Stockholm Environment Institute

Perceptions of climate-related investment risk in Southeast Asia's power sector

SEI Working Paper
January 2020

Peter du Pont

Cannelle Gueguenteil

Oliver Johnson

Stockholm Environment Institute
Linnégatan 87D 115 23 Stockholm, Sweden
Tel: +46 8 30 80 44 www.sei.org

Author contact: Peter du Pont
peter.dupont@asiacleanenergypartners.com
Editor: Tom Gill
Layout: Richard Clay
Cover photo: Power plant, Bangkok © Akaradech Pramoonsin / Getty

Stockholm Environment Institute is an international non-profit research and policy organization that tackles environment and development challenges.
We connect science and decision-making to develop solutions for a sustainable future for all.
Our approach is highly collaborative: stakeholder involvement is at the heart of our efforts to build capacity, strengthen institutions, and equip partners for the long term.
Our work spans climate, water, air, and land-use issues, and integrates evidence and perspectives on governance, the economy, gender and human health.
Across our eight centres in Europe, Asia, Africa and the Americas, we engage with policy processes, development action and business practice throughout the world.

Contents

Abstract

Given the growing international pressure to mitigate climate change and increasing fears around climate impacts, current expectations of continued investment in fossil fuels in Southeast Asia's power sector appear puzzling. This paper explores how power sector investors perceive climate-related risks and how they factor these risks into investment decision-making. In doing so, we seek to explain (a) why countries in Southeast Asia are making plans for – and investors are continuing to invest in – fossil-based power generation instead of renewable or clean generation options, and (b) what it would take to substantially shift investment from fossil generation into renewable options in the region. In order to understand how investors in Southeast Asia considered climate-related risks when making investment decisions, we undertook interviews with 17 industry experts working in Southeast Asia's power sector.

Overall, the results from our analysis suggest that there is currently a significant gap between the need to integrate climate risks within investor decision-making and the way these risks are currently being integrated and addressed in the Southeast Asia power sector. Our analysis shows that climate risk is either not a significant factor, ignored in light of other concerns, or only superficially integrated into decision-making. We discuss the factors behind these findings and question the assumption that risk is one of the main drivers of investment decision-making. We draw attention to other important factors, seldom reviewed in the literature, that lead investors in the power sector in Southeast Asia to either actively avoid, downplay, or ignore the potential impact of climate risks.

The results of this research point to an urgent need for action targeted at energy-sector investors in order to:

- shed light on climate-related investment risks
- share information on the likelihood and magnitude of risks
- lay out clearly the potential for stranded assets in a 10 to 15-year time frame, and
- encourage transparent, open and respectful dialogue and discussion on these critical issues.

1. Introduction

Over the last two decades, economic growth in Southeast Asia has been accompanied by large increases in energy demand. Over the next two decades, this growth in energy demand is expected to continue. Projections made by the International Energy Agency (IEA) suggest an increase in demand of around two thirds, accompanying a regional economy that almost triples in size, a population that rises by almost a quarter to 760 million, and the proportion of the region's population living in cities rising to nearly two thirds (IEA 2017a).

Despite large potential for renewables (REN21 2019), fossil fuels currently dominate the energy mix, accounting for 70% of total energy demand, and this dominance is expected to continue (IEA 2017a). This raises significant concerns about energy infrastructure assets that may be climate-vulnerable and could potentially become stranded assets – defined by Bos and Gupta (2019, p.1) as "assets that lose economic value well ahead of their anticipated useful life". Mercure et al. (2018) estimate the potential for a global wealth loss from stranded assets as US$1–4 trillion. While in some regions of the world such concerns about stranded assets are being translated into action through decisions on energy infrastructure investments (e.g. see Buckley 2019), it is not clear how seriously these concerns are being taken by investors in Southeast Asia.

In this paper, we explore how investors in the power sector in Southeast Asia make decisions about their investments. In particular, we analyse the factors that might be driving investors toward cleaner investments (or not). In doing so, we explain (a) why countries in Southeast Asia are making plans for – and investors are continuing to invest in – fossil-based power generation instead of renewable or clean generation options, and (b) what it would take to substantially shift investment from fossil generation into renewable options in the region. To answer these questions, we analyse how investors in fossil-based power supply perceive climate-related risks and how they factor these risks into investment decision-making in the region's power sector.

2. Growing pressure to rethink energy investments

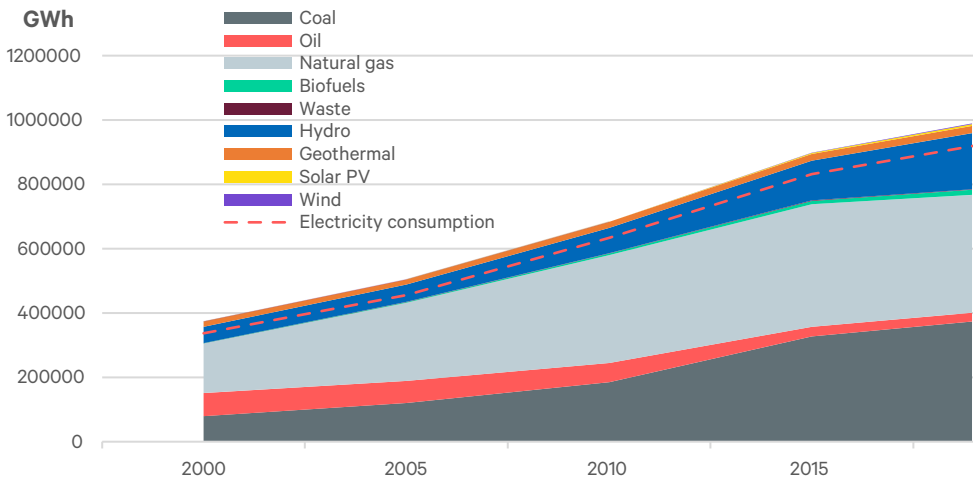
In April 2019, the Governor of the Bank of England, Mark Carney, warned the global financial sector that it could face severe losses if it did not start paying more attention to climate change risks when considering where to invest (Partington 2019). Carney stated that pressure to rethink energy investments comes from two sides: the need to act on climate mitigation commitments and increasing awareness of energy infrastructure investments that may be increasingly vulnerable to climate impacts. This is especially a challenge in Southeast Asia, where many countries view fossil fuels as a low-cost means of meeting growing energy demand and powering their fast-growing economies.

2.1 Continued use of fossil fuels in Southeast Asia

Recent economic growth in Southeast Asia has been coupled by significant increase in energy demand. Between 2000 and 2016, primary energy demand grew by approximately 70%, driven by a range of factors, including rising incomes, continued urbanization, increased energy access and population growth (IEA 2017a). Fossil fuels dominate the energy mix in the region, accounting for 70% of total energy demand. The uptake of renewables remains limited: there has been expansion of large hydropower projects in Cambodia, Myanmar and Lao PDR, but the use of non-hydro renewables has been sporadic and generally limited (for example, solar PV in Thailand or biogas in Indonesia) despite abundant renewable energy resources.

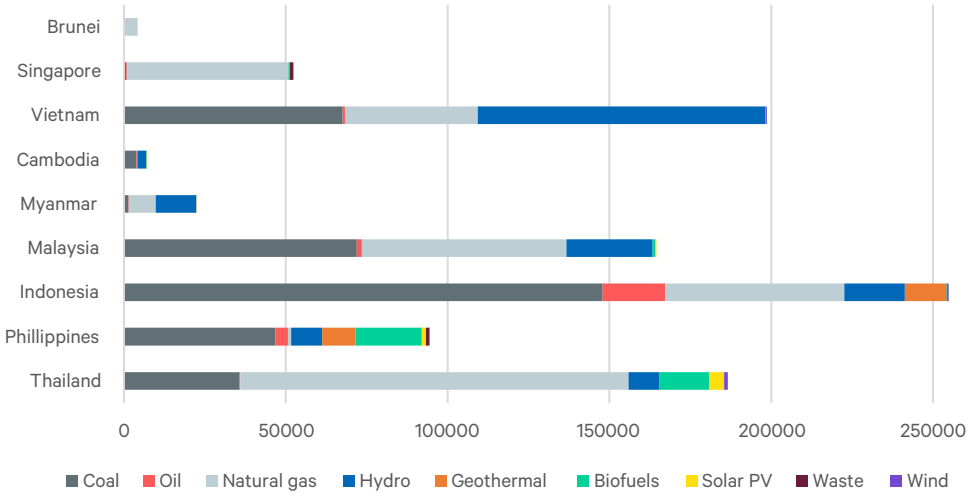
Figure 1 shows the electricity generation mix and consumption from 2000–2017 in the 10 member states of the Association of Southeast Asian Nations (ASEAN), and Figure 2 shows a snapshot of the electricity generation mix in ASEAN countries in 2017.

Figure 1. Electricity generation by source and consumption, ASEAN 2000–2017



Source: IEA (2019)

Figure 2. Electricity generation by source across ASEAN countries, 2017

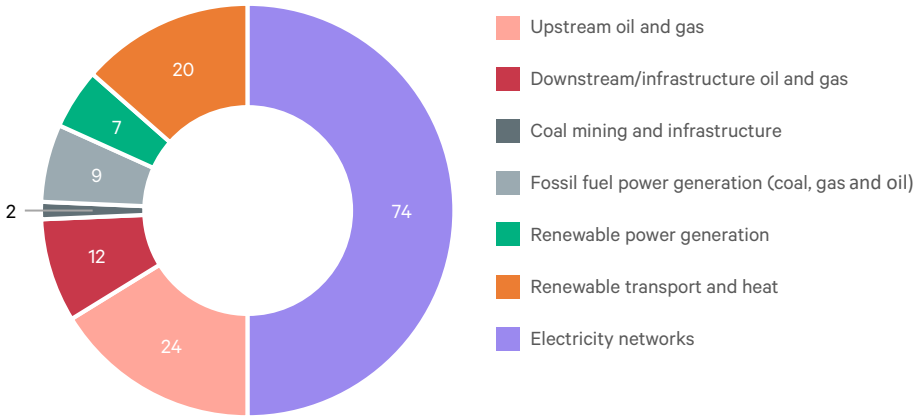


Source: IEA (2019)

The growth in Southeast Asia's energy demand is expected to continue: IEA projections suggest an increase of around two thirds, up to 1000 million tons of oil equivalent (Mtoe) by 2040, accompanying a regional economy that almost triples in size, a population that rises by almost a quarter from 640 in 2016 to 760 million, and the proportion of the region's population living in cities rising by almost two thirds. The power sector shapes the IEA's energy outlook for Southeast Asia as electricity demand is expected to more than double by 2040, reaching 565GW of power generation capacity. Although it is possible for renewables to cost-effectively meet much of this demand (IRENA 2018), the largest increases in supply are expected to come from coal and gas, with large hydro also playing an important role (IEA 2017a). This is a major concern for global climate change mitigation efforts, given that current fossil fuel infrastructure already puts us past a 1.5°C target (Tong et al. 2019).

As shown in Figure 3, energy infrastructure investment in Southeast Asia largely goes into fossil fuels and electricity networks. Much of the continued dependence on fossil fuels is a result of subsidies and national objectives to exploit domestic energy resources. Globally, the value of subsidies for production and consumption of fossil fuels and related technologies is estimated at around US$ 5 trillion (Coady et al. 2019). Countries in Southeast Asia have recently made significant efforts to reform fossil fuel subsidy regimes: fossil fuel subsidies in the region have slowly decreased from US$ 51 billion in 2012 to US$ 17 billion in 2015 (US$ 9 billion in electricity and almost US$ 8 billion in oil).[1] However, much work needs to be done to further decrease subsidies (Bridle 2019).

Figure 3. Energy investment in Southeast Asia by fuel (US$ [2016] billion)



Source: IEA (2017b)

2.2 Pressure to invest in cleaner energy infrastructure

As part of its global commitments to reduce carbon emissions during the coming decades, ASEAN has set a target across its member countries of reducing energy intensity 20% by 2020 and 30% by 2025 compared to a business-as-usual scenario, and reaching a 23% share of renewable energy in total primary energy supply by 2025 (ASEAN Centre for Energy 2015).

Recently, many large multinationals have been making pledges to reduce the carbon intensity of their energy investments. For example, in 2016 global power producer Engie pledged to divest US$ 15.1 billion of its fossil-based assets during 2016–2018, and to reinvest in lower-carbon, distributed, and renewable energy assets (Baker 2016). And in 2018, AES, another global power producer, announced a goal to reduce its carbon intensity by 70% by 2030 and to shift its energy asset holdings from fossil-based energy production into renewable energy. Indeed, AES is the first publicly-traded owner of utilities and power companies based in the US to disclose the resilience of its portfolio, consistent with the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) (AES 2018; TFCD 2017). Similarly, Sembcorp, a Singapore based regional power producer, has pledged to reduce its CO2 emissions by investing in energy efficiency improvements, expanding its gas and renewables portfolio, and developing new models for green business, products, and services (Sembcorp 2018).

However, it is not clear at all how these commitments will translate into action in terms of investment decisions and asset allocation. A 2018 report by Ceres analysed 600 of the largest companies in the US and found that, while around two-thirds (64%) of the companies made commitments to reduce greenhouse gas emissions, only slightly more than one-third (36%) set time-bound, quantitative targets. Even more concerning is that only one quarter of those

1 The latest decrease owes much to low oil prices, which allowed Indonesia, Thailand and Malaysia to push through further subsidy reform without much opposition.

targets would contribute toward reducing emissions in line with what is needed to keep global warming below 2°C (Ceres 2018). And despite climate risk likely to become a standard element in the fiduciary duties of officers of all multinational corporations (TFCD 2017),[2] investors and fund managers in some developed countries are only beginning to become aware of the importance of identifying and managing climate-related risks. In a 2018 survey, more than 60% of 562 respondents from six ASEAN countries agree that "investors and fund managers would reduce their investment exposure to high carbon assets and businesses" (Eco-Business Research 2018, p.6).

2.3 Vulnerability of energy investments to climate-related risks

It is clear that industries and businesses worldwide will be affected by climate change and climate risks and this will significantly influence their business strategies and decisions. Dietz et al. (2016) estimate that global financial assets worth US$ 2.5 trillion are directly at risk from physical effects of climate change. And a technical bulletin by the Sustainability Accounting Standards Board (SASB) found that 72 out of 79 US industries (accounting for 93% of the capital markets, or US$ 27.5 trillion) face climate risks more broadly (SASB 2018a). The private sector is increasingly responding to these risks, not least as pressure grows to divest from investments in companies that work in fossil fuels.

More than 1100 institutions worldwide have committed to divesting fossil fuel assets at a total value of over US$ 11 trillion.[3] For example, the Fourth Swedish National Pension Fund (APA) recently decided to divest from 22 coal companies (Environmental Finance 2018). Additionally, climate risks are increasingly affecting the insurance industry, which is on high alert about the climate change issue, as insurers have been paying back an increasing amount of weather-related claims (University of Cambridge Institute for Sustainability Leadership and PwC 2016).

2.4 How do investors assess risk in their investments?

An investor is a person who commits capital to some endeavour with the expectation of achieving a profit, usually on behalf of a legal entity with a set of financial liabilities and assets, such as a corporation or limited liability company. Liabilities refer to the responsibilities of the investor and/or the legal entity. Assets refer to any resource of economic value held by that entity, such as financial assets (e.g. equity or bonds). When deciding on how to invest their assets – or the assets of their organization – investors seek to identify "how best to allocate the assets between asset classes to minimize the risk of not meeting its liabilities at the lowest cost" (Silver 2017, p.99), in other words, how to generate profits while minimizing risks (Mayo 2019). In order to do this, an investor will decide upon a range of asset classes to invest in, each of which will have different degrees of potential risk and return.

Decisions on which types of asset to invest in depend on a variety of factors. One is the type of institution on behalf of which an investor is acting. Its governing constitution may play a role (including the board of the institution, its fiduciary duties and the level of risk it is willing to take), so might the size of the institution, practical considerations (for example, the cost of investing in an asset class), professional practice, ethics and other codes of conduct and regulations (Silver 2017). Another factor is individual investors – their education, experience, mindset, attitude to risk, financial knowledge, sector knowledge, and discretion over the portfolio (Baker et al. 2017; Hirshleifer 2015). Decisions around power sector investments will also be affected by the nature of the investment – whether the project is bankable, the availability of a solvent and reliable "offtaker"[4] to buy the power, whether the project is creditworthy, the legal framework of the country in which it is based and how disputes are adjudicated in that jurisdiction, and the level of

2 E.g. the TCFD report recommends that climate-related financial disclosures be provided in mainstream (i.e. public) annual financial reporting (page iv).
3 See: gofossilfree.org
4 An offtaker is an entity that buys the power from a power station. Usually this is a state-owned electricity company.

guarantees in place to mitigate risks (Koh 2018). Investors will rely on both formal risk accounting and informal networks to identify issues and risks associated with an investment.

All of these and other factors will influence the level of risk power sector investors are willing to take, including risks related to climate. With this in mind, we seek to understand how, if at all, are climate-related risks factored into decisions to invest in power plants in Southeast Asia?

3. Research approach for analysing climate-related investment risks

In this section, we set out or research approach for analysing climate-related investment risks, including the guiding framework and research design.

3.1 Climate-related risk framework

The Intergovernmental Panel on Climate Change (IPCC), broadly defines risk as "the potential for consequences where something of value is at stake and where the outcome is uncertain" (IPCC 2014, p.127). From this definition, climate-related risk is typically understood as a function of the probability of a certain hazardous climatic event multiplied by the severity of impacts and the vulnerability to those impacts. This definition allows for direct risks associated with exposure to certain hazardous climatic events (e.g. flooding of a power station or destruction of transmission infrastructure due to a storm) and indirect risks associated with exposure to actions related to reducing or reacting to direct risks (e.g. regulations on carbon emissions or on how power stations must plan for hazardous events).

Our framework to analyse physical and transition climate risks in more detail draws on the work of TFCD (2017) and Clapp et al. (2017), where direct and indirect climate risks are described as physical and transition risks, respectively (see Figure 4).

- **Physical risks** comprise risks related to potential changes in the physical environment, such as extreme weather events linked to climate change, which may disrupt assets and operations, and the economic value chains and communities in which power plants operate. These risks can also include risks to the availability of resources, such as water, and long-term weather changes, e.g. in wind patterns and solar irradiance.

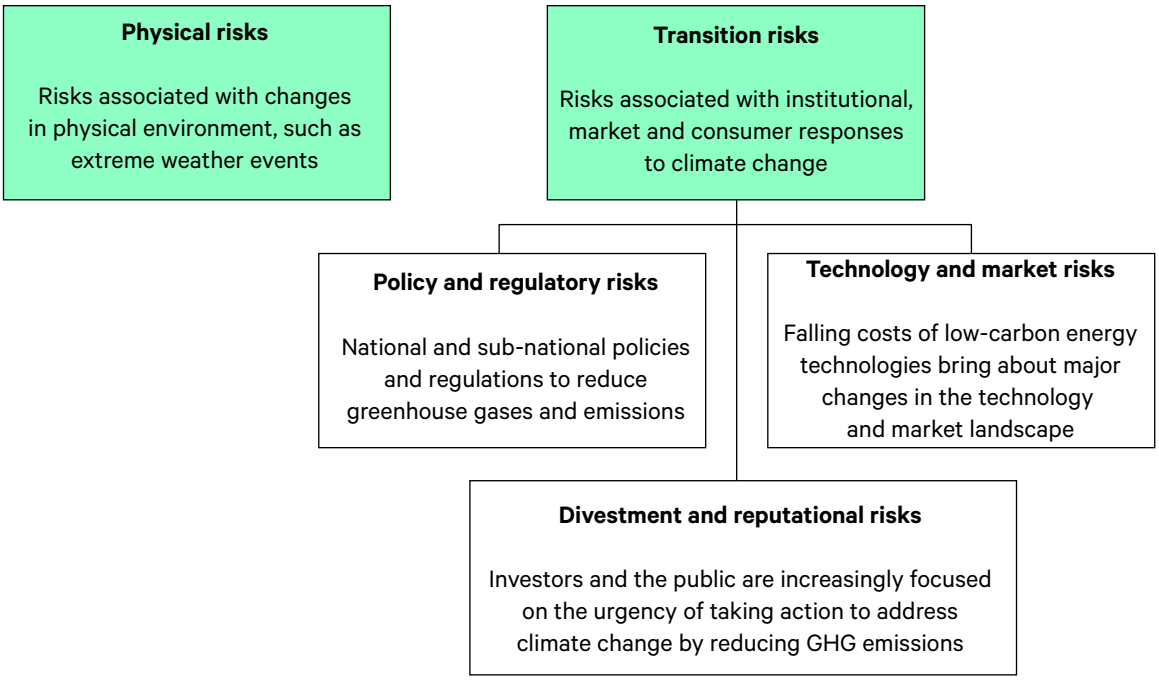
- **Transition risks** comprise risks related to potential responses to mitigate and adapt to climate change by governments, regulators, private sector competitors, consumers and concerned citizens, which may lead fossil fuels assets to become devalued and even stranded. We separate these transition risks into three categories:

  - **Policy and regulatory risks:** These risks include the range of legal, regulatory, policy, and liability issues related to climate change that affect energy investments. For example, governments may set a price for carbon emissions or restrictions on the use of certain energy sources (SASB 2018b); central banks may incorporate enhanced risk measures into financial regulations (Campiglio et al. 2018); and legal systems might increasingly consider liability claims for climate harms, or for damages associated with stranded assets (Burger and Wentz 2018; Ganguly et al. 2018).

  - **Technology and market risks:** Falling costs and improved performance of new and emerging technologies such as photovoltaic, energy storage, smart grids and downstream technologies (including electric vehicles and decentralized generation) are bringing about significant changes in the energy landscape. As a result, the needs of power markets and customers will change.

– **Divestment and reputational risk:** Pension funds, asset managers, and shareholders are increasingly focused on the impact of climate change and how energy companies respond to climate-related risks and opportunities. There is significant pressure from many of these stakeholders to divest from investments in coal power plants and other fossil-fuel energy assets.

Figure 4. Categories of climate-related risks



Source: Adapted from TFCD (2017) and Clapp et al. (2017)

3.2 Research design

We sought to understand how institutional investors in Southeast Asia consider different climate risks when making investment decisions. Our framework for analysing climate-related risks focuses on developing a practical understanding of how investors perceive climate risks, and our analysis had two components. First, we sought to explore how different physical and transition climate risks were perceived by investors. Second, we sought to understand how those climate risks were factored into investment decisions, including whether they raised concerns over potential for stranded assets – assets that unexpectedly or prematurely become devalued or converted into liabilities (De Lorenzo and Enkvist 2018).

Over the period June 2018 to February 2019 we undertook interviews with 17 industry experts working in Southeast Asia's power sector (see Table 2). Interview respondents included investors in both equity investing and lending, as well as investment experts who work as advisors, consultants and insurers. Respondents were selected non-randomly by drawing on existing networks to identify key actors, and by using the "snowball" technique with these key actors to identify further relevant respondents. We asked respondents questions about how they understood, assessed and made decisions around physical and transition risks, including whether they consider stranded assets to be a significant risk in the Southeast Asia power sector. We asked investors to reflect on how they factored different risks into their own investment decision-making. We also asked those who were not investors to reflect on their experience of how investors factored the different risks into investment decision-making.

Table 1. Summary of respondents

No	Affiliation	Sector	Country
1	Symbior Energy	Equity investor, energy project developer	Hong Kong, Bangkok
2	ERM Siam	Management consultant (energy and environment)	Thailand
3	Deloitte	Energy consultant (previously equity investor)	Thailand
4	DBS	Bank (energy sector debt)	Singapore
5	UN Economic and Social Commission for Asia-Pacific	International development organization	Bangkok
6	Re-Ex Capital	Transaction advisor, project developer, equity investor,	Singapore
7	SouthPole	Management consultant (climate and energy), equity investor	Thailand
8	Asian Development Bank	International financial institution (equity, debt)	Philippines
9	Infunde Development Pte. Ltd.	Equity investor, transaction advisor	Singapore
10	Institute for Energy Economics and Financial Analysis (IEEFA)	Financial research institute	Indonesia
11	Cenergi Southeast Asia	Equity investor, energy service company (ESCO)	Malaysia
12	Overseas Private Investment Corporation (OPIC)	Bilateral financial institution (debt, insurance)	Bangkok
13	Vector Energy Associates	Equity research, transaction advisor	Singapore
14	Ariel Re, Lloyd's Syndicate 1910	Insurer (energy sector projects)	Hong Kong
15	ClimateWorks Foundation	Charitable foundation	US
16	Climate Bonds Initiative	Association/non-profit working in investment	London
17	Institute for Energy Economics and Financial Analysis (IEEFA)	Financial research institute	Philippines

Data analysis involved compiling and coding interview notes and transcripts with reference to how the different physical and transition risks played a role in investment decision-making. Our analysis combined insights from investor respondents and non-investor respondents to present common themes and alternative perspectives.

4. Investor perspectives on climate-related investment risks

This section presents analysis of how climate-related risks are perceived by power sector investors in Southeast Asia, based on insights from our interviews with key stakeholders in the sector. It covers physical risks, three types of transition risks, and stranded assets.

4.1 Physical risks

In terms of investment in the energy sector, the physical risks of climate change refer to the increased likelihood of extreme weather conditions and events, and how these would impact on power generation assets. Generally, these physical risks were considered a well-understood factor in investment due diligence.[5] And, according to one investor, growing concern over potential physical risks in an increasingly uncertain climate meant environmental and social impact assessment had become even more important as a due diligence tool: investors expected them to be more detailed and exhaustive than before in order to better support investment decisions and to also ensure that projects would be considered "bankable". Respondents noted that projects have become more costly, and one interviewee suggested that physical risks may account for up to 10–15% of project costs.[6]

5 Interviews 8, 9, 10 and 11
6 Interview 6

At the same time, concern over the increased likelihood of extreme weather events has led many project developers and investors to look at options for insurance. One respondent explained the preference of investors to spread insurance exposure among a number of reinsurers across the region.[7] Although insurance could be used for new technologies, in geographical areas subject to extreme events, such as typhoons, it is now difficult to get insurance at an affordable rate (Booth 2018; Neslen 2019).

In both cases, respondents highlighted the importance of using climate risk data to better understand climate-related risks. One respondent described how the development of a national data platform for data on meteorology and climatology in the Philippines was being used by project developers to assess, understand, and mitigate climate-related risks that could affect project viability.[8] They explained that the enhanced mitigation measures were adopted by the project developer after reviewing data on weather and storm surges in the national data platform: data from the platform showed that potential storm surges at the proposed plant location were historically between 2.2 and 3.2 metres, but could potentially rise to as high as 5 metres.[9]

4.2 Transition risks: policy and regulatory risks

We use the term policy and regulatory risk to refer to current or potential regional and national policies and regulations to reduce greenhouse gas emissions. In ASEAN, member states have agreed to reduce their overall energy intensity by 20% by 2020 and 30% by 2025, compared to a business-as-usual scenario, and to reach a 23% share of renewable energy in total primary energy supply by 2025. At the national level, commitments have been outlined in Nationally Determined Contributions (NDCs) under the 2015 Paris Agreement.

A majority of respondents considered policy and regulatory risk to be a potentially significant risk to fossil fuel investments in the power sector, although currently having little impact until mandatory climate regulations such as carbon pricing or restrictions on fossil power plants gained traction in Southeast Asia. Instead, public funding – through state subsidies and export credit guarantees – was continuing to push fossil-based technologies.[10] Indeed, export credit agencies from countries such as Japan and South Korea were considered to bear a major responsibility for continued plans for large investments in coal power plants across Southeast Asia, especially in Vietnam and Indonesia, and to a lesser extent in Myanmar.[11]

Respondents cited instances of investors and project developers diversifying away from fossil fuels as part of a long-term strategy for firms to balance their portfolios to minimize risk from climate regulation in the distant future.[12] For example, Banpu Public Company, an incumbent independent power producer (IPP) in Thailand with a regional coal business, has begun moving fairly steadily to becoming a renewables-based company as part of its corporate strategy.[13] However, a number of respondents noted that most investors tended to use power purchase agreements (PPAs) to shield themselves from policy and regulatory risk. A PPA forms the contract between the generator of electricity and the buyer of the electricity (in many cases the state-owned electric utility) and is the foundational document for nearly any power sector investment. It outlines the terms and conditions under which the power plant will get paid and lenders will get repaid. What makes a project bankable is the certainty of repayment, and the PPA is often long-term – e.g. 15 or 20 years –offering certainty of revenue. Lenders typically look at how soon the capital investment into a power plant can be repaid, and whether this matches with the term of PPA.[14] Rather than integrating climate regulatory risk holistically within

7 Interview 14
8 Interview 17
9 The platform is PAGASA – the Philippine Atmospheric, Geophysical and Astronomical Services Administration (bagong.pagasa.dost.gov.ph).
10 Ibid
11 Interview 4. See also Bengali (2019).
12 Interviews 9 and 12
13 Interview 10
14 Interview 4

the decision-making process, the strategy to deal with policy and regulatory risk was often to secure a PPA that shifted liability for any future changes to the state-owned utility, as one interviewee described:

> *They [investors] protect themselves from worrying about such regulations through the way the PPAs are written. They are ironclad, shifting the liability to the state-owned utility, which is associated with the government that makes the rules.*[15]

On the other hand, PPAs for renewable energy projects often get much less protection. For example, the recently issued PPA associated with the solar PV feed-in tariff in Vietnam is not investor-friendly, because it has none of the standard protections that would be required by international banks and investors in order to finance a project.[16] In nearly all of the Southeast Asian countries, there is an incumbent state-owned utility that controls access to the grid and is pushing back against deregulation of generation and transmission and against open market access (Sen et al. 2018). At the same time, the incumbent, who may be working to stop or stall regulations to open the market to renewable energy, may be the same company that will be the offtaker of the electricity from new power plants. One respondent described the situation like this:

> *The bankability of a project in this context depends on a long-term contract, and whether the equity investor or the bank has enough confidence that the offtake contract for the power will provide enough assurance that the payments over time from the generation will amortize the cost of the investments.*[17]

Some respondents argued that the focus of climate regulations should be to address the issue of climate risk holistically, and to be "very forward looking and to provide safe exits for fossil assets in the future",[18] and to "transform a system like this"[19] rather than to enable investors to shift the burden of climate regulatory risks to future consumers. Respondents pointed to precedents in countries such as Germany, which have initiated regulatory efforts to devise long-term plans to phase out fossil fuels, including avoiding, or "working out" stranded assets. Some of the regulatory efforts include obligations on behalf of utilities to not invest in coal, while also giving them the right to use revenues from operating assets for investments into their diversification strategy; as well as compensatory payments for non-delivered electricity production and for commitments to exit fossil investment.[20] Such policies were seen by respondents as a way to "negotiate transformation" of the climate risks rather than displace the risks. One respondent put it bluntly:

> *In the absence of such pathways, or off-ramps, incumbents are very likely to entrench themselves in their position and take a very defensive and not constructive role in the transformation … What I would hope for is that we use climate related regulations to become very forward looking and to provide safe exits for fossil assets in the future – so regulation introduced for the purpose of ensuring soft landings.*[21]

4.3 Transition risks: technology and market risks

The second transition risk relates to the technology and market risks associated with climate change and includes the falling costs of renewable and emerging new energy technologies, which are bringing about major changes in the technology and market landscape. These changes will make fossil fuel investments less competitive and more expensive in the long-run (Bond 2018).

15 Interview 7
16 Interview 12
17 Interview 12
18 Interview 7
19 Interview 9
20 Interview 7
21 Interview 7

Despite the disruptive power of renewables, which have already gained significant investment in the region, respondents generally agreed that the power market structure in Southeast Asia limits the speed at which technology and market changes will occur in the future.[22] For example, Indonesia's vertically integrated and fully state-owned utility, PLN, has a relatively young fossil fuel asset base and a national grid designed to cater to dispatch large baseload power plants through high voltage lines to demand centres, often located far away from generation sites. Transforming such a physically and institutionally embedded power system will be a slow and awkward process. The technology already exists, but it will not be until regulation and incentives are put in place that the power market becomes more decentralized.[23]

Even so, investors and project developers in Southeast Asia's power sector seek to mitigate against technology and market risks through conditions set out in PPAs. This is similar to how PPAs are used to mitigate against policy and regulatory risks. As one respondent noted:

When it comes to thermal power, the technology risk in the context of climate change is that the price of renewables will come down so quickly that it undercuts the delivered cost of the thermal power. This is why having a long-term PPA, which locks in the price paid to the generator over a long period, is essential to help mitigate technology risk.[24]

Interestingly, one of the key market risks that was not discussed in detail by many respondents was equity in risk allocation. For example, none of the respondents directly raised the issue of who bears the risk of changing fuel costs. In nearly all PPAs in ASEAN countries, the offtaker – usually the utility – takes 100% of the risk of changes in fuel costs, and the investor or operator of the power plant is compensated for any changes in fuel costs via a pass-through payment. By contrast, in Europe and many locations in the US, the investor or operator of a power plant takes the risk of changing fuel costs.

It would have a significant impact on investment in coal power plants in ASEAN if governments and utilities in ASEAN were to make such a change in their PPA agreements. The status quo in ASEAN markets is that the owners of fossil assets are very well protected, and all risks are shifted to the offtaker – usually state-owned utilities – and their customers, who may need to pay higher prices.

4.4 Transition risks: divestment and reputational risks

The third transition risk is divestment and reputational risk. This refers to the likelihood of increasing investor commitment and public pressure to take urgent action to reduce greenhouse gas emissions, leading to reduced interest in owning existing or financing new fossil fuel power generation assets. According to our respondents, divestment risk was not a major driver of investment trends in Southeast Asian energy markets: public awareness campaigns and publicly listed companies concerned with reputation were not so prevalent as compared with Western countries. As one respondent put it:

Divestment works when you have publicly listed companies and when there is information transparency and stakeholder pressure. But that just doesn't exist here [in Southeast Asia]. Many of the large firms are family conglomerates, and private owned companies that often lack transparency.[25]

However, pressure to divest does appear to be working indirectly in Southeast Asian energy markets through global corporate procurement requirements for green energy. According to two respondents, while there is limited awareness of climate risks to equities among local or regional

22 Interview 7
23 Interview 10
24 Interview 4
25 Interview 7

equity investors, there is much greater awareness in international asset management firms.[26] Corporate buyers in these firms are becoming part of a green investment lobby for renewable energy regulations in several Southeast Asian countries. For example, in 2016 the Norwegian Central Bank divested between nine and ten billion US dollars of global pension fund investments from 52 companies that involved coal as a significant part of their business activities, including investments in Aboitiz Power, a major independent power producer in the Philippines (Zillman 2016; Power Philippines 2016).[27] According to one respondent, the impact of that decision has been for other IPPs in the country to take steps to diversify their investments into renewable energy, some of which were invested overseas because they could not identify investments in the Philippines within a suitable time frame.[28]

4.5 Stranded assets

Transition risks raise serious concerns over stranding of fossil fuel assets in Southeast Asia. Nearly all of the respondents (14 out of 17) indicated that stranded assets were a serious issue, and that they could have a significant impact on the balance sheet of companies, as well as on government budgets, in the next 20 years. With the price of coal generation stable or increasing, and the price of renewable energy and storage decreasing, and with natural gas available in many countries, there could be a significant economic price to be paid for commitments to coal power plants over the next 10 to 20 years.[29]

Already, the Philippines has an estimated 10GW of planned coal assets worth US$ 21 billion at risk of being stranded in the future (Ahmed and Logarta 2017). As retail competition has enabled manufacturers and other large customers to seek the cheapest power options, utilities have started to see reductions in the utilization rates of their current coal power plants to below the break-even rate required to be able to service debt, let alone repay their loans. Either the cost will be passed onto consumers, or new purchasing power agreements will be issued, and the risk will be transferred back to the investors. Meanwhile, stranded coal assets in India provide a stark lesson for neighbouring Southeast Asia. By 2018, around US$ 40 billion of coal investments in India were considered non-performing assets,[30] causing severe financing stress within the Indian banking sector (Buckley et al. 2019). These non-performing assets in the Indian power sector, arising due to a combination of factors including cancelled coal blocks, aggressive bidding, lack of PPAs, delays in land acquisition and poor infrastructure, amounted to 40.1GW of coal power capacity, of which 15.7GW were not even commissioned (Buckley and Shah 2018; Sharma et al. 2018).

Both the Philippines and India have a liberalized power market with competition in both generation and distribution. For other Southeast Asian countries with more vertically integrated and state-dominated power markets, stranded assets might be considered as less of an immediate threat and there was very little serious discussion among Southeast Asian policymakers about the extent of the stranded asset risk, or how to manage it.[31] Indeed, many respondents appeared confident that, in such countries, incumbent utilities and their government allies would be able to manage the potential threat from stranded assets, at least over the next few years. As one respondent put it, from an economic standpoint:

> *Coal still makes sense and will continue to make sense. I don't think there are other options to bring power on reliably around the clock for Vietnam, for Myanmar, that could offer the same reliability, at the same price. And I think, to the degree that governments view their mandate as providing cheap, reliable power for people,*

26 Interviews 7 and 16
27 The list included 22 firms from the US, seven each from China and India, three from Japan, two each from Australia, Canada, Chile, and Hong Kong, and one each from Greece, Poland, South Africa and the Philippines (Aboitiz Power).
28 Interview 17
29 Interview 4
30 A non-performing asset (NPA) is a loan or an advance where interest on and/or repayments of the principal remain overdue for a period of more than 90 days in respect of the term of the loan. An asset, including a leased asset, becomes non-performing when it ceases to generate income for the bank. See: http://164.100.47.193/lsscommittee/Energy/16_Energy_37.pdf
31 Interview 10

> *I'm not sure that anybody in their shoes would make a different decision. … Over a 10-year window, I don't see that there's going to be sort of a European level of value destruction as coal plants are mothballed and shut down, except in probably what would be a very optimistic battery solution.*[32]

And in political economy terms:

> *Most of those families or corporates that are backing existing [fossil fuel] infrastructure feel as though they can bend regulatory environments to whatever end they might need them to be bent to … any potential losses would be socialized, either by forcing a utility to eat it on their side and not raise electricity rates, or whatever the potential mechanism for recouping that loss would be. So, for the incumbents, it's kind of like heads I win, tails I win.*[33]

5. Analysis of investor attitudes: do they care about climate risks?

While the physical risks of climate change are increasingly apparent and inform investment decision-making to some extent, the transition risks seem to receive limited attention in investment decisions among *local and regional investors in Southeast Asia*. Even when the risks they do receive attention, there are a range of institutional factors that make it challenging or unwise to act upon them.

When analysing the interview results we found it helpful to categorize investor attitudes into three main areas: (a) established habits and perceptions; (b) pressure to commit large sums through established investment channels; and (c) avoidance of the problem and limited governance guard rails. Analysing these three areas can help explain the limited awareness and impact of climate risks on investment decision-making in the Southeast Asia power sector.

5.1 The force of established habits, perceptions, mindsets and institutions

One issue linked to slow change in investor mindsets is the static view of risks within the investment world. This issue has been documented in the literature. Silver (2017) notably points out how the static view of risks in investment models leads to an inability among investors to take into account changing and new conditions, such as climate change. This was a theme that recurred throughout the interviews, notably concerning models of risk analysis. In this sense, there is a question about the capacity of investors to have a flexible and adaptable understanding of risk, as opposed to a static, mechanical calculation. According to the interviews, the conception of risk within investment decision-making in the region's markets is relatively static and is not actively and dynamically re-assessed. This leads local and regional investors to be unaware of, or place very low importance on, climate risks.

Indeed, respondents understood the lack of awareness as a result of the historical market structure of single state power monopolies. This finding illustrates another dynamic at play in the decision-making around investment, which is rarely acknowledged: the role of habit and ease in directing investment towards coal. One respondent summarized the point in this way: "And they know how to do it [invest in fossil-based power plants]. That's the other thing. They have a habit of investing into certain types of power assets, and it's what they know how to do".[34]

32 Interview 13
33 Interview 15
34 Interview 6

One reason behind this dynamic is that investors believe that the "green" energy sector provides lower returns than traditional investments, and therefore they tend to ignore the risks increasingly inherent in traditional fossil investments in order to achieve higher investment returns. This attitude is caused by multiple factors. The first is the relative riskiness and historical low returns of "green" investments—perceptions forged from an era when grid-scale renewable energy was in the early stages of its development in the region.[35] Compared to large coal power plants, renewable energy projects carry the stigma for many investors of being small-scale and more risky. In addition, because of the capital-intensive nature of renewable energy projects, investors have to lock-in capital expenditures in the earlier years and only get return a few years into the investment cycle (usually half according to the respondents).[36] In addition, respondents noted that the risks involved in non-green investments were not borne by the investors themselves, and externalities were not factored into the computation of profit.

5.2 Pressure to spend large sums through established channels

Another, practical factor driving investment into large-scale projects (often coal power-plants) rather than smaller-scale (green) projects, is the need to deploy large amounts of capital, relatively quickly, into familiar investment vehicles. Many investors holding large portfolios face considerable pressure to find projects that are large enough to absorb the funds they have to invest and with which they have plenty of experience, which means they are not taken out of their comfort zone or required to do additional due diligence.

Respondents also pointed out that it is important to distinguish between investors looking for short-term returns and those holding longer-term investments. Short-term investors have an investment cycle of five to ten years, thus they pay little attention to longer-term climate risks, even if the overall performing life of the asset they invest in might be 20 or 30 years.

Similarly, entrenched utility monopolies did not appear to see climate risks as something they need to pay attention to right now in their investment decision-making. Their assets and expertise often lie in fossil-fuel-related technologies and systems, and this makes it difficult to shift organizational focus. Investors need to make sure they have a reliable offtaker for their power over a 10 to 20-year period. Rather than use a risk-based approach, banks and institutional investors often take a formulaic approach to climate risks, relying on compliance guidelines and procedures.[37] While awareness of climate risks in utility investments is gradually increasing, it is not yet causing enough concern to stimulate widespread shifts.

5.3 Limited financial governance

Another issue highlighted by the respondents was the tendency of investors to rely on "repayment" mechanisms and sovereign guarantees to mitigate risk, rather than analyse company fundamentals and perceived climate risks when making an investment. This phenomenon often leads investors toward investments with significant exposure to climate risks. Overall, respondents said that investors tend to adopt an approach toward risk that does not focus on analysing the fundamentals of a company, but rather "mostly go by the ratings"[38] of expected returns.

In the investment market today, there exist a wide range of international and company-specific standards that aim to integrate ethical imperatives such as sustainability into investment allocation. Typically, these were seen by respondents as having created a general negative bias towards certain sectors that carry climate risks such as the coal power-sector. However, respondents pointed out several shortcomings within this area. For example, such standards may

35 EIU 2011
36 Interview 3
37 Interview 5
38 Interview 13

focus on specific metrics such as carbon intensity, rather than on integrating sustainability in a holistic manner. As one respondent, said, "the problem often comes with the short investment cycle. Many investors only come in when the project is close to construction; they have a short-term focus, and don't factor in overall sustainability of the project over its project lifetime."[39] Notably, respondents pointed out that such frameworks are not designed to meet the needs of smaller-scale projects.

Moreover, respondents pointed out that investors exercise a problematically wide margin of decision-making around these standards – notably in choosing to apply an "environmental and social governance-lite" version of a standard. When a risk such as a climate-related risk is identified, in general it is integrated by adding an extra cost to the project; however, as one respondent pointed out, a common practice is often to integrate environmental and social governance concerns by underweighting the index on power, but still holding on to investments in coal.[40] The lack of commitment on the part of investors to little more than surface compliance with investment standards appears to be one of the reasons behind the lack of integration of climate risks.

Does climate risk need to be integrated as an additional "check box", or does it require a change that is deeper and cuts across the very way the decision-making is undertaken? The overwhelming impression from the interviews was that the integration of climate risks into investment decisions does in fact require deeper changes in investment decision-making. Ultimately, this raises the question of whether climate risk should be integrated as a standard risk in investment decision-making, or whether it should be mandated through some regulatory mechanism.

Respondents pointed out that, despite progress being made by many financial institutions in integrating climate risk into their investment decision-making, it is still common for strategic investments to be made in the power sector without any such consideration. Although banks may have stopped lending for fossil fuel power plants, fossil fuel power plants still get built because of strategic equity investors who choose to ignore climate risks.

6. Conclusions

This paper analysed awareness and understanding of climate risk related to the power sector in Southeast Asia, and the impacts of such risks on investment decision-making in the sector. Overall, the results from our analysis suggested that there is currently a significant gap between the need to integrate climate risks within investor decision-making and the way these risks are currently being integrated and addressed in the Southeast Asia power sector.

The interviews suggest that climate risk is either not a significant factor, ignored in light of other concerns, or only superficially integrated into decision-making. We discuss the factors behind these findings and question the assumption that risk is one of the main drivers of investment decision-making. We draw attention to other important factors, seldom reviewed in the literature, that lead investors in the power sector in Southeast Asia to either actively avoid, downplay, or ignore the potential impact of climate risks.

The ramifications of this research are that there is an urgent need for action from governments, financial regulators and energy sector associations targeted at power sector investors in order to:

39 Interview 3
40 Interview 10

- shed light on climate-related investment risks
- share information on the likelihood and magnitude of risks
- lay out clearly the potential for stranded assets in a 10 to 15-year time frame, and
- encourage transparent, open and respectful dialogue and discussion on these critical issues.

To start with, it is important to gather better data and develop more refined analytical tools to quantify climate-related investment risks and their impacts. Meanwhile, important policy and regulatory action would involve addressing the influence of major incumbent players in decision making in order to open opportunities to shift investment patterns.

References

AES (2018). AES announces carbon intensity reduction of 70 percent by 2030; publishes climate scenario report. 13 November. http://www.aes.com/investors/press-releases/press-release-details/2018/AES-Announces-Carbon-Intensity-Reduction-of-70-Percent-by-2030-Publishes-Climate-Scenario-Report/default.aspx.

Ahmed, S. J. and Logarta, J. (2017). *Carving out Coal in the Philippines: Stranded Coal Plant Assets and the Energy Transition*. IEEFA and Institute for Climate and Sustainable Cities, Manila, Philippines.

ASEAN Centre for Energy (2015). *ASEAN Plan of Action for Energy Cooperation (APAEC) 2016–2025*. ASEAN Centre for Energy, Jakarta, Indonesia.

Baker, A. (2016). Engie to accelerate divestment from coal, merchant plants. BNamericas.com, 25 September. https://www.bnamericas.com/en/news/engie-to-accelerate-divestment-from-coal-merchant-plants.

Baker, H. K., Filbeck, G. and Ricciardi, V. (2017). How behavioural biases affect finance professionals. *The European Financial Review,* 2 January. https://www.europeanfinancialreview.com/how-behavioural-biases-affect-finance-professionals/, https://www.europeanfinancialreview.com/how-behavioural-biases-affect-finance-professionals

Bengali, S. (2019). China, Japan and South Korea, while vowing to go green at home, promote coal abroad. *Los Angeles Times*, 13 May. Online ed.

Bond, K. (2018). 2020 Vision: *Why You Should See Peak Fossil Fuels Coming*. Carbon Tracker, London.

Booth, K. (2018). Profiteering from disaster: why planners need to be paying more attention to insurance. *Planning Practice & Research*, 33(2). 211–27. DOI:10.1080/02697459.2018.1430458.

Bos, K. and Gupta, J. (2019). Stranded assets and stranded resources: Implications for climate change mitigation and global sustainable development. *Energy Research & Social Science*, 56. 101215. DOI:10.1016/j.erss.2019.05.025.

Bridle, R. (2019). Reforming Fossil Fuel and Electricity Subsidies to Drive a Renewable Revolution. Asia Clean Energy Forum. Presentation at the Asia Clean Energy Forum. 17 June. http://asiacleanenergyforum.pi.bypronto.com/2/wp-content/uploads/sites/2/2019/06/01_Richard-Bridle_Reforming-Fossil-Fuel-and-Electricity-Subsidies-to-Drive-a-Renewable-Revolution.pdf

Buckley, T. (2019). *Over 100 Global Financial Institutions Are Exiting Coal, With More to Come*. Institute for Energy Economics and Financial Analysis (IEEFA). http://ieefa.org/wp-content/uploads/2019/02/IEEFA-Report_100-and-counting_Coal-Exit_Feb-2019.pdf

Buckley, T. and Shah, K. (2018). IEEFA update: India coal plant cancellations are coming faster than expected. 23 August. https://ieefa.org/india-coal-plant-cancellations-are-coming-faster-than-expected

Buckley, T., Shah, K., Garg, V. and Nicholas, S. (2019). IEEFA report: India's stranded asset risk in thermal power sector underestimated. *Institute for Energy Economics & Financial Analysis,* 18 December. https://ieefa.org/ieefa-report-indias-stranded-asset-risk-in-thermal-power-sector-underestimated

Burger, M. and Wentz, J. (2018). Holding fossil fuel companies accountable for their contribution to climate change: where does the law stand? *Bulletin of the Atomic Scientists*, 74(6). 397–403. DOI:10.1080/00963402.2018.1533217.

Campiglio, E., Dafermos, Y., Monnin, P., Ryan-Collins, J., Schotten, G. and Tanaka, M. (2018). Climate change challenges for central banks and financial regulators. *Nature Climate Change*, 8(6). 462–68. DOI:10.1038/s41558-018-0175-0

Ceres (2018). *Turning Point: Corporate Progress on the Ceres Roadmap for Sustainability*. Ceres, Boston.

Clapp, C., Lund, H. F., Aamaas, B. and Lannoo, E. (2017). *Shades of Climate Risk: Categorizing Climate Risk for Investors*. CICERO, Olso. Report 2017-01.

Coady, D., Parry, I., Le, N.-P. and Shang, B. (2019). Global Fossil Fuel Subsidies Remain Large: An Update Based on Country-Level Estimates. *IMF Working Papers*, 19(89). 1. DOI:10.5089/9781484393178.001

De Lorenzo, L. and Enkvist, P. (2018). *Framing Stranded Asset Risks in an Age of Disruption*. Stockholm Environment Institute, Stockholm.

Dietz, S., Bowen, A., Dixon, C. and Gradwell, P. (2016). 'Climate value at risk' of global financial assets. *Nature Climate Change*, 6(7). 676–79. DOI:10.1038/nclimate2972

Eco-Business Research (2018). *Power Trip: Southeast Asia's Journey to a Low Carbon Economy.* Eco-Business, Singapore.

Environmental Finance (2018). AP4 Pension Fund Divests from 22 Coal Companies. June. https://www.environmental-finance.com/content/news/ap4-pension-fund-divests-from-22-coal-companies.htm

Ganguly, G., Setzer, J. and Heyvaert, V. (2018). If at first you don't succeed: suing corporations for climate change. *Oxford Journal of Legal Studies*, 38(4). 841–68. DOI:10.1093/ojls/gqy029

Hirshleifer, D. (2015). Behavioral finance. *Annual Review of Financial Economics*, 7(1). 133–59. DOI:10.1146/annurev-financial-092214-043752

IEA (2017a). *Southeast Asia Energy Outlook* 2017. OECD/IEA, Paris.

IEA (2017b). World Energy Investment 2017. https://webstore.iea.org/world-energy-investment-2017

IEA (2019). Electricity Information 2019. https://webstore.iea.org/electricity-information-2019

IPCC (2014). *Climate Change 2014 – Synthesis Report: Annex II*. UNFCCC, Bonn. https://www.ipcc.ch/site/assets/uploads/2018/05/SYR_AR5_FINAL_full_wcover.pdf

IRENA (2018). *Renewable Energy Market Analysis: Southeast Asia*. International Renewable Energy Agency (IRENA), Abu Dhabi.

Koh, J. M. (2018). *Green Infrastructure Financing*. Springer International Publishing, Cham. DOI:10.1007/978-3-319-71770-8.

Mayo, H. B. (2019). *Investments: An Introduction*. Cengage Learning, Boston.

Mercure, J.-F., Pollitt, H., Viñuales, J. E., Edwards, N. R., Holden, P. B., et al. (2018). Macroeconomic impact of stranded fossil fuel assets. *Nature Climate Change*, 8(7). 588–93. DOI:10.1038/s41558-018-0182-1

Neslen, A. (2019). Climate change could make insurance too expensive for most people – report. *The Guardian*, 21 March. Environment. https://www.theguardian.com/environment/2019/mar/21/climate-change-could-make-insurance-too-expensive-for-ordinary-people-report

Partington, R. (2019). Mark Carney tells global banks they cannot ignore climate change dangers. *The Guardian*, 17 April. Environment. https://www.theguardian.com/environment/2019/apr/17/mark-carney-tells-global-banks-they-cannot-ignore-climate-change-dangers

Power Philippines (2016). Aboitiz Power among 52 firms excluded from Norway bank fund. *Power Philippines News*, 11 July. https://powerphilippines.com/2016/07/11/aboitizpower-among-52-firms-excluded-norway-bank-fund

REN21 (2019). *Renewables 2019 Global Status Report*. REN21, Paris. https://www.ren21.net/reports/global-status-report

SASB (2018a). *Climate Risk Technical Bulletin*. Sustainability Accounting Standards Board (SASB), San Francisco. https://library.sasb.org/climate-risk-technical-bulletin

SASB (2018b). *Climate Risk: From Principles to Practice. (Phase 1: SASB, CDSB, and TCFD Converge on a Global Approach to a Global Challenge)*. Sustainability Accounting Standards Board (SASB), San Francisco. https://www.cdsb.net/sites/default/files/final.climate-risk-principlestopractice-092518.pdf

Sembcorp (2018). Sembcorp Launches New Climate Change Strategy. 29 March. https://www.sembcorp.com/en/media/media-releases/corporate/2018/march/sembcorp-launches-new-climate-change-strategy

Sen, A., Nepal, R. and Jamasb, T. (2018). Have Model, Will Reform? Assessing the Outcome of Electricity Reforms in Non-OECD Asia. *The Energy Journal*, 39(4). DOI:10.5547/01956574.39.4.asen

Sharma, S. N., Layak, S. and Kalesh, B. (2018). How India's power story derailed, blowing a Rs 1.74 lakh crore NPA hole. The Economic Times, 16 September. Online ed. https://economictimes.indiatimes.com/industry/energy/power/how-indias-power-story-derailed-blowing-a-rs-1-74-lakh-crore-npa-hole/articleshow/65822950.cms

Silver, N. (2017). Blindness to risk: why institutional investors ignore the risk of stranded assets. *Journal of Sustainable Finance & Investment*, 7(1). 99–113. DOI:10.1080/20430795.2016.1207996.

TFCD (2017). *Final Report: Recommendations of the Task Force on Climate-Related Financial Disclosures.* Task Force on Climate Disclosure (TFCD), Basel, Switzerland. https://www.fsb-tcfd.org/wp-content/uploads/2017/06/FINAL-2017-TCFD-Report-11052018.pdf

Tong, D., Zhang, Q., Zheng, Y., Caldeira, K., Shearer, C., Hong, C., Qin, Y. and Davis, S. J. (2019). Committed emissions from existing energy infrastructure jeopardize 1.5 °C climate target. *Nature*, 572(7769). 373–77. DOI:10.1038/s41586-019-1364-3

University of Cambridge Institute for Sustainability Leadership and PwC (2016). *Closing the Protection Gap: ClimateWise Principles Independent Review 2016*. ClimateWise, Cambridge.

Zillman, C. (2016). These companies just got banned from the world's biggest wealth fund. 18 April. https://fortune.com/2016/04/18/coal-divestment-norway-wealth-fund

Visit us

SEI Headquarters

Linnégatan 87D Box 24218
104 51 Stockholm Sweden
Tel: +46 8 30 80 44
info@sei.org

Måns Nilsson
Executive Director

SEI Africa

World Agroforestry Centre
United Nations Avenue
Gigiri P.O. Box 30677
Nairobi 00100 Kenya
Tel: +254 20 722 4886
info-Africa@sei.org

Philip Osano
Centre Director

SEI Asia

10th Floor, Kasem Uttayanin Building,
254 Chulalongkorn University,
Henri Dunant Road, Pathumwan, Bangkok,
10330 Thailand
Tel: +66 2 251 4415
info-Asia@sei.org

Niall O'Connor
Centre Director

SEI Tallinn

Arsenal Centre
Erika 14, 10416
Tallinn, Estonia
info-Tallinn@sei.org

Lauri Tammiste
Centre Director

SEI Oxford

Florence House 29 Grove Street
Summertown Oxford
OX2 7JT UK
Tel: +44 1865 42 6316
info-Oxford@sei.org

Ruth Butterfield
Centre Director

SEI US
Main Office

11 Curtis Avenue
Somerville MA 02144-1224 USA
Tel: +1 617 627 3786
info-US@sei.org

Michael Lazarus
Centre Director

SEI US
Davis Office

400 F Street
Davis CA 95616 USA
Tel: +1 530 753 3035

SEI US
Seattle Office

1402 Third Avenue Suite 900
Seattle WA 98101 USA
Tel: +1 206 547 4000

SEI York

University of York
Heslington York
YO10 5DD UK
Tel: +44 1904 32 2897
info-York@sei.org

Chris West
Acting Centre Director

SEI Latin America

Calle 71 # 11–10
Oficina 801
Bogota Colombia
Tel: +57 1 6355319
info-LatinAmerica@sei.org

David Purkey
Centre Director

SEI Stockholm Environment Institute

sei.org

@SEIresearch @SEIclimate