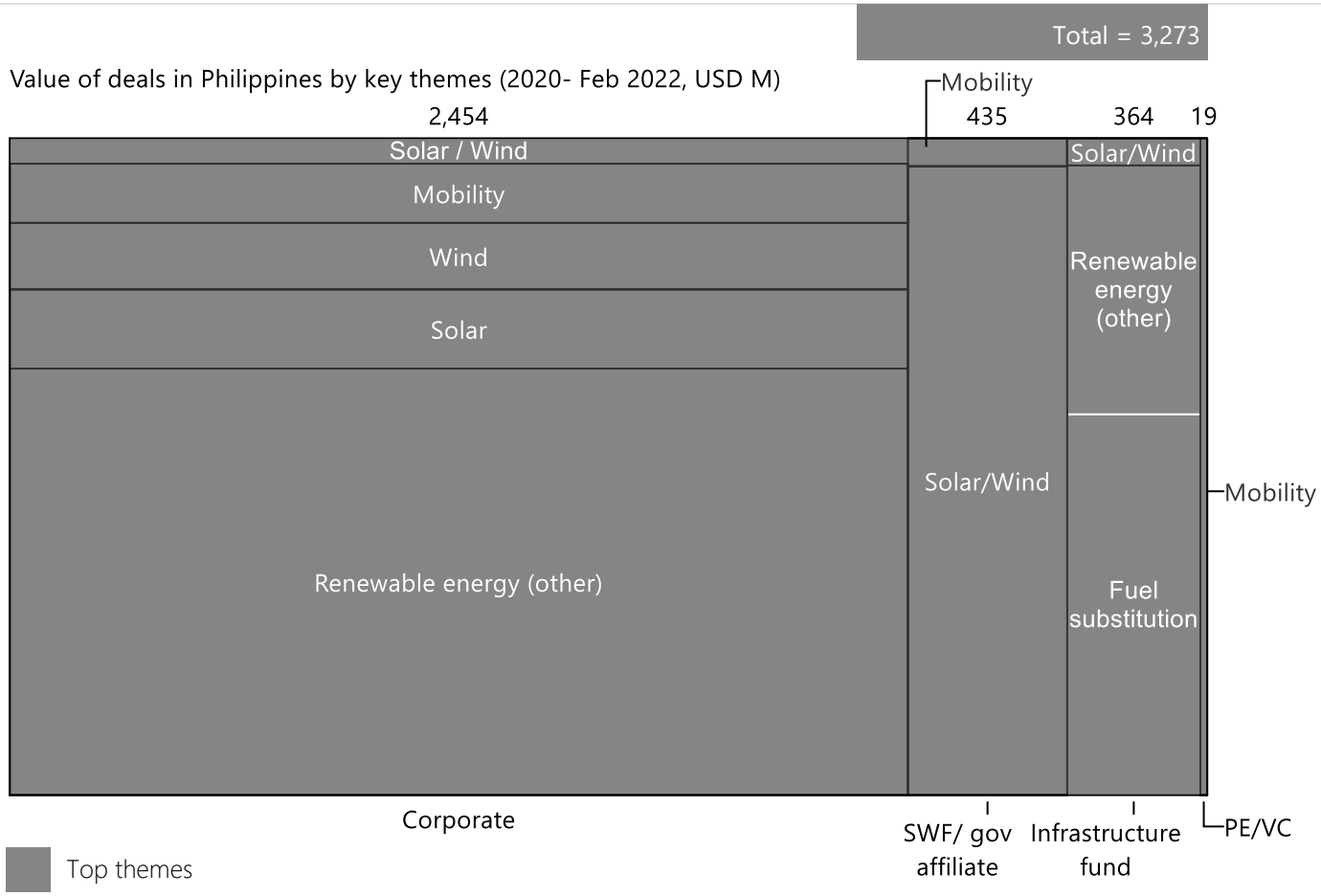
ENERGY	**Renewables** accounted for ~21% of gross electricity generation in 2019 and have **declined in share since 2008**; energy storage ramp-up essential to mitigate "duck-curve" phenomenon	Recent implementation of **coal power moratorium encouraging**. However, essential to also **enact moratorium 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**	ENABLERS **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	↘	?	?	↘

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; CBD; Reuters; Business World; SBTi; PGBC; Company websites

Growing capital flow into the green economy, with focus on Solar and Wind

Investment flows[1]



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 investors[2]:

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

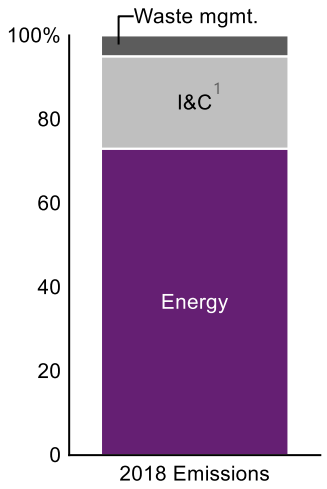
☆ Highest investment potential

	Sustainable farming	★ Solar	★ Built environment	★ Wind
	Opportunity: Farmer service platforms	**Opportunity:** Commercial and industrial Solar	**Opportunity:** Efficient cooling	**Opportunity:** : Onshore and offshore wind
Tailwinds:	**Digitalization increases productivity,** addressing concerns in declining labor participation in agri	**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/m²/day**	**Government-mandated** AC efficiency standards, with Minimum Energy Performance Standards reviewed and revised every 3 years **Bold government targets** (e.g., Green Building Code in 2015 promoting resource management measures) **High electricity cost (highest in ASEAN)** likely to incentivize innovation in energy efficiency tech	**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**
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	**Lack of strong regulations enforcement by government** **Lack of incentives** for sustainable building operations	No agreed prices (FiT); **unclear regulatory timeline for commercial structure** (e.g., green auction, PPA) **~90% offshore wind potential is found in deep waters (>50m),** requiring floating offshore wind turbines, potentially **increasing costs and technological complexity** **Lengthy and complex** procedures to obtain project permission

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

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)

Key details	**Peak**	**emissions by 2030**
	3%	of total energy demand to be **met by solar** by 2030
	80%	of **green buildings** by 2030
Challenges	**50%**	**emissions reduction** by 2050 (vs. 2030 peak); faces space constraints for utility-scale renewables development
	Lack	energy to be imported from **low-carbon sources by 2035**, posing implications for energy security; need to **secure alternative options**

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)

Continue to de-risk DeepTech and ClimateTech investments through preferential tax rebates to investors and dedicated co-investment schemes

Provide **fiscal and non-fiscal incentives to both local and foreign acquisitors**, and work with domestic exchanges to **streamline early offerings of DeepTech companies**

Ambiguity + conflicting incentives

Legend: Positive outlook | Uncertain outlook | Challenging outlook

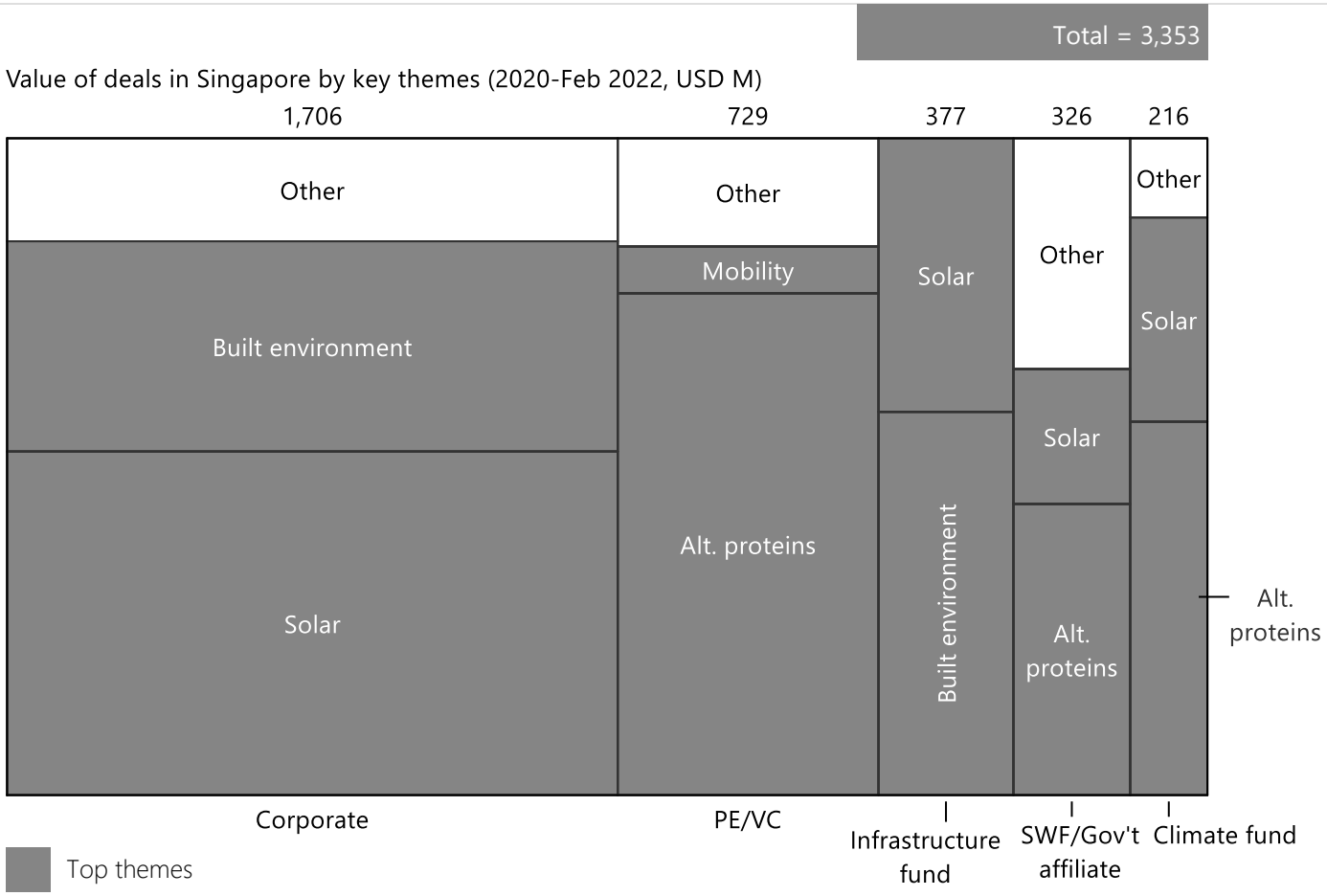
ENERGY	**Limited options** for power sector decarbonization due to geographical constraint on renewables. **Green H2** shows promise but takeoff expected only in mid 2030s	All new car and taxi registrations to be **cleaner-energy models by 2030**. Further ramp-up of EV charging infrastructure and **accompanying 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
2030 TRAJECTORY	↘	↗	↗	↗ ↗

Note: (1) I&C: industrial & construction

Source: EIA; UNFCCC; NEA; Climate Action Tracker; EMA; Power Technology; Green Plan; The Straits Times; CNBC; The Edge; SBTi; CityWire Asia; Company websites; Lit. search; Bain analysis

Green investments continue to grow across asset categories, with alternative proteins gaining spotlight

Investment flows[1]



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[2]:

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

Highest investment potential

	Forest conservation **Opportunity:** Project origination, feasibility, development & design, and Carbon credit sales and trading	★ Built environment **Opportunity:** Efficient cooling and green building products
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) **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

Acronym		Acronym		Acronym	
1M5R	"1 must 5 reductions" – VN national policy to promote best practices in lowland rice cultivation	FTA	Free Trade Agreement	MoU	Memorandum of understanding
2W	Two-wheelers (e.g., motorbike)	GDP	Gross domestic product	MRV	Monitoring, reporting, and verification (of carbon credits)
3W	Three-wheelers (e.g., tricycle)	GE	Green Economy	Mt	Metric ton
4W	Four-wheelers (e.g., car)	GHG	Greenhouse gases	MtCO2e	Megatons of CO2 emissions
AC	Air conditioning	GLC	Government-linked companies	MW	Megawatt
ACE	ASEAN Center for Energy	GP	General partners	MWp	Megawatt peak
ADB	Asian Development Bank	Gt	Gigaton	NAMA	Nationally appropriate mitigation actions
AEDP	Alternative Energy Development Plan	GtCO2e	Gigatons of CO2 emissions	NCCC	National Climate Change Committee
Agtech	Agriculture technology	GW	Gigawatt	NDC	Nationally Determined Contributions
APAC	Asia-Pacific	H2	Hydrogen	NGO	Non-governmental organization
APG	ASEAN Power Grid	ha	hectares	O&G	Oil and gas
ASEAN	Association of Southeast Asian Nations	HDV	Heavy duty vehicle	O&M	Operations and maintenance
BAU	Business-as-usual	HVAC	Heating, ventilation, and air conditioning	OECD	Organisation for Economic Co-operation and Development
BCA	Building and Construction Authority	I&C	Industrial and construction	OEM	Original equipment manufacturer
BEV	Battery electric vehicle	ICE	Internal combustion engine	PE	Private equity
BREEF	Building Retrofit Energy Efficiency Financing	ICT	Information and communications technology	PPA	Power purchase agreement
C&I	Commercial and industrial	IDEA	India Digital Ecosystem of Agriculture	PV	Photovoltaic
CAPEX	Capital expenditure	IFC	International financial corporation	R&D	Research and development
CCUS	Carbon capture, utilization, and storage	IOT	Internet of things	RAC	Refrigeration and air conditioning
CEA	Controlled environment agriculture	IRR	Internal rate of return	RE	Renewable energy
CO2	Carbon dioxide	JV	Joint venture	REDD+	Reducing emissions from deforestation and forest degradation
COP	Conference of the Parties	KPI	Key performance indicator	REIT	Real Estate Investment Trust
CPG	Consumer packaged goods	kWh	Kilowatt-hour	ROI	Return on investment
DCS	District cooling system	LCOE	Leveralized cost of electricity	RPS	Renewable portfolio standards
E2E	End-to-end (from beginning to end)	LCU	Local currency unit	SASB	Sustainability Accounting Standards Board
E2F	Energy Efficiency Fund	LCV	Light commercial vehicle	SBTI	Science-Based Targets initiative
EBIT	Earnings before interest, and taxes	LDV	Light duty vehicle	SEA	Southeast Asian nations; Bain GE report scope includes Indonesia, Malaysia, Singapore, Thailand, Philippines, and Vietnam
EBITDA	Earnings before interest, taxes, depreciation, and amortization	LED	Light-emitting diode	SME	Small and medium enterprises
EDGE	Excellence in Design for Greater Efficiencies	LP	Limited partners	SWF	Sovereign wealth fund
EOY	End-of-year	LTV	Loan-to-value	tCO2e	Tons of CO2 emissions
EPC	Engineering, procurement, and construction	m	Meter	UNFCCC	United Nations Framework Convention on Climate Change
ESG	Environmental, social, and governance	MAC	Marginal abatement cost	VALCOE	Value-adjusted leveralized cost of electricity
ETS	Emissions trading scheme	MFI	Microfinance institution	VAS	Value-added service
EV	Electric vehicle	MNC	Multinational corporation	VAT	Value-added tax
FiT	Feed-in tariff	MNO	Mobile network operator	VC	Venture capital