QUALITY INFRASTRUCTURE INVESTMENT IN ASIA

Background note for the 2022 OECD-ADBI High-Level Seminar

OECD

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Introduction

Infrastructure investments that are aligned with long-term development goals can contribute to economic development and serve as enablers for achieving environmental, social and governance (ESG) objectives and the Sustainable Development Goals (SDGs).

When scarce resources are used on projects that fail to deliver net benefits to society or when projects lead to environmental degradation, infrastructure investments can undermine social and economic development by posing risks to fiscal sustainability, and increase exposure to climate risk and other externalities. Given the inherent high cost and long-term nature of infrastructure, a life-cycle approach is essential to be able to realise the potential of quality infrastructure investment (QII) as a catalyst for growth and sustainable development (OECD, 2020[1]).

This background note gives an overview of elements of QII that were discussed at the 2022 OECD-ADBI High Level Seminar on Quality Infrastructure Investment in Asia. The first section discusses quality infrastructure investment in Asia and the meaning of sustainable investment; the second section explores debt sustainability and its relation to infrastructure investment; the third section examines the topic of infrastructure resilience; and, the fourth section focuses on the energy transition and its financial landscape.

1 Quality infrastructure investment in Asia

Asia's rapid growth has contributed to the rising demand of infrastructure development, including utilities, transportation, telecommunications, and health. Infrastructure development has been a key driver of growth in Asia over the last decades, which includes through the development of infrastructure (Bizimana and Jaramillo, 2021[2]).

Going forward, the Asian Development Bank estimates that USD 1.7 trillion of annual investment is required until 2030 for developing Asia to maintain its growth momentum, tackle poverty, and respond to climate change (ADB, 2017[3]).

In 2019, the G20 endorsed the G20 Principles for Quality Infrastructure Investment (QII), which is a set of voluntary, non-binding principles that reflect the G20's strategic direction and aspiration for Quality Infrastructure Investment (QII). The Preamble of the QII Principles states that infrastructure is a driver of economic prosperity and that quality infrastructure contributes to maximising the positive impacts of those investments (G20, 2019[4]).

Principle 1.2 highlights sustainability aspects in infrastructure investment. Infrastructure investment should take into account economic, environmental and social, and governance aspects, consistent with the 2030 Agenda for Sustainable Development. These considerations should be entrenched throughout the infrastructure's life cycle, as well as in infrastructure investment (G20, 2019[4]).

Infrastructure assets are exposed to long-term and complex risks creating challenges to investors in assessing and managing risks over it lifetime. While some institutional investors with a long-term horizon may consider such assets attractive for asset-liability management purposes, this has not translated to actual noticeable investment in practice. There is thus a need to create an environment in which investors are better able to make decisions by having relevant information and data availability is a key issue for infrastructure assets.

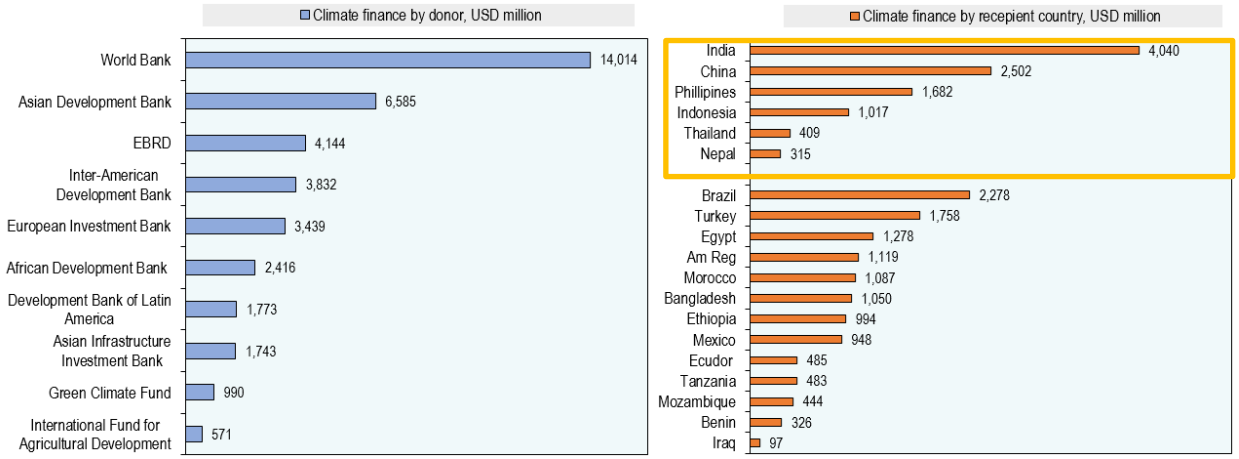
Financing of sustainable infrastructure

As public sector, domestic resources may be insufficient to close the infrastructure-financing gap, there is increasing demand for the private sector financing to fill the gap. In Asia, the majority of infrastructure financing comes from public actors, including state-owned enterprises. The private sector faces a lack of well-prepared, bankable and investment-ready projects to be able to actively participate in infrastructure investment. Given the capital-intensive nature of infrastructure assets, there is also the uncertainty that there may be insufficient financial returns on investments.

Climate finance is an important part of quality infrastructure investment. Expected climate finance that goes into infrastructure is substantial. Global climate finance accounted for USD 632 billion in 2019/2020 (Climate Policy Initiative, 2021[5]). From Figure 1, India is likely to be one of the largest recipients of climate finance in Asia, followed by China, Philippines, Bangladesh and Indonesia. They dwarf other regions in terms of overall financing that is expected for the climate transition. In addition, the expected proportion of

private sector that will be part of this transition is substantial, in instruments such project-level debt and equity, debt, and balance sheet financing.

Figure 1. Expected distribution of climate financing by country in Asia



Source, Financial Times, COP26: where does all the climate finance money go? (3 November 2021) https://www.ft.com/content/d9e832b7-525b-470b-89db-6275853315dd.

Developing a market for sustainable infrastructure assets, including with specific financial instruments, is important when it comes to financing infrastructure projects. Infrastructure bond markets are relatively new in emerging countries in the region, as well as sovereign and non-sovereign green bonds (Suk Hyun, 2017[6]). For investors and savers, bonds offer attractive investment opportunities in terms of returns. Some initiatives are emerging that promote sustainability, such as the Green Bond Grant Scheme of the Monetary Authority of Singapore (MAS), which was introduced in 2017 (Infrastructure Asia, 2022[7]).

Given the financial risks associated with infrastructure assets, the role of development finance institutions (DFIs), multilateral development banks (MDBs) and national development banks (NDBs) is important in providing guarantees and risk mitigation instruments. Additionally, public private partnerships (PPPs) can be effective to channel private capital and funds into infrastructure projects, as they provide a framework of bringing needed additional investment to public infrastructure and also as a mechanism for improving infrastructure planning, implementation, operation and maintenance (ADB, 2019[8]).

Blended finance is expected to pay a major role, given that greenfield projects cannot be developed without substantial donor grants in order to manage the risks of many infrastructure projects in developing markets. Many blended finance vehicles have been developed by MDBs and donor agencies to try to fill the gap, and to crowd in private financing into infrastructure projects. However, it is not clear the extent of the success of these projects, and how blended finance can be most effectively structured to bring in private financing (CAPS, 2022[9]).

The meaning of sustainable infrastructure

It is unclear what constitutes sustainable infrastructure, as there are differing views. For example, many consider renewal energy projects to be sustainable infrastructure which is a more sector based view. Or environmental, social and governance (ESG) factors of projects could be taken into account. Even with respect to ESG factors, there is no agreement on which aspects should be taken into account. For example, an examination by the OECD of the 21 sustainable finance and infrastructure initiatives reveals that there is some convergence in sustainable finance and infrastructure initiatives. This is particularly the

case in relation to environmental or 'E' factors, as some of the initiatives are focused on climate change. However, the initiatives are focused on climate mitigation and not climate adaptation and resilience, which requires greater consideration given the impact that climate change is having on infrastructure assets, particularly in relation to disasters (Table 1).

Table 1. Most common assessment measurements and relevant QII Indicator(s)

	Most common measurement among assessed frameworks	QII indicators measurement
Environmental		
Greenhouse emissions reduction	Reduction against business as usual baseline Y/N tCO2/year	GHG Emissions reduction/avoided tCO2/year
Pollution control	Air, water and soil pollution Y/N Air quality, fine particulate matter emission:PM2.5 and PM10	Local air pollutants reduced, tonnes per year
Biodiversity and ecosystem conservation	Endangered species Y/N Number of Species impacted Percentage of land impacted/ disturbed	--
Energy efficiency	Energy efficiency in buildings, CO2e/p-km Use of renewable energy or energy savings, MWh/GWh	Energy consumption, kWh or MJ/year
Waste reduction	Waste management and recycling Y/N Reduction of waste: metric tonnes or percentage of total over lifetime of project Waste prevented/minimised/reused/recycled	--
Social		
Stakeholder engagement	Stakeholder engagement plan Number of displaced people, including minorities and indigenous people	Stakeholder engagement, Y/N, number of beneficiaries Design minimizes land acquisition and involuntary resettlement, Y/N
Community development	Management of public health and safety risks, Y/N	Community development contributions, currency Infrastructure improvement in local community, Y/N Rural infrastructure assets established or improved, Km for roads, GWh for electricity, and m3 for water
Human & labour rights compliance	Labour standards Y/N Fair wages, % of employees	Fatal/non-fatal occupational accidents, #
Gender	Gender equality, inclusiveness and empowerment plan Y/N	Female direct jobs supported by the project, #
Governance		
Anti-corruption	Anti-corruption protocols & procedures, Y/N	Governance body members that have received training on anti-corruption, number of members and percentage of members Anti-corruption protocols & procedures, Y/N
Corporate governance and sustainability disclosure	Corporate governance structures Y/N	Fiscal sustainability Y/N Information disclosure Y/N Transparency and accountability measures in procurement and financial management supported in implementation Y/N

Note: Y/N stands for a question that can be answered with yes or no.

The social and governance - or 'S' and 'G' - factors lack a more quantitative approach to their evaluation. Their assessment is based on yes/no responses which leads to a binary or tick box evaluation approach. While this is helpful in terms of ensuring that the issue is considered, it may not encourage projects to improve their performance on ESG over time.

Many of the initiatives assessed only list the areas of consideration, without elaborating how these areas could be specificallyevaluated. This means that, while the various initiatives cover similar areas, initiatives that provide a more risk-based approach and enable a more granular understanding are limited in number. Thus, an ESG approach may be insufficient to evaluate sustainable infrastructure at this time.

More discussion is needed to enable a better understanding of what constitutes sustainable infrastructure and to improve the quality of investmenttherein. Initially, this would require a stocktake of approaches beyond ESG factors and being able to take advantage of existing ESG methodologies in sustainable finance.

Challenges that hamper sustainable infrastructure investment

There are a number of challenges when it comes to financing sustainable infrastructure in Asia but also more generally. Asian developing countries which have less mature financial markets will have to depend on public sector financing, especially at the early stages of the project cycle, and greater coordination between public and private sector is needed to ensure sufficient financing can be made available.

The lack of sustainability or ESG investment data in the infrastructure sector can hamper investors' ability to properly assess the sustainability of specific projects. While a number of databases collect infrastructure asset and project level data, ESG investment data are limited and compiled using different indicators and standards to measure sustainability aspects, which leads to inconsistency.In addition, available data is skewed towards advanced financial market data, and limited for emerging and developing markets. Therefore, data on ESG investments in Asia, especially developing Asia are scarce.

The sustainable infrastructure market could benefit from better ESG disclosure requirements underpinned by appropriate governance structures, reviews and controls. The lack of mandatory and consistent reporting of non-financial information by companies makes it challenging for data collectors to acquire this information, and challenges investors to make informed investment decisions (OECD, 2022[10]).

Improving reporting standards of infrastructure projects could greatly contribute to increasing sustainable investment in the infrastructure sector. The Recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) would be a good starting point, but extending this to infrastructure specific aspects could be an important consideration.

Given that ESG data collection for infrastructure is still in its early stages, there is scope to implement a more meaningful data standard, and specify the measures governments can take to ensure the facilitation of collecting relevant data. This may involve using more technological and innovative means for data collection, starting from the administration of corporate reporting which may be paper-based in some jurisdictions, thereby posing a barrier to both collection and aggregation.

In addition, when examining legal and regulatory barriers to QII in Asia, several common barriers are relevant for most countries in Asia:

- Undeveloped lender security rights
- Undeveloped treatment of termination and compensation events
- Limited government support measures (public funding) packages
- Insufficient guidance and regulation for SOEs participation
- Lack of standardised PPP contract provisions
- Lack of PPP selection, prioritisation and pipeline development methodologies
- Unbalanced risk allocation

There are also barriers from regulations related to security interests and ownership, currency convertibility and land use and acquisition.

Social infrastructure has not always been considered an infrastructure asset in Asia, but there is increasing recognition that social infrastructure, which includes education, health, public order, culture and recreational infrastructure, are also important infrastructure assets. These infrastructure projects have proven to be as successful for private investors as traditional infrastructure projects, yet they are subject to fewer of the regulatory constraints cited above and have a lower risk profile.

2 Debt sustainability of infrastructure investment

Infrastructure investments are important to promote growth and reduce poverty and can lead to significant development gains as they can raise productivity, promote private investment and facilitate trade. (G20, 2019[4])

Infrastructure projects are oftentimes financed by borrowing, which can have an impact on sovereign debt sustainability.[1] Principle 6.2 of the G20 Principles for Quality Infrastructure Investment states that financial sustainability for each infrastructure project is necessary, as well as macro-level debt sustainability to achieve sustainable growth. (G20, 2019[4])

Infrastructure debt can have positive or negative impacts on debt sustainability. On the one hand, infrastructure debt that finances productive and sustainable infrastructure can lead to higher income that could eventually offset the cost of the debt service and help to balance the risks to debt sustainability. In contrast, infrastructure investments with low or even negative rates of economic return can lead to unsustainable debt levels and can trigger a spiral of lower sovereign credit ratings and higher debt service commitments. (CAREC, 2019[11])

To have infrastructure investments create growth opportunities and attract foreign direct investments (FDI), the quality of institutions, legal frameworks, governance, and access to finance are important elements to be considered, as they can pose significant obstacles if they are weak. Further, measures of project preparation and planning could lead to better project outcomes to support the financial viability of projects. This is in accordance with the G20 Principles for Quality Infrastructure Investment which highlights the role of well-designed and well-functioning governance institutions to assess financial sustainability of individual projects and prioritise potential infrastructure projects based on available overall financing. (G20, 2019[4])

Debt sustainability in Asia

A rise in public indebtedness increases the risk of debt vulnerabilities, which has implications for the investment in infrastructure projects. While higher public infrastructure spending can raise growth, its benefits depend on how this spending is financed and managed. If the fiscal space is not managed, large lending for infrastructure projects can contribute to debt distress. This risk exists in developing Asian economies, given their limited fiscal space and weak public investment efficiency.

While Asia has experienced rapid capital growth over the last two decades, its debt burden has increased substantially in recent years, with governments, corporations, households, and sub-nationals borrowing large amounts, while the COVID-19 pandemic has exacerbated the situation. However, due to Asia's

[1] Debt sustainability of a country means that it is able to "meet its current and future external debt service obligations without recourse to debt relief, rescheduling, or the accumulation of arrears" (UNCTAD, 2022[51]). A country's public debt burden can be measured by debt as a percentage of gross domestic product (GDP) (Ferrarini, Giugale and Pradelli, 2022[13]).

growth in global public equity markets and corporate bond markets global investors still view the region as a good option for investments for greater diversification and opportunities for their financial portfolios. (Roulet, 2020[12]) Especially while interest rates in advanced economies were close to zero and return opportunities were limited in their markets.

In 2019, Asia accounted for about a third of the world's public debt, with USD 25 trillion out of USD 72 trillion with Asian countries. Around half of that USD 25 trillion was owed by Asian Development Bank (ADB) members (Ferrarini, Giugale and Pradelli, 2022[13]). The public debt burden (public debt to GDP) of developing Asia was 53 percent, which is relatively moderate compared to a world average of 75 percent and more than 100 percent in advanced economies, except for Japan with a ratio exceeding 200%. However, this must be considered against the sovereign credit ratings of each country and associated funding costs this implies (Roulet, 2020[12]).

In 2020, ADB's regional members' fiscal deficit increased by USD1.6 trillion, which grew even more in 2021. In 2022, several Asian countries – Bhutan, Fiji, the Lao People's Democratic Republic, Maldives, Mongolia, India, Pakistan, and Sri Lanka – reached 70 percent of public debt to GDP, which is the "high scrutiny" threshold of the International Monetary Fund (IMF) for public debt monitoring. This was the result of the pandemic, due to which the region's GDP grew at −0.7 percent in 2020, with South Asia at −6.8 percent, and the Pacific at −6.1 percent (Ferrarini, Giugale and Pradelli, 2022[13]).

While Japan and China have large debt, they have high credit ratings (A+ by Standard & Poor's) (World Government Bonds, 2022[14]). In the case of Japan, the country mainly borrows in local currency and there is a deep and broad domestic investor base to purchase the debt. Additionally, the interest rate is lower than the country's rate of growth. As Japan's population is aging quickly, debt sustainability could become challenging in the long run.

China's total debt was 243 percent of GDP by the end of 2019. Unique to China is that the main holders of China's debt are domestic non-financial corporations, which accounted for more than 150 percent of China's GDP in 2019. This debt is concentrated in large, state-controlled firms and almost all of the debt is owed to local state-owned banks (Ferrarini, Giugale and Pradelli, 2022[13]). China is by far the largest Asian issuer of corporate bonds. The country has moved from very low issuance levels prior to the financial crisis in 2008 to a high issuance amount of USD 1.9 trillion in 2019. At end 2019, about 80% of total corporate debt has been issued in local currency. This generally indicates that Chinese companies are raising funds to finance local investment projects (Roulet, 2020[12]). Later during the pandemic, the Chinese government's fiscal and monetary stimuli included tax cuts, targeted loans and looser credit, and the issuance of new bonds to build infrastructure. These short-term measures go in a different direction than China's supply-side structural reforms that the country started in 2015 to make its corporate debt more sustainable. Whether China's supply side reforms are continued after the pandemic or not could determine whether China' debt problem can be considered sustainable in the future (Ferrarini, Giugale and Pradelli, 2022[13]).

In contrast to Japan and China, several low and middle-income Asian countries are dealing with high debt with external creditors. In 2020, the IMF reported that, of the 21 Asian lower income economies, the risk of public debt distress was high in 12 countries and moderate in four. In most of these countries, debt levels rose significantly in the last decade by 11 percent of GDP and the composition of the debt has shifted to private lenders, as well as more non-concessional loans, with more foreign currency and shorter-term debt. The increase of emerging Asia's share of foreign-currency denominated debt in 2021 was due to lower borrowing costs, accounting for 4.2% of its total debt (OECD, 2022[15]). Multilateral organisations and non-Paris club countries, such as China, India and United Arab Emirates, held the majority of public external debt of emerging Asian countries. In order to finance large additional public expenditures as a result of the pandemic, developing Asian countries might seek short term solutions in the form of concessional financing including grants, loans and guarantees from official creditors. After the pandemic

financing might be done through thematic bonds, blended impact funds and government insurance, which limit the tendency towards heavy borrowing (Ferrarini, Giugale and Pradelli, 2022[13]).

In terms of corporate debt, Asian corporates have made increasing use of bond issuance for their funding needs since 2008, complementing traditional channels such as bank lending. Bank intermediated credit remains the dominant source of financing for companies in the region, as bank-based financial intermediation has a traditionally strong position in Asia. However, the dominant position of bank credit is increasingly being challenged (Roulet, 2020[12]). Corporate bond issuances have continuously increased since 2005, leading the corporate debt outstanding to GDP ratio to rise from 14% of GDP in 2008 to 29% in 2019, with China being by far the largest contributor to the growth. In 2019, the outstanding amount of emerging Asian financial corporate bonds accounted for 20% of the global financial corporate bond outstanding amount (Roulet, 2020[12]).

Table 2. Indebtedness levels and risk of debt distress for developing Asian countries

	General Government Gross Debt (% of GDP)			Risk of Debt Distress		
Country	**2010**	**2015**	**2020**	**2015**	**2019**	**2020**
Afghanistan	7.7	9.2	7.8	High	High	High
Australia	20.4	37.7	57.3			
Bangladesh	35.5	33.7	39.6	Low	Low	Low
Bhutan	61	98.6	121.3	Moderate	Moderate	Moderate
Cambodia	28.7	31.2	34.2	Low	Low	Low
China, People's Republic of	33.9	41.5	68			
India	66.4	69	89.6			
Indonesia	24.5	27	36.6			
Japan	205.7	228.4	254.1			
Kiribati	8.5	19.9	17.7	High	High	High
Korea, Republic of	29.5	40.8	47.9			
Lao PDR	49.3	53.1	70.9	Moderate	High	High
Malaysia	51.2	57	67.4			
Maldives	52.7	53.4	118.3	Moderate	High	High
Marshall Islands	38.6	33.7	27.4	High	High	High
Micronesia, Fed. States of	28.8	25.6	16.5	High	High	High
Myanmar	52.2	36.3	42.4	Low	Low	Low
Nepal	34	25.6	39.2	Low	Low	Low
Pakistan	60.7	63.3	87.2	Moderate	High	High
Papua New Guinea	17.3	29.9	46.7	Low	Moderate	High
Philippines	47.6	39.6	51.7			
Samoa	39.7	58.9	55.6	Moderate	High	High
Solomon Islands	22.9	9	15.3	Moderate	Moderate	Moderate
Taiwan Province of China	36.9	35.9	32.7			
Tajikistan	36.6	34.7	47.8	High	High	High
Thailand	27.8	32.2	45			
Timor-Leste	0	2.8	11.7	Low	Low	Low
Tonga	44.7	51.2	41.9	Moderate	High	High
Tuvalu	27.6	57.6	16	High	High	High
Vanuatu	19.4	36	47.7	Moderate	Moderate	Moderate
Vietnam	36.8	46.1	46.3			

Source: IMF Global Debt Database, retrieved from Global Debt Database - General Government Debt (imf.org); and Word Bank Debt Sustainability Analysis, retrieved from Debt Sustainability Analysis (worldbank.org)

The Belt and Road Initiative

Potential debt concerns in the region may also arise from China's Belt and Road Initiative, which is responding to major infrastructure gaps in Asia and boosting economic growth and global trade. The Belt and Road Initiative (BRI) was initiated by China and seeks to connect Asia with Africa and Europe via land and sea networks with the aim of improving regional integration, increasing trade and stimulating economic growth. The BRI is associated with large investments in infrastructure development for ports, roads, railways and airports, as well as power plants and telecommunications networks. Since 2019, Chinese BRI lending volumes have declined and BRI now places increasing emphasis on "high quality investment", including through greater use of project finance, risk mitigation tools, and green finance (EBRD, 2022[16]).

However, the BRI has raised important questions about the risk of debt problems in less developed countries. The increase in public debt to finance infrastructure projects may be potentially concerning if it limits other spending as debt service rises, and creating balance of payment challenges. The risks could be especially high for the small and fragile economies of the Pacific, given their small size and structural vulnerabilities. Several small Asian-Pacific states are some of the most heavily indebted countries to China, including Laos, Tonga, Cambodia and Samoa. The large volume of China's lending and its lack of strong institutional mechanisms to protect the debt sustainability of borrowing countries could pose risks to these countries (Lowy Institute, 2019[17]).

The majority of Chinese official development finance are loans with only a minority being concessional. The main source of Chinese development financing comes from its state-owned policy banks. China's state-owned commercial banks have also become increasingly overseas lenders under the BRI. The non-concessional nature and the large volume of Chinese-owned debt under the BRI has raised concerns that the initiative could generate debt sustainability problems in developing countries. (Lowy Institute, 2019[17]) For example, a state-owned Chinese firm gained a majority equity in the Hambantota Port in Sri Lanka after the country ran into debt related difficulties. A lack of transparency about the BRI limits official numbers and commercial terms of Chinese lending (CSIS, 2022[18]).

The OECD has set up the Debt Transparency Initiative to ensure better assessment of the levels of indebtedness, debt pricing and other transaction terms, and to operationalise the IIF Voluntary Principles, especially with regard to debt data from Low Income Countries (LICs). The OECD seeks to develop a data repository to make public data on private financing to countries that are eligible for the Poverty Reduction and Growth Trust (PRGT) available, which could help to make the international co-ordination and negotiations of debt servicing and suspension fairer and more substantial, and to improve borrowers' debt sustainability (OECD, 2022[19]).

Areas for further discussion

While infrastructure investments are necessary to promote growth and can create additional debt paying capacity, the pressure debt financing of infrastructure can apply on debt sustainability, especially for countries that already have limited fiscal space, needs to also be taken into account. Investments should target quality infrastructure development to support long-term financial and environmental sustainability.

In Asian developing countries with no fiscal space, debt relief and increased concessional lending, as well as models of blended finance by multilateral and bilateral donors could contribute to the reduction of debt distress and rebuild fiscal space. Technical assistance could strengthen the capacity for countries to manage their debt as well. Further, public-private partnerships (PPPs) could be a way to bring in the private sector. However, a high level of co-operation and expertise is needed to ensure good infrastructure development, in order to avoid contingent liabilities to become direct liabilities to governments.

3 Climate resilience in the Asia-Pacific region

The Asia-Pacific region is one of the regions most exposed to the impacts of climate change. Millions of people live in coastal regions especially vulnerable to sea level rise, changing rainfall patterns, floods and storms. Droughts will occur in West, Central and South Asia where the population often depends on rain-fed agriculture. Approximately, 64% of the region's population is expected to live in urban areas by 2050. Urban communities are among the most vulnerable to climate change due to the concentration of poverty and inequalities, informal settlements and ageing and overburdened infrastructure networks. According to the World Meteorological Organization (WMO), more than a third of power plants, cable networks, airports and road infrastructures are located in high-risk areas prone to climate hazards (WMO, 2021[20]) Between 2004 and 2020, disasters caused losses of over USD 500 billion in the region, affecting 2.1 billion people. (Goldfinch, 2022[21])

Climate change impacts can induce direct losses due to damage to infrastructure, disruption in services and affect supply chains. Interdependencies between water, energy or transport infrastructure in urban areas, but also between rural and urban areas (and critical ecosystems in both areas), can create cascading effects and result in the failure of infrastructure networks. For instance, the floods in Bangkok in 2011 significantly affected the car industry in Japan, as suppliers were located in the flood areas. Taking into account these interdependencies and the need to address the effects of climate change, stronger regional co-operation in the construction of resilient infrastructure could benefit the region (OECD, 2018[22]).

As investments in infrastructure play a central role in the economic development agendas of many countries in the region, mainstreaming climate resilience in infrastructure will be key to sustaining economic growth. If risks are left unaddressed, there is a possibility of reversing development progress made in recent decades and creating a future that is increasingly uncertain and unequal (Goldfinch, 2022[21]).

Internationally, the need to strengthen climate-resilience in infrastructure is recognised. The G20 Principles on Quality Infrastructure Investment (QII) highlight the need to build resilience against extreme climate events. They point out that climate risks should be factored in when planning, budgeting, designing, building, operating and maintaining infrastructure.

Climate resilient infrastructure can be defined as infrastructure that is planned, built and operated in a way that is prepared for and adapted to climate change conditions. It reduces, but might not fully remove the risk of climate-related disruptions. Ideally, climate resilience is integrated in the life-cycle of the infrastructure asset. Given the context-specific nature of climate adaptation, the measures used to achieve resilience vary broadly. Measures can be structural, such as changing the composition of road surfaces or organisational such as investment in early warning systems or measures to adjust to changing circumstances over the asset's lifetime. (OECD, 2018[22])

The way the resilience aspect is planned and designed has important impacts on an asset's robustness to climate change, as infrastructure is long-lived and capital-intensive. For instance, choices about location and design determine whether and to what extent losses occur due to disasters. In addition, strategic coherence and efficient delivery can be obtained by integrating climate risk assessment into early-stage planning of infrastructure (ADB, 2021[23]).

Nature-based solutions

Nature-based Solutions (NbS) can be a cost effective way to strengthen infrastructure resilience, while also delivering other societal benefits. NbS are measures that protect, sustainably manage or restore nature, with the goal of maintaining or enhancing ecosystem services to address a variety of social, environmental and economic challenges (OECD, 2020[24]). NbS can be considered as an umbrella concept for other approaches, such as ecosystem-based adaptation, eco-disaster risk reduction, green infrastructure and natural climate solutions (OECD, 2020[24]). An example of NbS are green-roofs, roofs of a building that are partially or completely covered with vegetation (Calheiros and Stefanakis, 2021[25]), which are nature-based solutions that are mainstreamed in infrastructure planning to mitigate flood risk and increase the resilience of the original infrastructure. Other examples are artificial reefs and sand-dune restoration to prevent coastal erosion and restore previously damaged marine habitats.

Given the uncertainty and high upfront cost of grey infrastructure[2], nature-based solutions have the potential to improve infrastructure resilience effectively. Grey infrastructure can be costly to build and maintain, as well as inflexible, since it is often designed assuming static climatic conditions. For example, coastal defences have become increasingly expensive to adapt to rising sea levels and maintain over time. NbS in contrast offer flexibility and room for natural systems to regenerate.

Despite the potential of NbS in the Asia-Pacific region to strengthen infrastructure's resilience to climate change impacts, their uptake remains low, as financing remain limited (OCHA, 2021[26]).

Building infrastructure resilience

A range of considerations can prevent new and existing infrastructure from being built and operated in a climate resilient manner, in particular from the complexity involved in anticipating climate events.

It is difficult to fully understand and account for the benefits of resilience measures, which limits the motivation to develop such measures. Planning decisions are often based on a simplistic view of risk. For instance, many assessments only take into account benefits that come from reducing disaster losses and do not properly consider the economic or social development impacts from adapting resilience measures. Policies could create incentives to support climate resilience mainstreaming (OECD, 2020[24]).

There is a considerable uncertainty about future climate risks that make investment decisions into resilience difficult. Information on climate projections may not be readily available, nor in a sufficiently granular format needed to inform infrastructure development. More granular risk information that takes into account future demographic, economic, and climate scenarios could improve decision-making. Ways to address these barriers could be the increased use and standardisation of open source data, tools to assess vulnerability or training sessions for infrastructure stakeholders (ADB, 2022[27]).

Financing resilient infrastructure

Investments in resilient infrastructure will be critical in shaping economic and environmental sustainability, bearing in mind that infrastructure usually has a long lifespan. There is growing evidence that resilient investments can deliver stronger economic returns considering the potential financial and losses that can occur due to climate events. Ex ante investment before a disaster can reduce costly damage and losses and provide additional benefits. Thus, when these investments are made, they will be a determining factor in the strengthening resilience to disaster and climate risk in the region (OECD, 2018[22]).

[2] Grey infrastructure is man-made and engineered, such as dams, dikes and storm surge defences (OECD, 2020[24]).

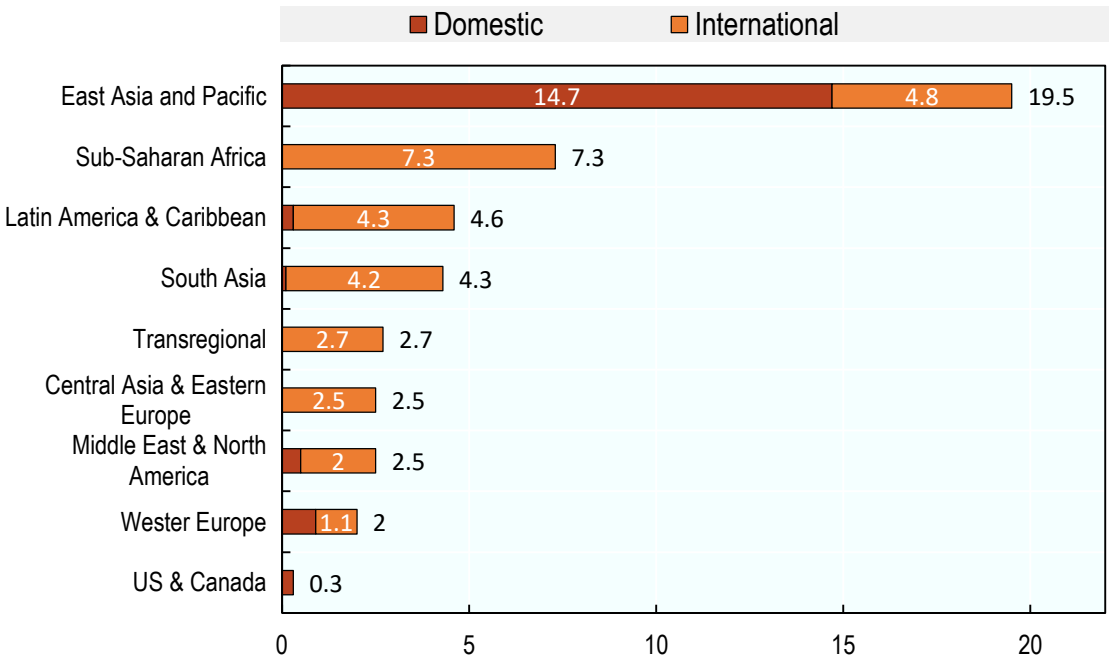
The World Bank calculates that, by incorporating resilience into infrastructure, the return on investment can be as high as four times the cost of the original infrastructure project, especially when taking into account the cost of lives, damage to property, and disruption of the economy. Relative to this, incorporating resilience in infrastructure is assumed to increase the cost of a project by an average of 3-4% (World Bank Group, 2019[28]).

Financing for climate-resilient infrastructure may require a mixture of public and private resources. In developing countries, public funding for infrastructure is much higher than in developed countries, at 60-65%, compared to 40% in developed countries. Consistent data on finance flows for climate-resilient infrastructure is lacking, as resilience is hard to isolate from overall infrastructure financing. In addition, there is no commonly accepted taxonomy for climate-resilient finance, making it difficult to assess the share of public and private investments in climate-resilient infrastructure. (OECD, 2018[22]).

Global finance for adaptation more generally and not specific to infrastructure increased by 53% reaching USD 46 billion in 2019/2020, compared to USD 30 billion in 2017/2018. Despite this positive trend, there is a general lack of total adaptation finance, which accounts only for 7% of total climate finance (Climate Policy Initiative, 2021[5]). This is far below the scale necessary to respond to existing and future climate change (UNEP, 2021[29]) . East Asia and the Pacific had the highest amount of global adaptation finance in 2019/2020, amounting to 46% of global flows, of which the large majority came from domestic sources, (see Figure 1. Adaptation finance by region, 2019/2020). The Climate Policy Initiative estimates that 81% of the investments in the East Asia and Pacific region were concentrated in China, considering its high public spending on climate projects and national policies for domestic investment (Climate Policy Initiative, 2021[5]).

Figure 1. Adaptation finance by region, 2019/2020

USD billion



Source: Climate Policy Initiative (20201). Global Landscape of Climate Finance 2021 Retrieved from Global Landscape of Climate Finance 2021 - CPI (climatepolicyinitiative.org)

Most global climate adaptation finance comes from public resources. A low amount of private finance flows into climate adaption due to barriers to mobilising private sector investment in this area and limitations on tracking the private sector adaptation investment that does take place. Tracking adaptation finance is difficult due to challenges with regard to context dependency, confidentiality restrictions, uncertain causality, and a lack of common impact metrics. Barriers to private sector investment in adaptation include concerns from private sector actors about the bankability of adaptation activities and limited internal capacity to identify and develop adaptation project pipelines (Climate Policy Initiative, 2021[5]). This makes it important to put policies and incentives in place to unlock private sector investment in adaptation and resilience.

4 Investing in energy infrastructure for the energy transition

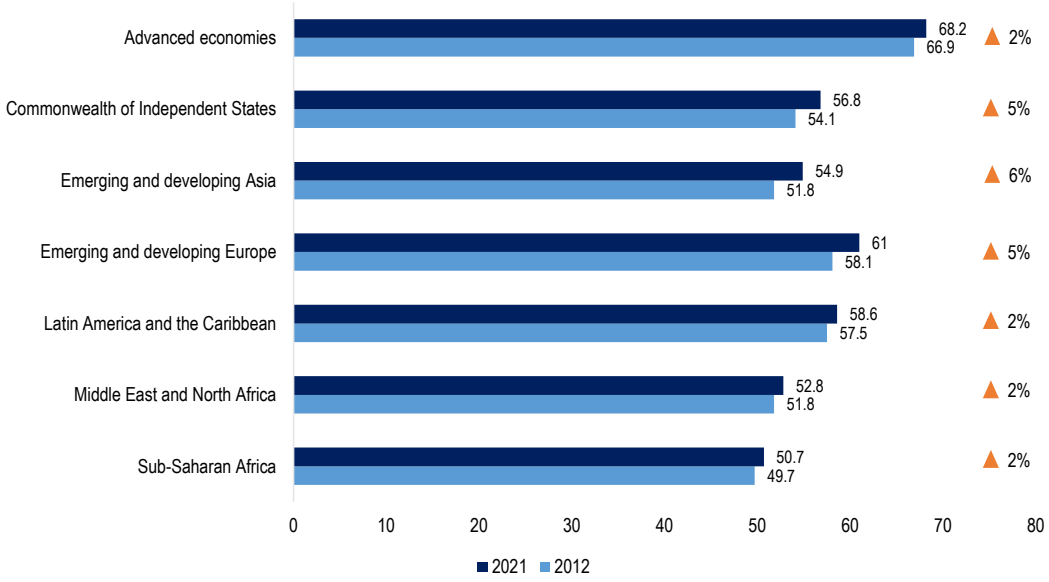
Achieving net zero carbon emissions by 2050 requires a global energy transition of a significant scale, as well as speed. In Asia, energy demand has been increasing steadily, due to strong economic and population growth in recent decades, and this demand is expected to keep growing. The International Energy Agency (IEA) projects that the region's total demand for electricity will grow to 1,506 million tons of oil equivalent by 2040, compared to 927 million tons in 2019. Currently, the region is responsible for about half of global emissions (IEA, 2019[30]). Meanwhile, one tenth of the region's population still lacks access to any form of electric energy.

Slowing down emissions in Asia requires a transition towards clean energy sources, such as wind and solar, as well as efficient energy storage mechanisms (Susantono et al., 2021[31]). However, the transition towards more sustainable technology is costly and most governments do not have the resources to address this. A steady increase in renewable energy investment by the public and private sector is needed if the energy needs of the region are to be met.

Energy transition in Asia

According to the 2021 World Economic Forum's Energy Transition Index (ETI) (World Economic Forum, 2021[32]), an index that measures a country's level of energy transition progress, Asia has improved at the fastest rate in comparison to other regions, increasing its ETI index score by 6% as compared to a decade ago (Figure 1). However, energy per capita in emerging and developing Asia has grown by almost 18% within the past decade, in contrast to a 4.8% fall in advanced economies.

Figure 1. Regional Energy Transition Index (ETI) score 2021 and change from ETI 2012



Source: World Economic Forum, 2021. Retrieved from WEF_Fostering_Effective_Energy_Transition_2021.pdf (weforum.org)

Emerging Asia is traditionally heavily dependent on fossil fuels, such as natural gas, oil and coal for energy generation. In 2021, fossil fuels made up 85% of energy demand in the region, with several countries heavily dependent on fossil fuel imports.

Moreover, many people depend on traditional biomass for cooking and heating. The COVID-19 pandemic slowed down the use of clean cooking stoves and fuels, as the ability of households to be able to pay for clean fuel decreased. In 2020, many people in developing Asia returned to the traditional use of solid biomass for cooking. Some governments enacted policies to ensure continued delivery of biomass during the pandemic; for instance, in India, the government provided support for free refills of liquefied petroleum gas (LPG) cylinders (Susantono et al., 2021[31]).

The IEA estimates that nearly 80% of coal demand in 2020 came from Asia, and it projects that the level will stay above 80% in 2050. Currently, coal makes up around half of the region's energy mix, with China and India being particularly reliant on it, with coal powering the industrial development and economic growth of most Asian countries. Even though China announced to stop financing new coal projects abroad, coal-fired power plants are still in the pipeline in the country itself. Vietnam and Indonesia, which are two of the top 10 coal power generating countries globally, pledged to stop unabated coal power by 2040 (IEA, 2021[33]).

If they were to meet net zero emissions by 2050, Asian countries would need to be committed towards phasing out coal. To reach this goal, the construction of new coal projects needs to be reviewed, as well as the phasing out of existing coal power plants. However, coal power plants are relatively young at around 13 years in Asia, with those in South East Asia, India and China being around 11 years of age, compared to an average age of 30 to 40 years in developed markets (Figure 2). In addition, most of the capital invested in coal power plants still needs to be recovered, with a risk of stranded assets if a rapid phase out is implemented (IEA, 2021[34]).

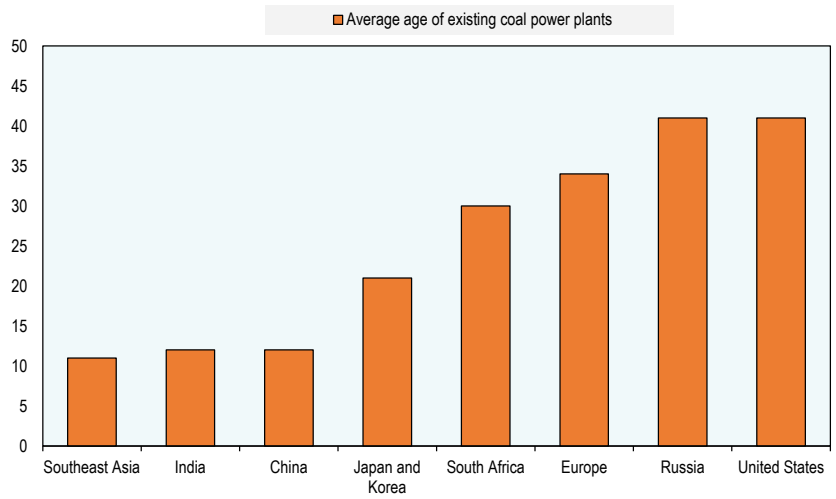
In 2019, Indonesia, Vietnam, Philippines and Thailand's operating coal-fired power plants had a capacity of 80 GW, with power plants in construction accounting for 24 GW and the ones in pre-construction having a capacity of up to 52 GW (Figure 3). In 2021, Carbon Tracker, a financial think tank, reported that China,

India, Indonesia, Japan and Vietnam plan to build more than 600 coal power units, which accounts for 80% of the world's new coal-fired power plants (S&P Global, 2022[35]). While some of the new coal plants under construction will replace older, more polluting ones, together they will add to total emissions (Reuters, 2021[36]).

For coal dependent countries, the closure or repurposing of power plants and coal mines could have significant economic and social consequences, since the economy is often closely tied to the coal value chain. Therefore, closures should take into account the impacts on affected workers and communities, and on the repurposing of affected land. This is likely to entail long-term engagement by many different parts of government and local businesses.

Thus, coal retirement could be a real challenge to Asia's energy transition with the young age of existing coal power plants and more projects in the pipeline. It is necessary to shift investment away from new coal projects and develop policies to support this change (IEA, 2021[33]).

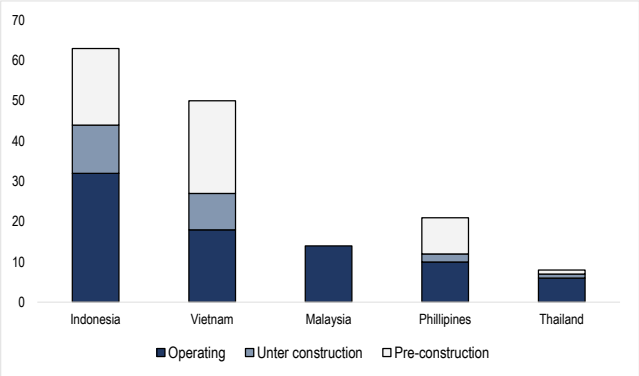
Figure 2. Average age of existing coal power plants, 2020



Source: International Energy Agency. World Energy Outlook 2021. Retrieved from World Energy Outlook 2021 (windows.net)

Figure 3. Capacity of coal-fired power plants in Southeast Asia, 2019

In Gigawatt (GW)



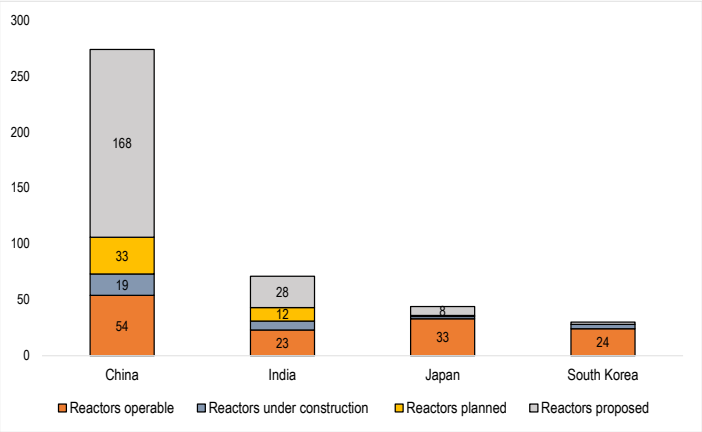
Source: International Energy Agency, 2021. Retrieved from Capacity of coal-fired power plants in Southeast Asia, 2019 – Charts – Data & Statistics - IEA

In the transition towards a lower carbon future, liquefied natural gas (LNG), a fossil fuel that produces fewer emissions than coal and oil, is expected to play a key role in Asia for the next 10 to 15 years (World Economic Forum, 2021[37]). In 2021, Asian countries accounted for nearly three-quarters of the global LNG imports (IEA, 2021[33]). Some Asian countries regard it as a transition option that replaces coal, as it provides stability while capacity for renewables is developed. Some countries have already started replacing coal with LNG.

Asia makes significant use of nuclear power, capturing about one fourth of operational nuclear power units in the world, even after the nuclear disaster at Fukushima in 2011. According to the World Nuclear Association, in 2022, Japan has 33 operative reactors while proposals, planning or construction have started on an additional 11 reactors (World Nuclear Association, 2022[38]). India plans to triple its number of nuclear power plants to 72 in total, while China has proposed the construction of 168 new reactors in addition to 18 being built and 37 being planned. Overall, 35 reactors around Asia are already in construction, whereas there are 15 plants under construction for European countries (World Nuclear Association, 2022[38]).

Figure 4. Nuclear power reactors in Asia, 2022

Count of reactors

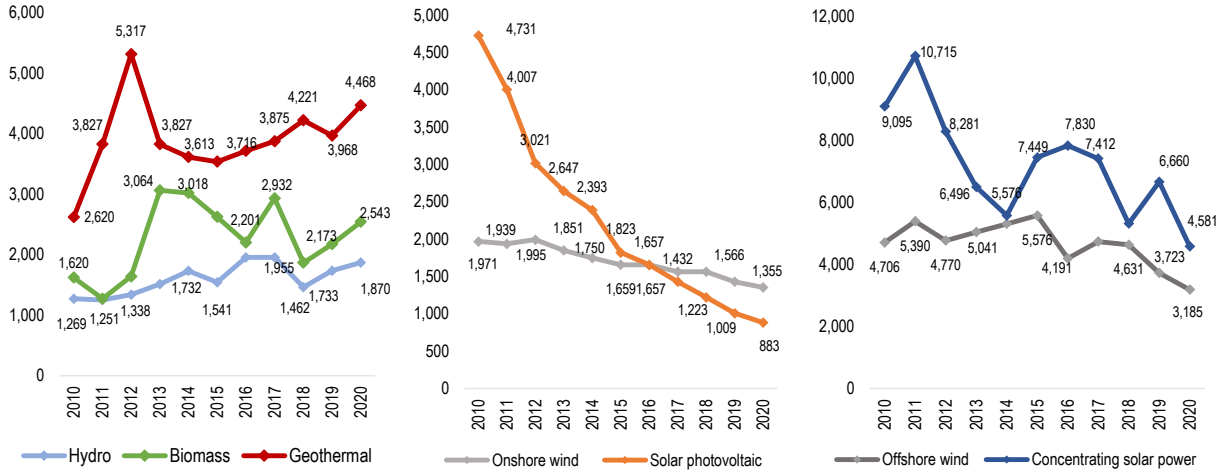


Source: World Nuclear Association, 2022. Retrieved from World Nuclear Power Reactors | Uranium Requirements | Future Nuclear Power - World Nuclear Association (world-nuclear.org)

Over the long-term, meeting growing consumption with fossil fuels will come at the expense of energy security, as fossil fuel reserves are limited and costs are rising, in addition to damaging the environment. The diversification of energy supply through investments in renewable energy, in combination with improvements in energy efficiency offers a good option to expand the energy system while achieving socio-economic and environmental benefits.

The cost of clean energy generation, notably solar and wind, has fallen significantly in recent years, due to improved technologies, economies of scale and competitive supply chains. New renewable capacity in solar and wind is increasingly cheaper than new fossil fuel-fired capacity, and it increasingly undercuts the operating costs of existing coal-fired power plants. Figure 5 presents the trend in the global weighted-average total installed costs of renewable power generation technologies between 2010 and 2020. More established renewable technologies for bioenergy – for power, geothermal and hydropower – have not seen significant cost reductions, while there were strong reductions in total installed costs for solar and wind technologies (IRENA, 2020[39]).

Figure 5. Global weighted-average total installed costs by technology, 2010-20



Source: IRENA. (2021). Renewable Power Generation Costs in 2020. Retrieved from Renewable Power Generation Costs in 2020 (irena.org)

Many countries made Nationally Determined Contributions (NDCs) to reduce Green House Gas (GHG) emissions following the Paris Agreement. Japan and South Korea have announced plans to achieve net zero emissions by 2050, which are legally embedded in their laws, and China announced to become carbon neutral by 2060. Indonesia plans to reach net zero carbon emissions by 2060, and India has targets for this by 2070. Further, in the framework of the ASEAN Plan of Action for Energy Co-operation, Southeast Asian countries have committed to meeting a target of 23% renewable energy in total primary energy demand by 2025 (IEA, 2021[40]).

Solar accounted for 13% of the total renewable energy-based electricity generation in Asia in 2019. Solar electricity production increased 45 times from 2011 to 2019, from around 8.4 terawatt hours (TWh) in 2011 to over 370 TWh in 2019, while the global production of solar electricity increased 11 times. Moreover, Asia accounted for more than half of total solar electricity production in the world in 2019 (IRENA, 2022[41]).

IRENA estimates that total wind electricity production, onshore and offshore, in Asia grew five-fold during 2010 and 2019, from 98 TWh in 2010 to 491 TWh in 2019 (IRENA, 2022[41]). Next to solar, Asia has a large wind resource potential in terms of its electrical power capacity and energy production, and this potential is largely untapped in many countries (Susantono et al., 2021[31]).

Renewable hydropower (excluding pumped storage) represents a large source of electricity, accounting for 62% of total renewable energy based electricity production in Asia in 2019. Renewable hydropower production in Asia was 1,812 TWh in 2019, a 40% increase from its 2011 level (IRENA, 2022[41]). China is the biggest producer of hydropower in Asia, holding several of the world's largest hydro power stations. The country's electricity generation with renewable hydro power was 1,273 TWh in 2019. Other large hydro power producers are India, Vietnam and Japan, with 145 TWh, 93 TWh and 80 TWh renewable hydro power production in 2019, respectively (IRENA, 2022[42]). To date, Bhutan and Nepal rely mostly on hydropower for electricity compared to other sources of renewable energy (Vaidya et al., 2021[43]). In many Asian countries, the exploitable hydropower potential is significantly higher than its utilisation (Susantono et al., 2021[31]).

Bioenergy resource exist in different forms, such as solid biomass (including fuelwood, agricultural residues and animal waste), renewable municipal waste or liquid biofuels. Bioenergy as a whole accounted for 6.7% of the total renewable energy-based electricity generation in Asia in 2019, at 193 TWh (IRENA, 2022[41]). There remains significant unexploited potential for power generation based on this resource in the region (Susantono et al., 2021[31]).

Biomass waste including bagasse, biogas, and renewable municipal waste is also considered a significant resource for energy production in several countries in Asia, comprising 7% of the Asia's renewable energy-based electricity generation. Biomass waste of different kinds contributed to about a quarter of bioenergy based electricity production in Asia in 2019. Only a small fraction of the potential is being used to produce electricity in Asian countries, which indicates significant opportunities to develop these energy resources.

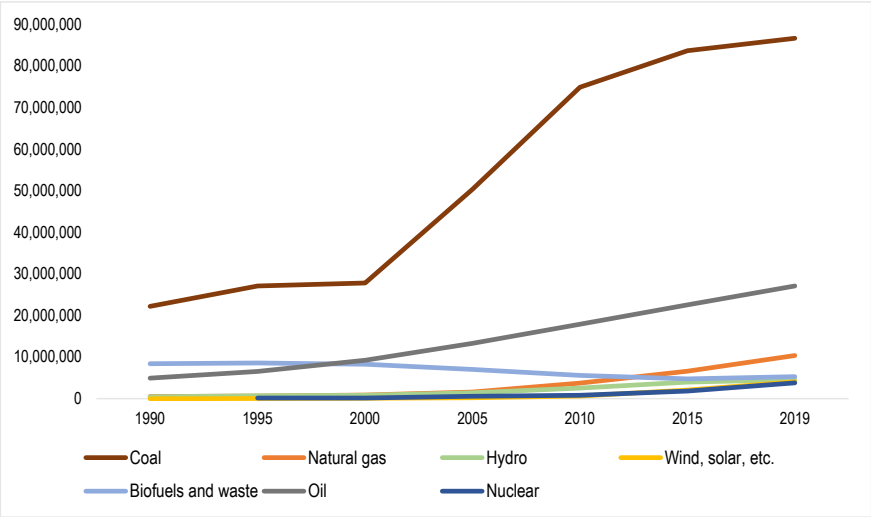
Production of geothermal energy in Asia was 28 TWh in 2019 while the total installed power generation capacity of geothermal in the region was 4,584 MW. Indonesia aims to increase its geothermal power generation capacity to 5 GW by 2025, while the Philippines has a target to have its geothermal capacity to 3,200 MW by 2030.

In terms of energy efficiency, significant developments are taking place in the Asia to improve energy efficiency in the transport sector, such as the growing number of electric vehicles. China holds 70% of global manufacturing capacity for electric vehicle batteries. In India, 380,000 electric vehicles were sold during 2019 to 2020. Further, almost two out of three high-speed rail lines in the world are reported to be in China. The energy intensities of space heating and lighting show significant improvements in energy efficiency during 2000 and 2019 (Susantono et al., 2021[31]).

Vietnam is one of the fastest growing renewable markets in the Asia-Pacific region. It holds one of the largest solar power capacity regionally and ranks top 10 globally (Amundi, 2021[44]). However, while the country is targeting almost 130 GW of renewable capacity by 2045, it is also more than doubling its anticipated coal fired capacity over the same period (IEA, 2021[33]).

Figure 6. China's total energy supply by source, 1990-2019

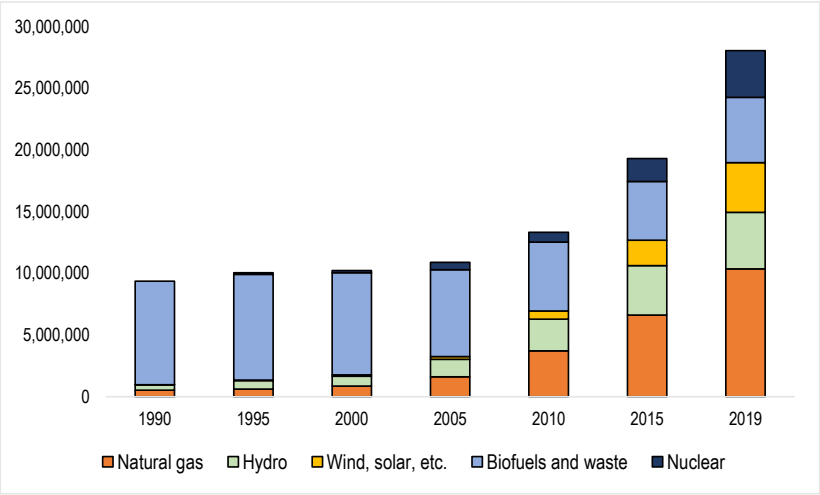
In Terajoule (TJ)



Source: International Energy Agency, 2020. Retrieved from https://www.iea.org/countries/china

Total energy supply by source, coal and oil (excluding People's Republic of China) 1990-2019

In terajoule (TJ)



Source: International Energy Agency, 2020. Retrieved from https://www.iea.org/countries/china

In certain markets, fossil fuels are still subsidised by governments, which can compromise the support for renewable energy expansion. The IEA estimates that in 2020, Chinese fossil-fuel subsidies amounted to USD 25.5 billion, while they were USD 24 billion in India, and USD 6.9 billion in Indonesia (IEA, 2022[45]). Other countries with fossil fuel subsidies are Malaysia and Brunei and to a lesser extent Thailand and Vietnam. The renewable energy and energy efficiency potential of countries in the region can only be fulfilled if these subsidies are phased out. This would also make room for public finance resources that can be reallocated towards renewable sources.

Further, grid limitation can inhibit additional renewable capacity. Grid is highly fragmented in Asia and there are issues in the operationalisation of off-grid areas. In most countries of the region, state-owned enterprises have a monopoly over power generation, transmission and distribution utilities, with the exception of the Philippines where a private consortium, the National Grid Corporation of the Philippines, has a concession to operate the sector (IEA, 2021[46]). Thus, while there is a need to develop and upgrade transmission and distribution networks in Asia, it would also be beneficial to allow for a more adaptive environment with the participation from market players and attract private sector investment. In 2021, Vietnam proposed an amendment to its electricity law which permits all economic actors, including foreign investors to invest in developing electricity transmission lines. The country hopes that with private sector allowed to build transmission lines, state-owned enterprises will no longer have to annually invest large amounts in constructing them (Long, 2021[47]).

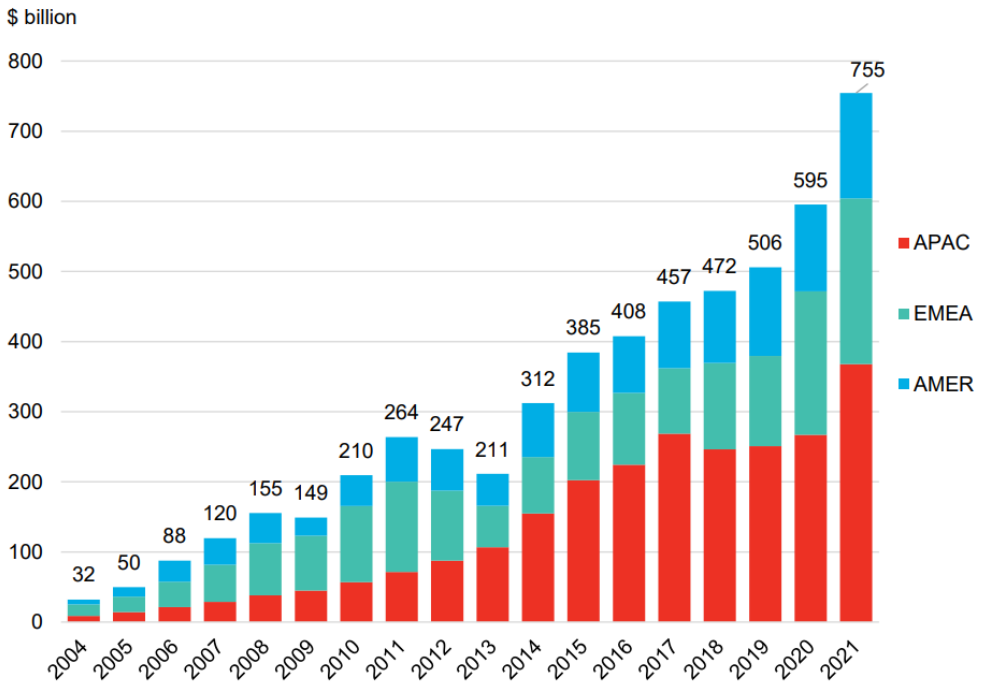
Financing the energy transition

The energy transition in Asia requires a steep increase in clean energy investment. According to the International Energy Agency (IEA), annual clean energy investment in emerging and developing economies needs to expand by more than seven times– from around USD 150 billion in 2020 to over USD 1 trillion by 2030 – in order to achieve net-zero emissions by 2050. Financing is also needed in grid development, energy efficiency and storage (Susantono et al., 2021[31]).

The need to scale clean energy in Asia to meet its NDC offers a significant investment opportunity. The Asia-Pacific region attracted the highest overall levels in investment in low-energy carbon transition in 2021

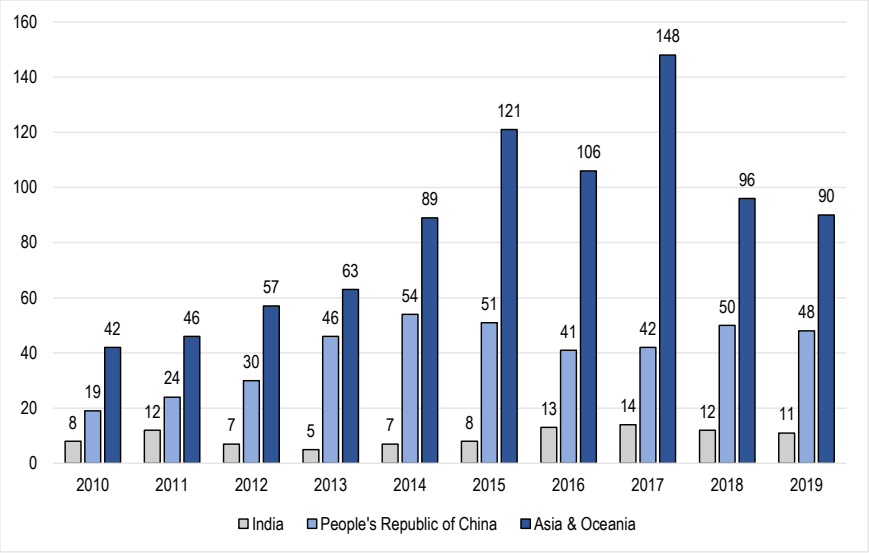
relative to other regions. It also realised the highest overall rate of growth in investments in this area, at 38%, with electrified transport being the largest driver. Investments in energy storage in China, Japan, Korea and India are very low when compared to investments electrified transport and renewable energy (IRENA, 2022[42]).

Figure 7. Global investment in energy transition by region, 2021



Source: BloombergNEF (2022). Retrieved from Energy-Transition-Investment-Trends-Exec-Summary-2022.pdf (bbhub.io)

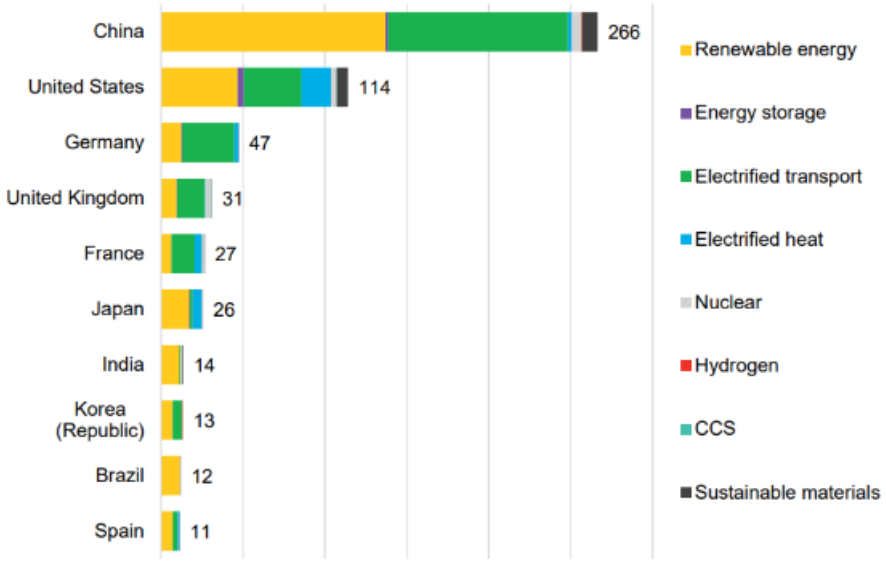
Figure 8. Investment Trend in Renewable Energy in Asia, 2010-19



Source: Renewable Energy Policy Network for the 21st Century (REN21). (2020). Renewables 2020 Global Status Report. Paris: REN21. Retrieved from: gsr_2020_full_report_en.pdf (ren21.net)

Global investment in energy transition by country, 2021

In USD billion



Source: BloombergNEF (2022). Retrieved from Energy-Transition-Investment-Trends-Exec-Summary-2022.pdf (bbhub.io)

There are several factors that limit private sector investment into the clean energy sector of the region. These include uncertainties over foreign currency availability and convertibility, political risks, and a low capacity of governments to prepare bankable power purchase agreements (PPAs). Clean energy and energy efficiency projects, as opposed to conventional energy projects, require a good understanding of the risks, uncertainties, and challenges involved in financing the supply and demand side (Susantono et al., 2021[31]). Moreover, the availability of bankable projects that offer adequate returns is limited.

The most bankable projects are often the largest scale projects which are often on-grid projects. This can lead to smaller and off-grid projects from being excluded by private financing (Anantharajah and Setyowati, 2022[48]). The role of MDBs and DFIs is important to assist private investment by providing de-risking mechanisms, structuring bankable projects, and co-financing private sector capital providers. Blended finance provided by DFIs is critical to attract private investment to markets at the early stages of projects when risks are harder to mitigate.

Another limitation towards investment in energy for some countries in Asia is that they have restrictions related to foreign participation and ownership, limiting the inflow of FDI. Therefore, in some countries, such as India, the role of FDI remains low (IEA, 2021[49]).

Areas for further discussion

A number of steps could be taken to support the energy transition in Asia including the gradual phasing out of fossil fuel subsidies, the introduction of carbon pricing, incentives for private investments in renewable energies, and a regulatory framework to strengthen energy efficiency.

While fossil fuel subsidies exist to enable energy access to the poorest populations, they could be rechannelled towards more efficient expenditure, such as expansion of the energy infrastructure or grants to the poorest households to ensure their energy access, subsidies to companies to promote renewable energy technology or other measures to address the transition towards renewables.

One example of a tool that can be used by the government to incentivise the transition from fossil fuels to renewable energy is the implementation of feed-in-tariffs (FiTs). According to the International Renewable Energy Agency (IRENA), the use of FiT is correlated with growing investments in renewable energies in the region, especially in Vietnam, the Philippines, Thailand and Malaysia. FiTs are government subsidies that require grid operators to purchase renewable energy from producers at a rate which is determined by the government and guaranteed for a fixed period of time. This incentivises renewable energy producers to operate with price certainty. FiT has influenced the development of renewable energy production and contributed to solar energy growth in China, Japan and Vietnam (Amundi, 2021[44]). FiTs for producers in Vietnam supported solar power capacity to be increased from 10 MW in 2018 to 4.5 GW in 2020. (Payerols, 2020[50])

The use of PPPs for renewable projects could also contribute to the expansion of the renewable energy market and channel investments toward riskier projects. However, there are very few PPP renewable energy projects in the region and a regulatory framework that supports PPPs with improved risk sharing between governments and investors could be critical.

For a renewable energy market to emerge, the role of the international community is important in providing financial assistance, as well as technology transfer, especially in the least developed countries in the region. One example of a tool to attract finance is the Energy Transition Mechanism, developed by the Asian Development Bank, a platform to accelerate the retirement of coal power by using blended finance and to support investment in renewables (IEA, 2021[33]).

Measures for energy efficiency requirements need to be strengthened, such as equipment certification and energy management obligations for industries, such as energy saving equipment in the construction industry.

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