Building disaster- and climate-resilient infrastructure through public–private partnerships

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Partnerships for Infrastructure acknowledges Aboriginal and Torres Strait Islander peoples as the traditional custodians of Country throughout Australia, and we pay our respects to Elders past and present. P4I also recognises early connections between Southeast Asia and the First Nations peoples of Australia.

Disclaimer

About the research

Disasters and climate change pose a significant threat to the long-term sustainability of development efforts in Southeast Asia. The region is increasingly vulnerable to disaster and climate risks, which have serious implications for its infrastructure and communities.

Between 2012 and 2021, inadequate resilience in infrastructure systems was a contributing factor in approximately 80,729 disaster-related fatalities in Asia and the Pacific. During this same period, extreme weather events and geophysical hazards resulted in direct physical infrastructure losses averaging around US$58 billion annually, equating to roughly US$159 million each day. These disasters not only caused substantial damage to infrastructure, homes and businesses, but also led to broader economic and social repercussions, affecting job security, productivity and the overall provision of essential services.[1]

Strengthening disaster and climate resilience has a strong economic investment rationale. For instance, World Bank analysis indicated that the net benefit of investing in more resilient infrastructure in low- and middle-income countries is estimated to be US$4.2 trillion over the lifetime of new infrastructure, with US$4 in benefit for each US$1 invested.[2]

Despite the critical need for resilient infrastructure in the face of escalating disaster- and climate-related shocks and stressors, a significant investment gap hinders the integration of disaster risk reduction and climate resilience measures into urban infrastructure projects.[3] While the up-front cost of incorporating these considerations is relatively low (an additional 3% per project),[4] the overall financial commitment required to achieve disaster- and climate-resilient, low-carbon infrastructure is substantial, estimated at over US$4.5 trillion annually until 2030.[5]

Closing the infrastructure financing gap necessitates the development of innovative financial solutions, as relying solely on public funds is insufficient. There is increasing interest in leveraging blended finance – utilising public finance, along with development and philanthropic capital, to attract private investment. Public–private partnerships (PPPs) offer a promising avenue for Southeast Asian governments to mobilise these investments; hence, it is essential to better understand how they operate and to establish effective regulatory frameworks to support their success.

To address a knowledge gap surrounding the benefits that PPPs can offer for infrastructure development in Southeast Asia, this brief outlines existing disaster and climate frameworks in the region, identifies key entry points for enhancing the disaster and climate resilience of infrastructure built through PPPs, and provides an overview of relevant Australian frameworks, practical PPP examples and global good practices. The brief was developed through a comprehensive literature review of publicly available reports and an analysis of Partnerships for Infrastructure (P4I) initiatives and lessons learned.

In alignment with the Australian Government's Southeast Asia Economic Strategy,[6] which promotes quality private sector investment in the region, and Australia's International Development Policy,[7] which hails state and community resilience as one of its focus areas, P4I has supported the Association of Southeast Asian Nations (ASEAN) Secretariat and P4I partner countries (Cambodia, Indonesia, Laos, Malaysia, Philippines, Thailand, Timor-Leste and Vietnam) in strengthening and embedding social inclusion and disaster and climate resilience considerations into PPP planning, procurement, decision-making processes, and sector policies and regulations.

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[1] Asian Development Bank, *Disaster-Resilient Infrastructure: Unlocking Opportunities for Asia and the Pacific*, April 2022, p. vii.

[2] S Hallegatte, J Rentschler and J Rozenberg, *Lifelines: The Resilient Infrastructure Opportunity*, Sustainable Infrastructure Series, World Bank, 2019, p. 2.

[3] See Box 1 on page 4 for definitions of 'disaster risk reduction', 'climate change adaptation' and 'disaster and climate resilience'.

[4] United Nations Office for Disaster Risk Reduction, *Resilient infrastructure*, UNDRR website, n.d., accessed 25 September 2024.

[5] Cities Climate Finance Leadership Alliance, *The State of City Climate Finance 2015*, CCFLA, 2015.

[6] Australian Government Department of Foreign Affairs and Trade, *Invested: Australia's Southeast Asia Economic Strategy to 2040*, DFAT, September 2023.

[7] Australian Government Department of Foreign Affairs and Trade, *Australia's International Development Policy*, DFAT, August 2023.

Flooding in Iriga City, Camarines Sur, Philippines, following the devastation of Super Typhoon Nina in 2016. Source: at.rma/Shutterstock

Navigating disaster and climate challenges in a context of economic growth

Southeast Asia's vulnerability to disaster and climate change risk creates a strong imperative for regional actions to strengthen disaster and climate resilience in infrastructure. Southeast Asia is projected to maintain robust economic growth, with forecasts of 4.5% in 2024 and 4.7% in 2025, driven by solid domestic and external demand, increased consumption, and a rebound in tourism. Investment in infrastructure projects across major economies further supports this growth, alongside a positive outlook for manufacturing exports.[8]

Box 1

Definitions

Disaster risk reduction is aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contributes to strengthening resilience and therefore to achieving sustainable development.[1]

Climate change adaptation is the process of adjusting to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.[2]

Disaster and climate resilience encompasses the necessary measures for addressing both disaster and climate risks.

While efforts are underway to synergise disaster risk reduction and climate change adaptation, more work is needed to enhance the coherence between these 2 approaches, including in relation to climate change mitigation, economic growth and sustainable development. P4I uses the term 'disaster and climate resilience' to integrate these efforts, offering a more holistic approach to addressing the evolving risks to infrastructure assets and the communities that depend on them.

[1] United Nations Office for Disaster Risk Reduction, *Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction*, UNDRR, 2016, p. 16.

[2] Intergovernmental Panel on Climate Change, *Climate Change 2014: Synthesis Report*, contribution of working groups I, II and III to the Fifth Assessment Report of the IPCC, 2014, p. 118.

[8] Asian Development Bank, *Asian Development Outlook*, ADB, September 2024.

The need to work towards disaster and climate resilience in infrastructure

Southeast Asia is one of the regions most exposed to disaster and climate risks. For instance, changes in rainfall and temperature can increase the frequency and severity of hazards, posing additional disaster risks to communities and built environments.[9] According to the Global Climate Risk Index 2020, Myanmar, the Philippines, Vietnam and Thailand were among the top 10 countries that were most severely affected by extreme climate events from 1999 to 2018.[10] This increased exposure has resulted in heightened vulnerability in communities due to worsening economic conditions in certain areas, increased poverty and inadequate insurance coverage (Box 2).

According to the sixth assessment report of the Intergovernmental Panel on Climate Change, disaster risks are set to increase further over the coming years and decades, as both climate and population patterns change.[11] Current approaches to disaster risk reduction must evolve to address the complex interdependencies and systemic vulnerabilities that arise from more frequent and compounding hazards.[12] These hazards range from slow-onset events (for example, sea level rise, desertification and biodiversity loss)[13] to intensive and extensive natural events (geological, hydrometeorological and biological) and human-induced events (environmental degradation and technological hazards).[14] For instance, inadequate drainage systems in urban areas can exacerbate flooding during heavy rainfall, while poorly constructed roads on unstable slopes can lead to landslides. These risks are further intensified when natural ecosystems are disrupted; for example, deforestation can destabilise soil and alter water cycles, leading to increased erosion and reduced land stability. The costs associated with maintaining and repairing such infrastructure rise dramatically, as systems become more susceptible to damage from disasters.[15]

Box 2

Factors contributing to disaster and climate change vulnerability in Southeast Asia

According to the *ASEAN State of Climate Change Report*, key factors contributing to disaster and climate change vulnerability include:

- a high level of extreme poverty in the region
- the high dependency of national economies and societies on sectors that are directly affected by climate change, such as agriculture and other natural resources
- pre-existing stress due to disaster loss and damage, including from droughts, typhoons and floods
- regional and global integration, with implications for the globalisation of local risks through global supply chains and transboundary rivers
- extensive coastlines with numerous coastal cities and highly concentrated economic activities in coastal areas
- the high propensity for migration within the region
- high deforestation in parts of the region, with negative implications for local resilience and environmental feedback effects.

Source: ASEAN, *ASEAN State of Climate Change Report*, ASEAN Secretariat, October 2021.

[9] World Wildlife Fund, *Deforestation and forest degradation*, WWF website, n.d., accessed 25 September 2024.

[10] D Eckstein, V Künzel, L Schäfer and M Winges, *Global Climate Risk Index 2020: Who suffers most from extreme weather events?*, Germanwatch, December 2019.

[11] Intergovernmental Panel on Climate Change, 'Chapter 6: Cities, settlements and key infrastructure', in *Climate Change 2022: Impacts, Adaptation and Vulnerability*, contribution of Working Group II to the Sixth Assessment Report of the IPCC, 2022.

[12] Australian Government National Recovery and Resilience Agency and Australian Institute for Disaster Resilience, *Systemic Disaster Risk*, Australian Disaster Resilience Handbook Collection, AIDR, 2021.

[13] As defined in United Nations Framework Convention on Climate Chage, *The Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention*, Decision 1/CP.16, UNFCCC, 15 March 2011, p. 6.

[14] As defined in United Nations Office for Disaster Risk Reduction, *Sendai Framework for Disaster Risk Reduction 2015–2030*, UNDRR, 2015.

[15] World Wildlife Fund, *Deforestation and forest degradation*, WWF website, n.d., accessed 25 September 2024.

Landslide and road damage in the Philippines. Source: Tunatura/Shutterstock

The need for disaster- and climate-resilient infrastructure becomes ever more critical as existing infrastructure still lacks the capacity to withstand the changing conditions, leaving communities ill-prepared to cope with the impacts of disasters.

Southeast Asia has a strong imperative and potential to contribute to global actions in addressing disaster and climate risks through decarbonisation pathways. As a rapidly developing region, greenhouse gas emissions in Southeast Asia have been rising in line with its industrialisation and associated land-use change.[16] According to the ASEAN Centre for Energy, the region's greenhouse gas emissions from the energy sector alone will increase by between 34% and 147% between 2017 and 2040 under different scenarios.[17] To contribute to the target of limiting global warming to 1.5 °C, ASEAN member states need to achieve net-zero CO_2 emissions by 2050 and net-zero greenhouse gas emissions by 2065 on average, according to the ASEAN Secretariat.[18]

Therefore, the region needs to prioritise disaster- and climate-resilient, low-carbon infrastructure investments to substantially reduce disaster and climate risks, damages and losses, and to ensure that decades of development progress would not be undone by future conditions.

Key regional-level disaster and climate commitments in Southeast Asia

ASEAN member states have been proactively addressing disaster risk reduction and climate change at the national, regional and global levels. For instance, at the regional level, the ASEAN Agreement on Disaster Management and Emergency Response – ratified in 2009 – serves as the foundational framework for disaster management. Its updated work program for 2021–2025 emphasises not only response but also disaster and climate resilience,[19] aligning with global agreements such as the Sendai Framework for Disaster Risk Reduction and the Sustainable Development Goals.

Additionally, the ASEAN Joint Statement on Climate Change to the 25th Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) articulated ASEAN member states' commitment and approach to disaster and climate resilience, emphasising the need to address these issues holistically (Box 3).[20]

[16] ASEAN, *ASEAN State of Climate Change Report*, ASEAN Secretariat, October 2021.

[17] ASEAN Centre for Energy, *The 6th ASEAN Energy Outlook 2017–2040*, ACE, 2020.

[18] ASEAN, *ASEAN State of Climate Change Report*, AEAN Secretariat, October 2021.

[19] ASEAN, *ASEAN Agreement on Disaster Management and Emergency Response (AADMER) Work Programme 2021–2025*, ASEAN Secretariat, December 2020.

[20] ASEAN, *ASEAN Joint Statement on Climate Change to the 25th Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC COP25)*, ASEAN Secretariat, 2 November 2019.

Box 3

ASEAN member states' actions to address disaster and climate change risk

ASEAN member states have reaffirmed their commitment to the UNFCCC and the Paris Agreement by:

- implementing measures to address climate change under the ASEAN Socio-Cultural Community Blueprint 2025
- promoting sustainable management of forests through the Reducing Emissions from Deforestation and Forest Degradation initiative and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
- reducing energy intensity in line with the ASEAN Plan of Action for Energy Cooperation 2016–2025
- launching the ASEAN Regional Strategy on Sustainable Land Transport, the ASEAN Fuel Economy Roadmap for the Transport Sector 2018–2025 with a focus on light-duty vehicles, and the Guidelines for Sustainable Land Transport Indicators on Energy Efficiency and Greenhouse Gas Emissions in ASEAN
- strengthening ASEAN's capacity in managing climate-related disasters through existing mechanisms under the ASEAN Agreement on Disaster Management and Emergency Response
- implementing the plan of action for Phase 2 of ASEAN Disaster Risk Financing and Insurance, and establishing the Southeast Asia Disaster Risk Insurance Facility, which has a focus on strengthening ASEAN member states' financial resilience by improving disaster risk assessment, financing and insurance solutions
- promoting collaboration with ASEAN's dialogue, sectoral dialogue and development partners and other external parties to enhance climate action in the region.

Source: ASEAN, *ASEAN Joint Statement on Climate Change to the 25th Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC COP25)*, ASEAN Secretariat, 2 November 2019.

There are ongoing efforts to increase the coherence between the Sendai Framework for Disaster Risk Reduction 2015–2030 and the Paris Agreement,[21] both of which have been endorsed by all UN member states, underscoring a collective commitment to mitigate disaster risks and losses on a global scale and address climate change. However, more integrated approaches across these frameworks are needed to maximise their effectiveness.[22] In May 2023, UN member states reaffirmed their commitment to the full implementation of the Sendai Framework following a mid-term review.[23] Given the region's vulnerability, Southeast Asia has a significant interest in the effective implementation of all Sendai Framework priorities.

ASEAN's Framework for Improving ASEAN Infrastructure Productivity – supporting ASEAN member states in enhancing connectivity and economic integration – also highlights the need to factor disaster and climate resilience into infrastructure investments.[24]

P4I has built expertise across the region in governance frameworks, procurement policies and contracting methods that manage disaster and climate risk in a gender-responsive, disability-inclusive and socially inclusive manner, in accordance with the Sendai Framework. This expertise is complemented by knowledge-sharing initiatives with partner countries in Southeast Asia, fostering collaboration and enhancing collective resilience. The foundation of this approach lies in the understanding that 'resilience' encompasses not only the integrity of physical infrastructure but also its capacity to serve communities in ways that bolster social and economic resilience and support them to respond to and recover from disaster impacts.

[21] United Nations Office for Disaster Risk Reduction, *What is the Sendai Framework for Disaster Risk Reduction?*, UNDRR website, n.d., accessed 25 September 2024.

[22] United Nations Office for Disaster Risk Reduction, *Promoting Synergy and Alignment Between Climate Change Adaptation and Disaster Risk Reduction in the Context of National Adaptation Plans: A Supplement to the UNFCCC NAP Technical Guidelines*, UNDRR, 2021.

[23] United Nations General Assembly, *Political declaration of the high-level meeting on the midterm review of the Sendai Framework for Disaster Risk Reduction 2015–2030*, UNGA resolution A/RES/77/289, 18 May 2023.

[24] ASEAN, *Framework for Improving ASEAN Infrastructure Productivity*, ASEAN Secretariat, October 2020.

The role of public–private partnerships in enhancing disaster and climate resilience

Private sector involvement is important to bridging the funding gap and advancing disaster- and climate-resilient infrastructure development. However, there are existing barriers that limit the scaling up of combined public and private investment (that is, blended finance) in many ASEAN member states. Addressing these barriers requires partnerships across the public and private sector, regional and multilateral development banks and development finance institutions, as well as regulatory changes. Policymakers can encourage private sector investment through regulatory considerations for risk mitigation.[25] Mechanisms like PPPs are one way to contribute to this de-risking, through more comprehensive long-term planning, while promoting disaster and climate resilience.

The definition of public–private partnerships varies by jurisdiction and legal framework. In general, PPPs represent a long-term contract between a private party and a government entity, for providing a public asset or service in which the private party bears significant risk and management responsibility, and remuneration is linked to performance.[26]

Examples of PPPs range from operations and maintenance contracts, where a private party is engaged to operate and maintain publicly owned infrastructure, to build–operate–transfer concessions, where private partners construct, operate and maintain infrastructure such as roads and bus terminals, before transferring the assets back to the government after the contract period.

PPPs may have broad application across a variety of sectors, including transport, energy, water and sanitation, healthcare, education and telecommunications, depending on the policy, market and institutional readiness in a jurisdiction.

Key public–private partnership benefits and strategies

PPPs enable public authorities to incentivise the private sector to meet new or demanding performance standards such as output specifications that define the quality and quantity of services or assets to be delivered by the private entity, and innovate for risk anticipation and mitigation. The potential benefits of PPPs in achieving disaster risk reduction and climate change objectives include the following:

- **Utilise private sector expertise and efficiency –** Strengthening the disaster and climate resilience of infrastructure, and the decarbonisation of infrastructure, present challenges that may require innovative solutions in areas such as design, accessibility, construction methods, operations and maintenance, and emergency response. PPP contracts can be designed by public authorities to attract private sector expertise that facilitates technology adoption and operational excellence.
- **Incentivise investment in decarbonisation and overall resilience –** Mechanisms such as performance-based payments and penalties incentivise the private sector partners to make up-front and ongoing investments that enable them to meet disaster and climate resilience targets as well as decarbonisation objectives.
- **Generate transformation –** PPPs have the potential to be transformative when they attract innovative private sector enterprises that address social and economic challenges in new ways. For example, using human-centred design puts an emphasis on understanding user needs – both explicit and latent. Insights from conversations with users become the basis for exploring innovation opportunities.

[25] Convergence Blended Finance, *State of Blended Finance 2024*, Convergence, 2024.
[26] World Bank, *Public-Private Partnerships Reference Guide*, version 3, World Bank, 2017.

- **Steer projects towards resilience –** Long-term contracts steer investment and innovation towards resilience, as degradation of assets will be a cost to the developer and may breach performance requirements. Designing and building quality infrastructure reduces risk and costs, and brings economic and social benefits. Long-term resilience is more likely when independent appraisals (such as environmental impact assessments or strategic environmental assessments) and community consultations are used as stepping stones to better-quality infrastructure, more efficient use of resources, and the best development impact.
- **Promote management of long-term risk and costs throughout the project lifecycle –** As PPPs are typically long-term in nature and may transfer significant risks to the private sector partners, those partners have the incentives to minimise the future costs in maintaining, upgrading and recovering the infrastructure against anticipated disaster and climate risks. Thus, PPPs may potentially encourage good practices such as rigorous disaster and climate risk assessment, avoidance of high-risk location, adoption of resilient design standards, and whole-of-life cost analysis that accounts for disaster and climate risks.

Leveraging public–private partnerships for disaster and climate resilience in the energy and transport sectors

The energy and transport sectors account for the largest share of PPP investments in ASEAN member states. PPPs in these sectors offer wide-ranging opportunities to build the region's disaster and climate resilience and achieve decarbonisation targets.

Synergies for disaster and climate resilience and decarbonisation targets

While the energy and transport sectors are clear mitigation priorities for ASEAN member states, climate adaptation and disaster risk reduction targets are primarily focused on sectors like food and agriculture, water, health, forestry and biodiversity.

The energy and transport sectors are well suited to PPPs and are also the primary sectors for PPP investments in the region. This presents significant opportunities to structure PPPs in ways that integrate disaster and climate resilience into the energy and transport sectors, while also influencing other sectors such as forestry and biodiversity.[27]

Infrastructure investments for post-disaster recovery are often delivered as public investment projects through traditional procurement methods.

Given the wide-ranging potential benefits of PPPs, several initiatives have aimed to mainstream resilience approaches in PPPs, as well as broaden the use of PPPs in climate adaptation infrastructure.[28]

This trend is in line with the urgency to address the substantial infrastructure investment needs for post-disaster recovery. For example, the road reconstruction and recovery efforts after Typhoon Haiyan (Super Typhoon Yolanda) hit the Philippines in 2013 focused on rebuilding resilient infrastructure to strengthen future coping capacity against similar climatic and non-climatic shocks. Reconstruction and continuity of services in the aftermath of disasters are crucial to supporting the livelihoods of those most affected. Efficiencies in accessing capital to respond to such disasters are essential, as they enable quicker mobilisation of resources necessary for effective recovery.[29]

In various projects, measures reducing disaster risk have sometimes been recommended as part of environmental impact assessments or strategic environmental assessments. As such, there is typically a foundation of understanding among stakeholders about the importance of risk assessments, paving the way for more robust approaches. This includes conducting dedicated vulnerability and climate risk assessments to develop a disaster and climate risk profile of infrastructure projects, and identify the optimal solutions.

[27] ASEAN, *ASEAN State of Climate Change Report*, ASEAN Secretariat, October 2021.

[28] K Weekes and G Diaz-Fanas, 'How do we link private sector participation and climate resilient infrastructure right now? Some ideas from PPIAF', *Getting Infrastructure Finance Right*, World Bank, 4 March 2021.

[29] Global Facility for Disaster Reduction and Recovery, *Philippines: Typhoon Yolanda Ongoing Recovery: Recovery Framework Case Study*, World Bank, May 2015.

Aerial view of Nhat Tan Bridge in Hanoi, Vietnam. Source: Nguyen Quang Ngoc Tonkin/Shutterstock

Public–private partnership investments in the region

The energy sector – including electricity and natural gas infrastructure – accounts for just over two-thirds (68%) of total PPP investments in ASEAN member states (excluding Singapore and Brunei) from 1990 to 2023, at about US$160.7 billion. This is followed by the transport sector – comprising roads, railways, ports and airports – which collectively accounts for a quarter of total PPP investments over the same period, at about US$58.8 billion.[30] A further breakdown of the investment concentration by sector and country is shown in Table 1.

Table 1: PPP investments in ASEAN member states, by key sector and country, 1990–2023

ASEAN member state*	Total PPP investment amount (USD billion)									
	Electricity	Natural gas	Roads	Railways	Ports	Airports	Information and communications technology	Water and sewerage	Treatment and disposal	Total
Vietnam	20.25	1.30	3.72	–	1.09	0.02	–	0.25	0.07	26.69
Thailand	28.36	0.72	0.15	5.50	0.20	0.02	4.25	0.70	0.11	40.01
Philippines	30.40	0.43	6.22	2.41	1.30	3.25	0.76	4.23	0.03	49.02
Myanmar	1.33	0.72	–	–	0.15	–	–	–	–	2.21
Malaysia	16.97	0.15	7.35	1.49	3.99	0.28	–	3.91	0.08	34.21
Laos	17.80	–	–	5.70	0.09	–	0.09	–	–	23.69
Indonesia	39.24	–	6.56	6.07	1.52	0.48	0.59	1.59	–	56.05
Cambodia	2.99	–	0.01	–	–	1.27	0.08	–	–	4.35
Total	**157.35**	**3.32**	**24.01**	**21.16**	**8.34**	**5.31**	**5.77**	**10.67**	**0.28**	**236.22**

* Source data does not include Singapore and Brunei.

Source: Analysis using World Bank, *Private Participation in Infrastructure (PPI) database*, accessed 1 June 2024.

[30] Based on analysis of World Bank, *Private Participation in Infrastructure (PPI) database*, accessed 1 June 2024.

Australian good practices in the public–private partnership process

Moving forward, it is important to seize the opportunities to integrate climate change and disaster risk reduction considerations as governments in the region continue to use PPPs to deliver infrastructure projects and services. In this regard, it is beneficial to share existing good practices and frameworks from Australia so that governments in the region can take advantage of relevant experiences and lessons learned. This is followed by a brief compendium of good practices identified across the PPP project cycle, from project identification and prioritisation to project appraisal and structuring, procurement and contract management.

Climate change adaptation and disaster risk reduction roles and responsibilities in Australia

Policymakers in Australia have demonstrated an early commitment to integrating disaster risk reduction, social inclusion and climate change measures in infrastructure delivered through PPPs. In 2012, Australian governments at all 3 jurisdictional levels – national, state and territory, and local – issued a policy statement that clarified the roles and responsibilities for climate change adaptation (including disaster risk reduction) in Australia.[31]

The principles provide a clear policy foundation to address resilience against disaster and climate risks, both of which often overlap or interact in the face of the impacts of climate change.

Among other things, the policy statement establishes the following principles:

- **Climate risk management should build on existing effective climate risk practices.** Climate risks are often an extension of existing risks (including disaster risks), but climate change means adverse events may happen more often and more severely, and may happen in different places. Sometimes, climate change may create new risks that will impact women and men in different ways. Indigenous communities may be more severely affected, with negative impacts on their culture and livelihoods.
- **Those who are best placed to understand and manage disaster and climate risks should be recognised and enabled to do so.** For risk management to work well, risk bearers should know and accept their climate and disaster risks and their responsibility to deal with them. Risk management methods for these risks should suit the specific situations and preferences of those affected.
- **Governments cannot and should not pay for all the costs of adapting to the effects of climate change.** It would also be inefficient and inappropriate for governments to make decisions for businesses and individuals, who are better placed to understand and manage their own disaster and climate risks. Since most of the assets and activities at risk from climate change are owned or managed by businesses, community groups or individuals, it is fair to expect that those entities and individuals handle their exposures. However, resources must be available to ensure climate change does not disproportionately affect women, people living with disability, or marginalised people and communities.
- **While government policies will affect private sector activity, much action in adapting to expected climate change and exacerbated disaster risk in Australia will need to be done by private parties who respond to climate change and disaster risks as they respond to other risks that could affect their livelihoods.** Private parties and governments may have different capacities to adapt to climate change, depending on their exposure to risk, and access to resources and knowledge. Governments – on behalf of the public – should mainly be responsible for managing risks to public goods and assets and government service delivery, and creating a framework that supports and encourages private sector adaptation.

[31] Council of Australian Governments, *Roles and Responsibilities for Climate Change Adaptation in Australia*, COAG, 2012.

Multimodal transport in Jakarta, Indonesia. Source: Photogeratphy/Shutterstock

Good practices in Australia's National PPP Guidelines

In 2011, the then Department of Climate Change and Energy Efficiency published an analysis that reviewed how regulation and policies can play key roles in promoting climate change adaptation (and thereby disaster risk reduction) in Australian infrastructure projects.[32] The department assessed the regulatory frameworks for infrastructure, including for PPPs, to identify their roles and potential to support or hinder effective climate change adaptation. In particular, the analysis reviewed Australia's National PPP Guidelines for major infrastructure project procurement.[33]

The analysis found that Australia's National PPP Guidelines provide a principles-based framework for PPP projects and embed flexible and accommodative key entry points to facilitate disaster risk and climate change considerations in procurement decisions, even though climate change considerations are not explicitly referenced in the guidelines. The key entry points are as follows:

- **Technical standards** can be used to set standards for infrastructure to ensure that it is resilient to disaster risk and climate change. The technical requirements and specifications for major infrastructure projects are flexible and adaptable. They can be based on performance or outputs. This allows each project to include measures to address both disaster and climate risks.
- **In-built risk assessment** allows for disaster and climate risks to be incorporated into existing regimes for risk assessment.
- **Optimal risk allocation** allows for disaster and climate risks to be allocated to the party best able to manage them, adopting a partnership approach to managing long-term PPP contracts.
- **A modification regime** enables the government to make changes to the project throughout the life of the project. This regime allows the government to respond to emerging climate science and alter or adjust parts of the project to ensure the infrastructure can adapt to evolving climate risks.
- **A 'fitness for purpose'** warranty requires the private party to ensure that the infrastructure is suitable for the intended purpose specified in, or reasonably inferred from, the project documents. If the project objectives are clearly and appropriately identified, this warranty may be broad enough to cover disaster and climate risks.

Integration with state and territory–level regulations

Given these entry points, Australia's National PPP Guidelines may have synergies with other prevailing regulations and policies developed by various government agencies and different levels of government. For instance, states and territories have used PPPs for projects that contribute to disaster and climate resilience and disaster recovery (for example, flood mitigation and bushfire recovery efforts). This potential complementarity of policy frameworks in delivering disaster and climate resilience considerations in infrastructure PPPs in Australia is illustrated in Table 2.

[32] Maddocks, *The Role of Regulation in Facilitating or Constraining Adaptation to Climate Change for Australian Infrastructure*, report for the Australian Government Department of Climate Change and Energy Efficiency, 2011.

[33] Australian Government Department of Infrastructure and Regional Development, *National Public Private Partnership Guidelines: Overview*, DIRD, 2008.

Table 2: Australia's framework for delivering climate- and disaster-resilient infrastructure through PPPs

Level of government	PPP guidelines and responsible agencies	Frameworks, strategies and guidelines that support climate- and disaster-resilient infrastructure*
National	National Public Private Partnership Guidelines (Department of Infrastructure, Transport, Regional Development, Communications and the Arts, DITRDCA) National Guidelines for Infrastructure Project Delivery (DITRDCA)	Critical Infrastructure Resilience Strategy National Disaster Risk Reduction Framework National Strategy for Disaster Resilience Australian Transport Assessment and Planning Guidelines Standards Australia's codes, standards and rating schemes
States and territories	Partnerships Victoria Procurement Requirements (Victorian Department of Treasury and Finance) New South Wales (NSW) Procurement Policy Framework, NSW Public Private Partnership Policy and Guidelines (NSW Treasury) Project Assessment Framework: Queensland Public Private Partnership Supporting Guidelines (Queensland Treasury) Public Private Partnerships Commercial Principles, Project Disclosure Policy and Public Sector Comparator Policy (Western Australian Department of Treasury) South Australian Industry Participation Policy and Procedural Guidelines (SA Department of Treasury and Finance) Winning Government Business website (Tasmanian Department of Treasury and Finance) Guidelines for Public Private Partnerships (Australian Capital Territory Government – Treasury) Northern Territory Project Development Framework (NT Department of Industry, Tourism and Trade)	Community Resilience Framework for Emergency Management (Emergency Management Victoria) NSW Critical Infrastructure Resilience Strategy (Emergency NSW) Queensland Strategy for Disaster Resilience (Queensland Reconstruction Authority) ACT Climate Change Adaptation Strategy (Australian Capital Territory Government) Land use planning guidelines (administered by various government agencies in all states and territories) Social Procurement Framework (Victorian Government)

* This is not an exhaustive list.

Source: Adapted from *Arup, Public–Private Partnerships (PPPs): An industry perspective on their role as drivers of infrastructure resilience in Australia*, Arup, 2019.

Disaster risk reduction and climate change considerations in Australian infrastructure projects and private sector roles

Australia is experiencing more frequent and severe disasters, including bushfires, floods and storms, exacerbated by climate change. Recent years have seen catastrophic events that underscore the vulnerability of Australia's infrastructure. For example, the 2019–2020 bushfire season and severe floods in southeastern Australia in 2022 have demonstrated the urgent need for resilient infrastructure to protect communities from these risks.[34]

Given that many infrastructure projects in Australia are delivered through PPPs, it is essential to integrate disaster and climate risk considerations into these long-term contracts. Failure to do so can expose stakeholders to vulnerabilities throughout the asset's lifespan, leading to increased fiscal burdens on governments when disasters occur. Boxes 4, 5 and 6 present examples of Australian PPPs and the disaster- and climate-resilient, low-carbon features that the private sector entity or consortium was responsible for implementing.

Aerial view of highway junctions in Bangkok, Thailand.
Source: Travel man/Shutterstock

Box 4

EastLink toll road in Melbourne

EastLink is a large urban road project with a construction cost of A$2.5 billion, which opened to traffic in 2008. The project is Victoria's second fully electronic tollway and links the Eastern Freeway in Mitcham with the Frankston Freeway in Melbourne's south-eastern region. It was delivered under a PPP model where the Victorian Government awarded a 39-year concession to a private consortium to finance, design, construct, commission, operate, maintain, repair and ultimately hand over EastLink to the state government at the end of the concession period.

Key disaster- and climate-resilient, low-carbon features and responsibilities of the private sector partner:

- **Climate risk register:** Maintains a climate risk register using Commonwealth Scientific and Industrial Research Organisation (CSIRO) data to identify and manage key operational risks. CSIRO employs scenario analysis within the climate risk register to evaluate how different climate scenarios could affect infrastructure over time. This includes stress-testing existing assets against projected climate conditions to identify weaknesses and areas needing enhancement.
- **LED lighting and zero-emissions vehicles:** Upgraded tunnel lighting to light-emitting diodes (LEDs) and integrated zero-emissions vehicles into the service fleet.
- **Fire-resistant materials:** Incorporated fire-resistant road materials and emergency planning to ensure functionality during bushfires due to the tollway's location in a fire-prone area.

Source: Adapted from EastLink, *EastLink Sustainability Report: FY2022*, EastLink, 2022.

[34] Infrastructure Australia, *Resilience Principles: Infrastructure Australia's Approach to Resilience*, Infrastructure Australia, June 2022.

Engineer working on photovoltaic panels in Queensland, Australia. Source: zstock/Shutterstock

Box 5

Victorian Desalination Plant

The PPP between the Victorian Government and the AquaSure consortium to build a desalination plant was announced in 2007 during the 'millennium drought' of the 2000s – widely considered the worst drought on record for southeast Australia. During the drought, water storage levels receded to a critically low level of 17% in Melbourne's largest reservoir. The plant is located in the coastal town of Wonthaggi, just over 100 kilometres southeast of the Melbourne city centre.

Key disaster- and climate-resilient, low-carbon features and responsibilities of the private sector partner:

- **Environmental impact and coastal protection:** Conducted environmental impact assessments and implemented coastal protection measures, including a 2-kilometre underground pipeline and environmentally sensitive brine discharge methods to protect marine ecosystems.
- **Advanced desalination technologies:** Utilised innovative desalination technologies to ensure a reliable water supply, regardless of rainfall.
- **Flood-resilient infrastructure:** Designed elevated structures, robust water intake systems and underground tunnels to mitigate risks from rising sea levels, storm surges and extreme weather.
- **Bushfire resilience:** Constructed the plant with fire-resistant materials and integrated automated fire suppression systems, and developed emergency protocols, to enhance resilience against bushfires.
- **Reliable power supply:** Connected to the electricity grid via a dedicated high-voltage underground cable and equipped with backup power systems to prevent outages during storms or disasters.
- **Scalable water output:** Developed an operational model that adjusts water output based on demand, allowing for increased production during droughts or emergencies affecting natural water supplies.

Source: Adapted from Partnerships Victoria, *Victorian Desalination Project: Project Summary*, Victorian Department of Sustainability and Environment, November 2009.

Box 6

Melbourne Metro Tunnel

In 2017, the Victorian Government undertook a PPP with the Cross Yarra Partnership consortium to deliver the Tunnel and Stations PPP work package as part of the Metro Tunnel Project in Melbourne. The private sector partner is responsible for the design, construction and financing of a 29-kilometre tunnel, 5 underground stations, station fit-out, mechanical and electrical systems, and commercial opportunities at the new stations. In addition, it has to deliver specific maintenance and other services for 25 years.

Key disaster- and climate-resilient, low-carbon features and responsibilities of the private sector partner:

- **Green building practices:** Adopted green building practices and achieved a minimum 5-star certified rating under the Green Building Council of Australia's Green Star rating tools for all stations.
- **Design:** Received a certified rating for both its design phase and its completed construction, indicating that the project meets high standards for sustainability across various aspects, including environmental impact, resource use and community engagement.
- **Sustainability management plan:** Prepared and updated a plan that set out the processes, methodologies and initiatives to be implemented in order to achieve the sustainability requirements during the performance of the design and construction activities. The sustainability plan includes sub-plans for climate resilience (climate risk assessment and climate change adaptation plan), carbon and energy, materials and waste, and water.
- **Specific climate resilience measures:** Ensured robustness of the measures (including drainage and flood control, mechanical and electrical systems, and location requirements) by adopting the Melbourne Metro Rail Authority's climate change risk assessment and climate change adaptation plan as the basis for the adopted climate change projections and scenarios.
- **Specific energy sustainability measures:** Adopted specific energy measures (including energy efficiency, and renewable energy usage and equipment) to minimise greenhouse gas emissions.
- **Specific materials and waste measures:** Minimised materials volumes and ensured sustainable and responsible sourcing through strategies such as ensuring the use of certified materials, increasing the adoption of reused materials, and enhancing construction technologies.
- **Water sustainability measures during construction and operations:** Reduced the use of potable water, enhanced management of stormwater run-off, and harvested rainwater.

Source: Adapted from Victoria Government, *Tunnel and Stations Public Private Partnership: Project Summary*, Victorian Government, February 2018; and Herbert Smith Freehills, *Metro Tunnel: Tunnel and Stations PPP: Project Agreement*, 2017.

Global good practices

This section identifies good practices for developing inclusive, disaster- and climate-resilient PPPs based on a literature review of existing toolkits and materials.[35]

The PPP process is designed to ensure public investments lead to development of quality infrastructure that advances a country's development goals. This requires attending to both inclusion and resilience, in line with international best practice as defined in documents such as the G20 Principles for Quality Infrastructure Investment.

Better integrating gender equality and disability and social inclusion principles in infrastructure planning and delivery can ensure that benefits are distributed and accessible to women and marginalised groups, including people with disability, and Indigenous communities. These approaches can further contribute to economic growth by unlocking the potential of under-represented groups. Similarly, embedding disaster and climate resilience and low-carbon principles into infrastructure planning and delivery can ensure that infrastructure development is resilient to climate events and natural hazards. This not only protects assets for the private partners to the PPP contract, but also safeguards human lives and livelihoods, which is of primary importance to the public authority that commissioned the investment.

Table 3 provides an overview of global good practices to develop inclusive, disaster- and climate-resilient PPPs across the different phases of the PPP process.

Delegations from Thailand and Malaysia visit the Torrens Island Power Station near Adelaide, South Australia. Source: P4I

[35] We have drawn principally on the following sources: P Neves et al., *Climate Toolkit for Infrastructure PPPs*, World Bank, 2022; World Bank, *PPP Gender Toolkit*, World Bank, 2023; G Frisari et al., *Climate Resilient Public Private Partnerships: A Toolkit for Decision Makers*, Inter-American Development Bank, 2020; Global Center on Adaptation, *Climate-Resilient Infrastructure Officer Handbook*, GCA, 2021; and Group of Twenty, *G20 Principles for Quality Infrastructure Investment*, endorsed at the G20 Leaders' Summit in Osaka, Japan, on 28–29 June 2019.

Table 3: Overview of good practices to develop inclusive, disaster- and climate-resilient PPPs

Phase in PPP process	Good practices to incorporate social inclusion, disaster risk reduction and climate change considerations
Project identification and prioritisation	• Examination of the project's alignment with national disaster risk reduction and climate action priorities • Identification of the main greenhouse gas emission sources and potential emissions mitigation measures • Gender and disability analysis to understand how climate risks to infrastructure will impact women and men, people living with disability, and Indigenous communities in different ways • High-level disaster and climate risk screening
Project appraisal and structuring	• Integrating disaster risk reduction and climate change considerations into feasibility study • Greenhouse gas accounting study • Disaster and climate risk assessment • Economic and financial feasibility assessment • Technical feasibility assessment • Stakeholder and social impact study (data disaggregated by sex, disability and indigeneity) • Meaningful consultation with communities (including free prior informed consent principles) • Development of mitigation, inclusion and resilience performance requirements • Design specifications, including environmental and social safeguards that reduce greenhouse gas emissions and minimise vulnerability to climate change • Disaster and climate risk allocation • Development of monitoring and enforcement mechanisms
Tender and award	• Development of tender that incentivises bidders to integrate disaster risk reduction and climate change measures – for example, minimum qualifying criteria that require potential bidders to submit appropriate environmental and social management plans, as well as disaster prevention and risk response plans • Key performance indicators to include gender-specific technical requirements and accessibility • Mobilising climate finance from concessional sources and the market
Contract management	• Integrating disaster-related, climate and inclusion expertise in contract management team • Monitoring disaster-related, climate and inclusion performance • Dealing with changes related to disaster risk reduction and climate change • Feedback, grievance and redress mechanisms that are useable and accessible to all citizens

Source: Adapted from APMG International, *APMG Public–Private Partnership (PPP) Certification Guide*, World Bank Group, 2016.

Conclusion

Disaster and climate risks pose grave sustainable development challenges for Southeast Asia, as it is one of the most vulnerable regions to disasters and climate change globally. Several ASEAN member states rank among the most affected by extreme weather events in recent decades. Meeting the disaster- and climate-resilient infrastructure financing gap will require leveraging both public and private capital. To attract private investors, governments in the region need to adapt regulatory frameworks and mobilise innovative mechanisms such as public–private partnerships (PPPs). Approaches such as PPPs can help mitigate investment risks by providing long-term visibility and stability for private investors.

PPPs offer immense promise in driving disaster- and climate-resilient, low-emission and inclusive infrastructure development across Southeast Asia. By fostering innovation, investment and holistic life-cycle management, PPPs can enable governments to harness private sector expertise and resources to advance disaster risk reduction and climate change mitigation and adaptation. However, for PPPs to be effective in addressing disaster and climate risk, they must be structured to incorporate robust assessments, performance standards and appropriate risk allocation mechanisms. Energy and transport are the primary PPP investment sectors in the region, presenting significant opportunities to align these critical sectors with regional and national disaster risk reduction and climate goals.

Australia has significant experience in using PPPs to strengthen the disaster and climate resilience of its infrastructure projects. For instance, the EastLink toll road, the Victorian Desalination Plant and Melbourne Metro Tunnel projects demonstrate the sharing of disaster and climate risks between the public and private partners, and the accountability of the private partners for any shortfalls in meeting contracted performance requirements.

The Australian Government, through P4I, has partnered with government agencies in Southeast Asia to embed good practices in addressing gender equality, disability, social inclusion, disaster risk reduction and climate change considerations in PPPs. For instance, P4I has worked closely with the Philippine Department of Transportation to enhance the preparation, appraisal and prioritisation of infrastructure investment projects. This partnership resulted in the co-development of guidance notes and tools that address critical aspects like disaster and climate resilience in economic analysis, all designed to attract high-quality investments in key transportation infrastructure projects. Furthermore, P4I has provided advice to the Public-Private Partnership Center of the Philippines on regulatory reforms to the PPP Code's Implementing Rules and Regulations, advancing gender equality, disability and social inclusion from merely safeguard principles to performance-linked criteria for PPP projects.

Australia's Southeast Asia Economic Strategy to 2040 emphasises the importance of collaborating with partner countries to harmonise regulatory frameworks and enhance infrastructure standards across the region. This collaboration is seen as a significant opportunity for ongoing partnerships, which can lead to mutual economic benefits.

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