THE AIIB'S ENERGY OPPORTUNITY: BACKGROUND RESEARCH REPORT

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The new Asian Infrastructure Investment Bank (AIIB) will be a major new funder of infrastructure in developing Asia, where demand for power is growing faster than any other region in the world. Done right, it could promote an inclusive and sustainable Asian energy transition. The wrong lending choices, however, could have disastrous consequences for the region, which is particularly vulnerable to climate change. This memo considers current and potential AIIB fossil fuel projects and estimates emissions for each project and the cost of related climate change impacts. It also constructs three possible scenarios for future AIIB lending in order to examine their potential climate costs.

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INTRODUCTION

The Asian Infrastructure Investment Bank (AIIB) has three fossil fuel energy projects already approved as of June 2017.[1] This memo provides estimates of the climate damages that will result from the carbon dioxide (CO_2) emitted by each of these projects. Global damage estimates are given, as well as damage estimates for Asia alone. Damages are expressed in terms of dollars of damage per dollar invested by the AIIB.

The projects assessed are:

- the Myanmar Myingyan Power Plant Project;
- the Azerbaijan Trans-Anatolian Natural Gas Pipeline Project (TANAP); and
- the Bangladesh Natural Gas Infrastructure and Efficiency Improvement Project.

Details of these projects can be found at the AIIB Approved Projects page, which includes Approved Project Summaries and Project Documents.[2]

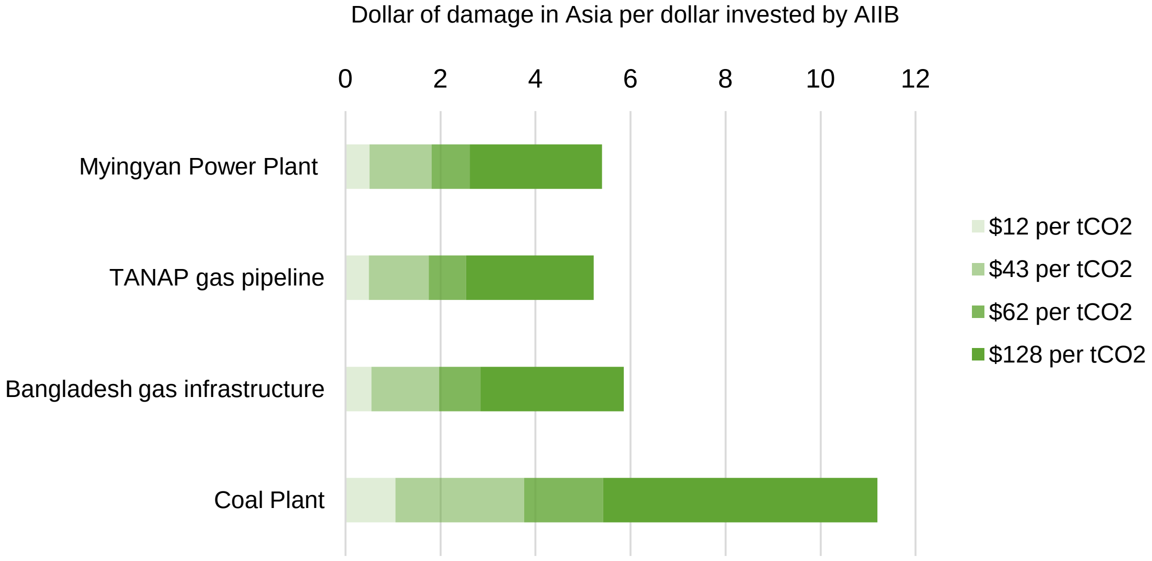
Additionally, for the purposes of comparison, this report also assesses the implications of a hypothetical modern coal power plant using the characteristics specified by the International Energy Agency (IEA) for a 1000 MW ultra-supercritical coal plant with an efficiency of 45%.

Further, this report looks at three possible scenarios for future AIIB lending in order to examine potential implications for climate impacts.

RESULTS: INDIVIDUAL INVESTMENTS

Figures 1 and 2 present the estimated climate damages from individual AIIB investments. Figure 1 shows the expected climate damages in Asia per dollar invested for each of the three AIIB projects studied, as well as the hypothetical coal power plant. For each project, four estimates are given, corresponding to different estimates of the climate damages per tonne of CO_2 emissions published by the United States Interagency Working Group on the Social Cost of Carbon (US IWGSCC, 2015). (The details and limitations of these values are explained in the Methods section below.) The climate impacts in Asia range from roughly $0.5 up to $6 of climate damage per dollar invested for the AIIB projects, and up to $11 for the ultra-supercritical coal power plant.

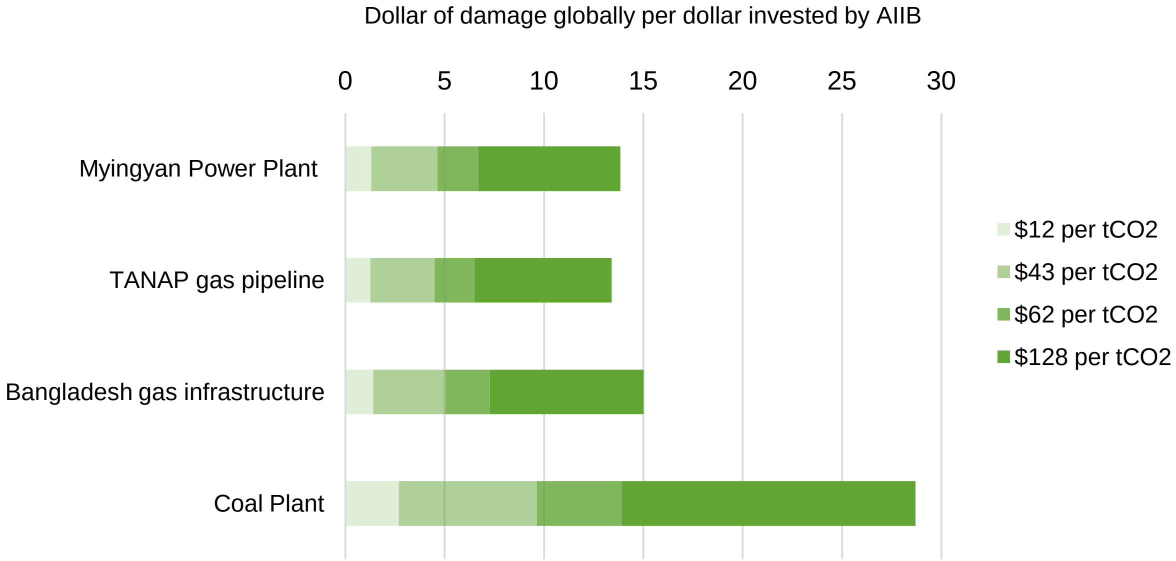
Figure 1. Climate damages in Asia per dollar invested in the three AIIB fossil fuel projects and a hypothetical ultra-supercritical coal power plant.



Note: The four coloured bar segments correspond to four different estimates of climate impacts per tonne of CO_2 (US IWGSCC, 2015).

Figure 2 shows global climate damages per dollar invested in the three AIIB projects and the ultra-supercritical coal power plant (for each of the four estimates of damage cost per tonne). The global climate impacts range from roughly $1.5 to $15 of climate damage per dollar invested in the three AIIB projects, and up to $29 for the coal plant.

Figure 2. Climate damages globally per dollar invested in the three AIIB fossil fuel projects and a hypothetical ultra-supercritical coal power plant.



Note: The four coloured bar segments correspond to four different estimates of climate impacts per tonne of CO_2 (US IWGSCC, 2015).

The implication is that quite a significant amount of climate damage could be attributed specifically to the financing being provided by the AIIB. (See Table 7 in the Methods section for a calculation of the total damages expected from each of these investments.) This would be especially true if the AIIB were to start investing in coal power plants, even if these were advanced technology power plants with relatively high efficiency.

RESULTS: INVESTMENT SCENARIOS

This section considers three possible future investment scenarios for AIIB's energy sector portfolio.

- **Scenario 1:** The first scenario reflects a rapid shift in annual lending (by 2020) such that both AIIB's direct lending and indirect lending through financial intermediaries is focused wholly on renewable energy sources and other non-fossil investments (e.g. energy efficiency and transmission, and distribution upgrading).
- **Scenario 2:** The second scenario reflects a shift to a portfolio in which AIIB maintains direct lending to gas power plants and infrastructure projects, and maintains indirect lending through financial intermediaries to both gas and coal projects.
- **Scenario 3:** The third scenario reflects a shift to a portfolio in which AIIB maintains both direct lending and indirect lending through financial intermediaries to both gas and coal projects.

In scenarios two and three, gas investments are assumed to be similar in type and carbon intensity to current investments. Coal investments are assumed to be characterized by the ultra-supercritical coal power plant assessed above.

For each of the three scenarios, the distribution of lending among gas, coal, and non-fossil/renewable investments is shown in Table 1. For AIIB direct lending, the 2017 figures are based on the distribution of lending in the AIIB investment portfolio of existing and pipeline projects as of June 2017. For indirect lending through financial intermediaries, the figures are inferred from information available about existing investments of one of the key intermediaries (IDFC Alternatives Ltd.,). Energy sector investments over the past twelve months (second half of 2016 to first half of 2017) are $1.8bn/year, and it is assumed they will increase to $15bn/year in 2025 and stay constant thereafter. This yields a total AIIB energy portfolio of $60bn in 2025. This is consistent with optimistic expectations (ODI, 2015) of AIIB growth to $120bn total investment in 2025, along with the assumption that 50% of lending is in the energy sector. In all scenarios, energy sector lending through financial intermediaries rises from an estimated 12% in 2017 to 31.7% in 2020 and stays constant thereafter.

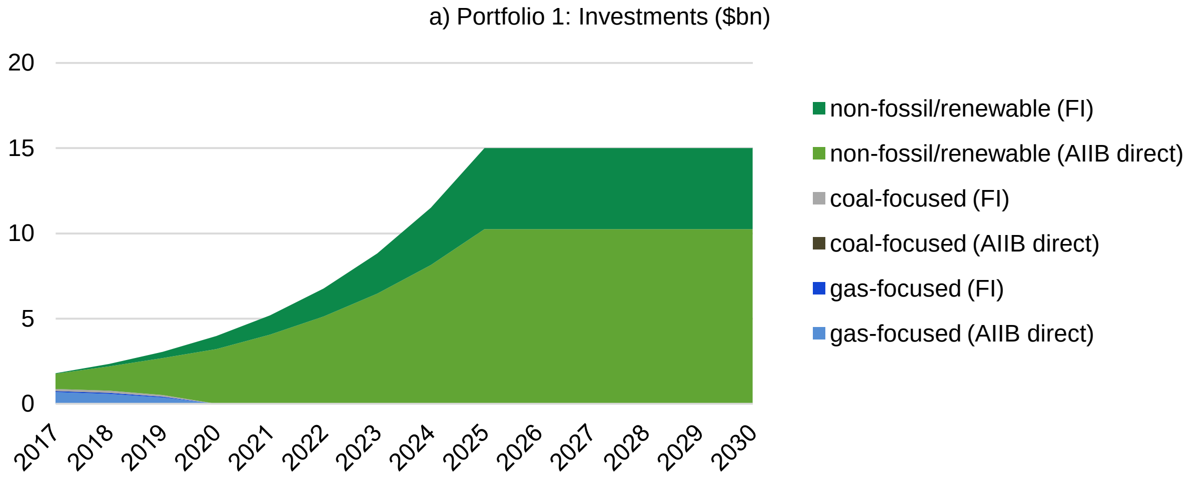
Table 1. Three scenarios for AIIB direct lending and lending through financial intermediaries, allocated among gas power plants and infrastructure, coal power plants and infrastructure, and non-fossil (e.g. efficiency and transmission upgrading)/renewable power.

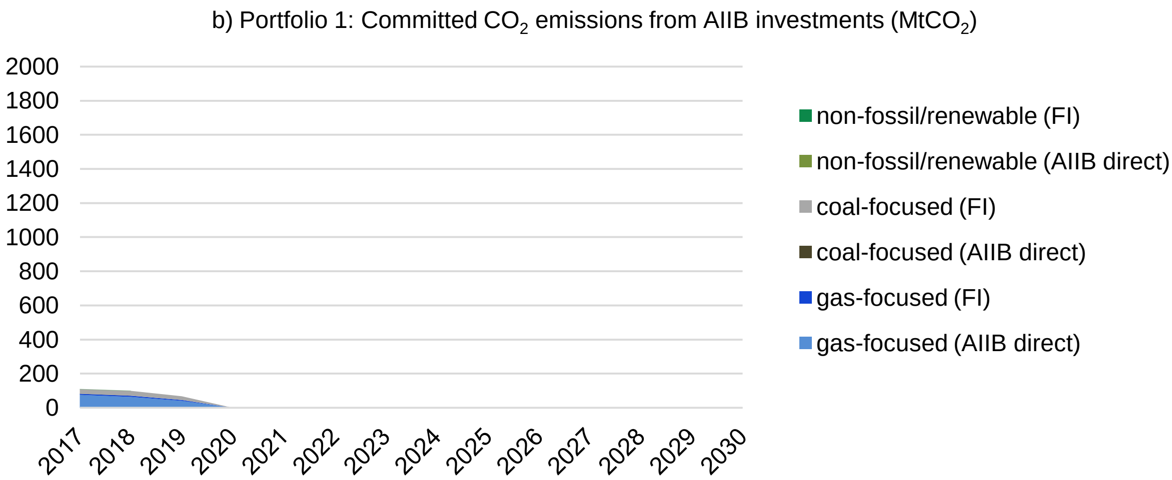
	2017			**2030**		
	Gas	**Coal**	**Non-fossil/ renewable**	**Gas**	**Coal**	**Non-fossil/ renewable**
Portfolio scenario 1						
AIIB direct	43%	0%	57%	0%	0%	100%
Financial intermediaries	29%	57%	14%	0%	0%	100%
Portfolio scenario 2						
AIIB direct	43%	0%	57%	43%	0%	57%
Financial intermediaries	29%	57%	14%	29%	57%	14%
Portfolio scenario 3						
AIIB direct	43%	0%	57%	33%	33%	33%
Financial intermediaries	29%	57%	14%	29%	57%	14%

The climate damages from each of the three AIIB investment scenarios were estimated by calculating the lifetime CO_2 emissions from the projects in each scenario, assuming a damage cost per tonne of CO_2 based on the results of the High-level Commission on Carbon Pricing (see Methods section): $40–80 in 2020 rising to $50–100 in 2030. The High-Level Commission's estimates fall within the range of the social cost of carbon published by the US government used for Figure 1 and Figure 2. It is important to note that these costs should be taken as a conservative lower bound for the actual damages that would be incurred due to CO_2 emissions. The High-Level Commission takes care to note that many types of damages are not included in the models used for calculating the social cost of carbon. (See Methods section for further detail.)

These figures below represent cumulative damages incurred in Asia. They include emissions from projects that are both direct AIIB investments (solid shading) and indirect investments made through financial intermediaries (dotted shading), where the portion made through financial intermediaries is assumed to be 31.7%, consistent with other development banks.

Figure 3. Energy sector investment portfolio scenario 1: Rapid shift to renewables and other non-fossil/renewable investments by 2020. Annual lending rises to $15bn by 2025, of which 31.7% is indirect lending through financial intermediaries.





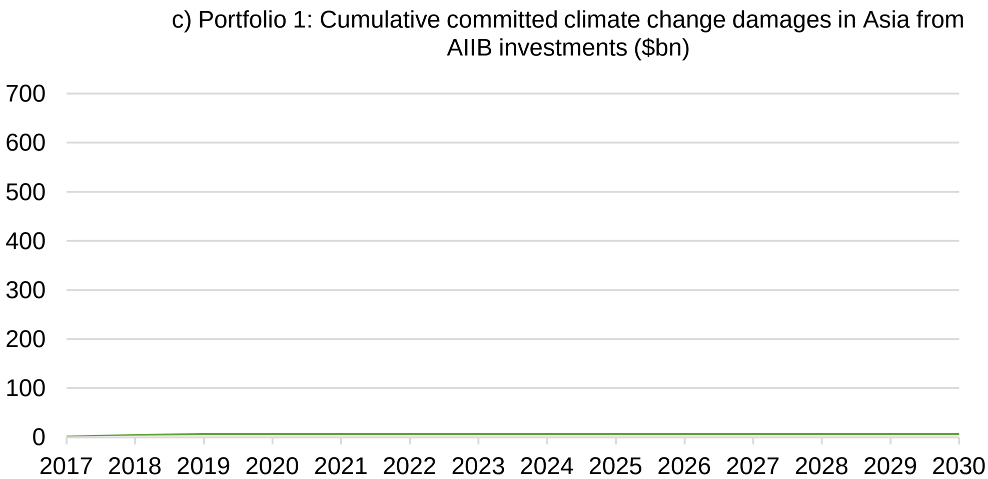
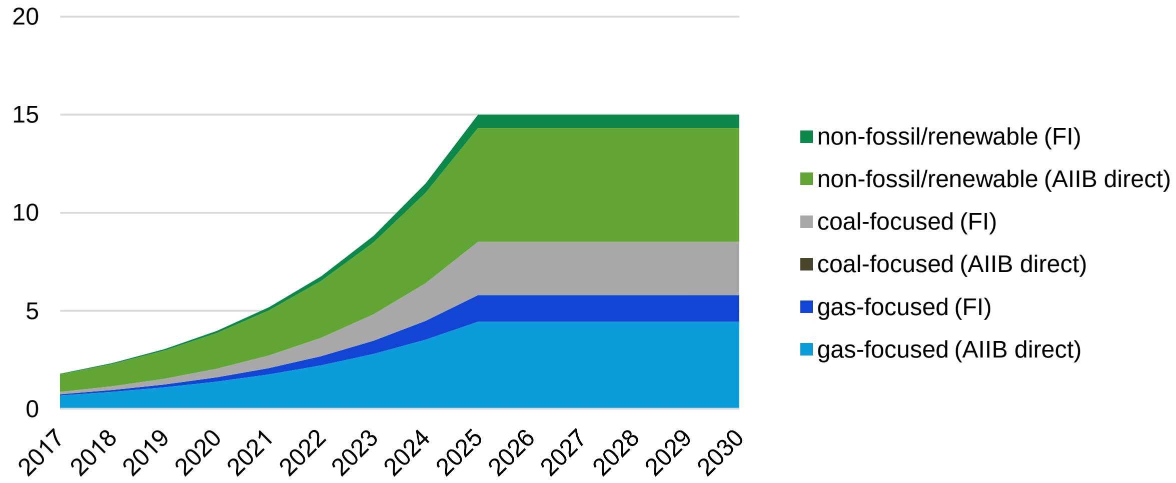
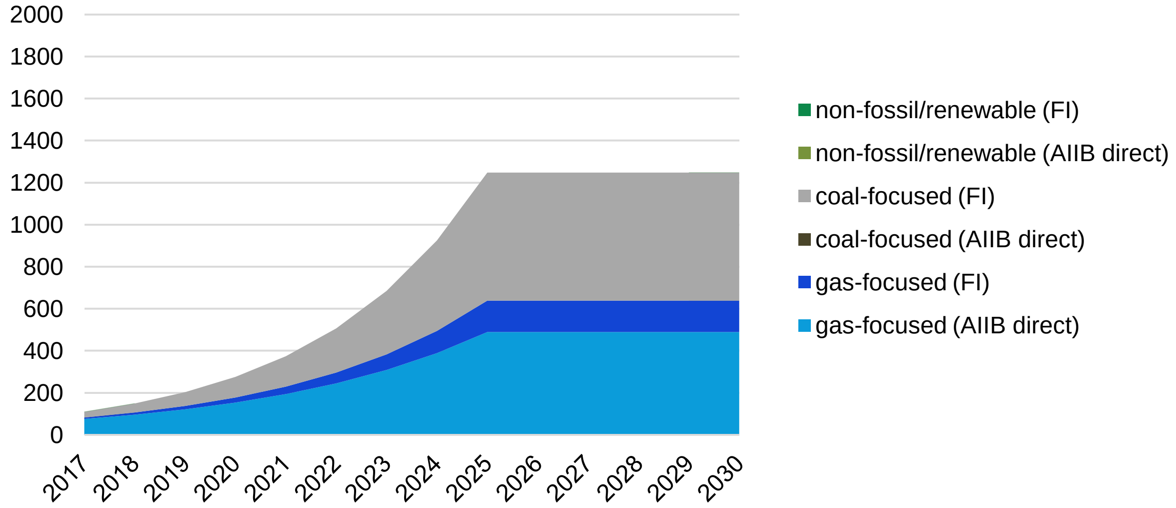


Figure 4. Energy sector investment portfolio scenario 2: AIIB continues direct investment in gas, and indirect investment through financial intermediaries in gas and coal. Annual lending rises to $15bn by 2025, of which 31.7% is indirect lending through financial intermediaries.

a) Portfolio 2: Investments ($bn)



b) Portfolio 2: Committed CO_2 emissions from AIIB investments ($MtCO_2$)



c) Portfolio 2: Cumulative committed climate change damages in Asia from AIIB investments ($bn)

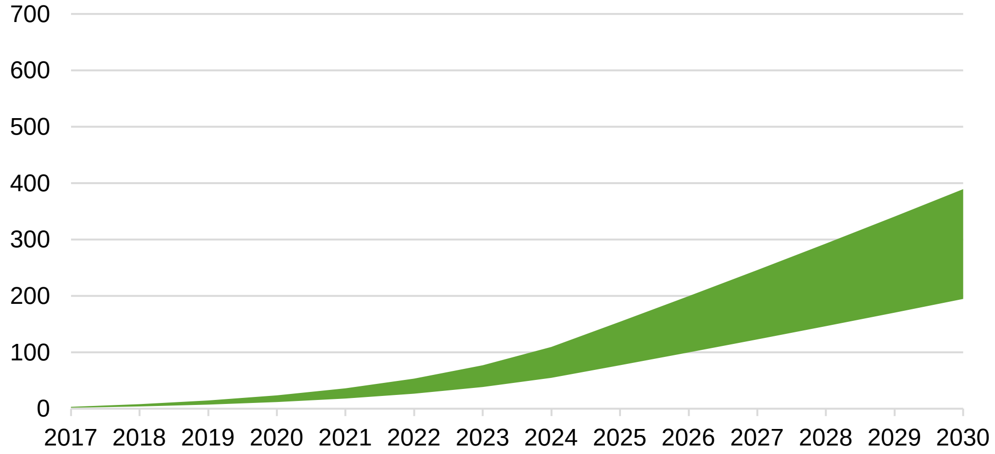


Figure 5. Energy sector investment portfolio scenario 3: AIIB has direct investment and indirect investment through financial intermediaries in gas and coal. Annual lending rises to $15bn by 2025, of which 31.7% is indirect lending through financial intermediaries.

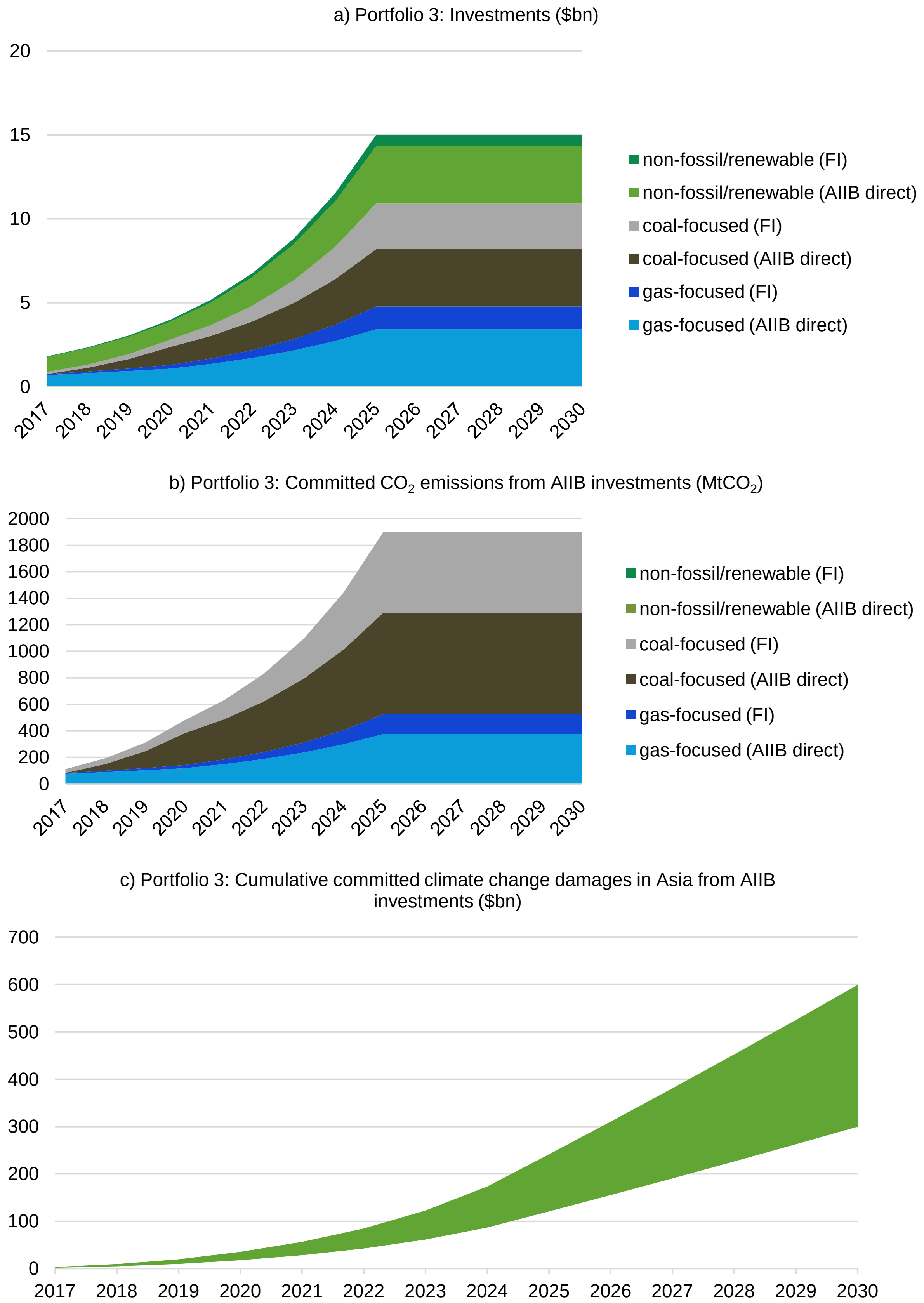


Table 2. For each scenario, cumulative emissions (in $MtCO_2$) throughout the lifetime of the portfolio of investments made by AIIB during the 2017–2030 period, along with committed impacts (in $bn) due to those emissions.

	Cumulative committed emissions ($MtCO_2$)	**Cumulative committed impacts in Asia ($bn)**	**Cumulative committed impacts globally ($bn)**
Portfolio 1	280	$4–9bn	$11–22bn
Portfolio 2	10,710	$195–389bn	$499–998bn
Portfolio 3	16,500	$300–600bn	$769–1537bn

Note: Impacts were estimated using the World Bank High-Level Commission on Carbon Pricing and must be considered a conservative lower bound. See Methods section for further detail.

METHODS

The scale of the AIIB investment for each of the three projects is available from the AIIB Project Documents and Approved Project Summary.[3] For the TANAP gas pipeline and Bangladesh gas infrastructure projects, total investment is also available. For the Myingyan Power Plant, an estimate of the total investment was made based on the power plant capacity and an IEA (2016) estimate ($625/kW) for capital cost of a natural gas combined cycle power plant. (See Table 3.)

Table 3. AIIB investment, total investment (and AIIB share) for each of the three fossil fuel projects in the current AIIB portfolio.

AIIB project	**AIIB investment ($m)**	**Total investment ($m)**	**AIIB % of total**
Myingyan Power Plant	$20m	$149m	13.5%
TANAP gas pipeline	$600m	$8,600m	7.0%
Bangladesh gas infrastructure	$60m	$453m	13.2%

Lifetime CO_2 emissions were estimated for each of the three AIIB projects and the hypothetical coal power plant based on techno-economic information available in the AIIB Project Documents and Approved Project Summary, and other sources as identified in Table 4. In each case, lifetime CO_2 were taken as being equal to the carbon content of the fuel (in CO_2 terms).

Table 4. Techno-economic assumptions used in the calculation of lifetime CO_2 emissions.

Project	Techno-economic parameter	Source
Myingyan Power Plant	Capacity: 225 MW	AIIB Approved Project Summary
	Lifetime: 30 years	US EIA, *AEO 2017*
	Capacity factor: 87%	US EIA, *AEO 2017*
	Efficiency: 57%	IEA, WEO 2016
	Capital cost: $625/kW (average of Asian costs)	IEA, WEO 2016
TANAP gas pipeline	Capacity: 16 billion cubic meters/year	AIIB Approved Project Summary
	Lifetime: 25 years (loan term)	AIIB Approved Project Summary
Bangladesh gas infrastructure	Capacity: 1 trillion cubic feet (total)	AIIB Project Document
Ultra-supercritical coal power plant	Capital cost: $800/kW (typical Chinese-built plant)	IEA, WEO 2016
	Efficiency: 453%	IEA, WEO 2016
	Capacity factor: 87%	US EIA, *AEO 2017*

Calculations assume complete combustion to CO_2, with no methane emissions from partial combustion or leakage, and they neglect upstream, downstream, and construction emissions. Note, this could be a significant underestimate of total greenhouse gas emissions, specifically if fugitive methane emissions are significant. A recent study (Schweitzke et al, 2014) estimated fugitive emission rates for natural gas at 2–4%, and rates can be much higher in locations where operation and maintenance practices are less attentive to controlling leakage. At the high end of the 2–4% range, the global warming caused by the fugitive methane would exceed the warming caused by the CO_2 arising from methane combustion, since methane's global warming potential is roughly 30 times that of CO_2 (IPCC, 2013).

Table 5 presents lifetime CO_2 emission estimates from the three AIIB projects and the coal plant.

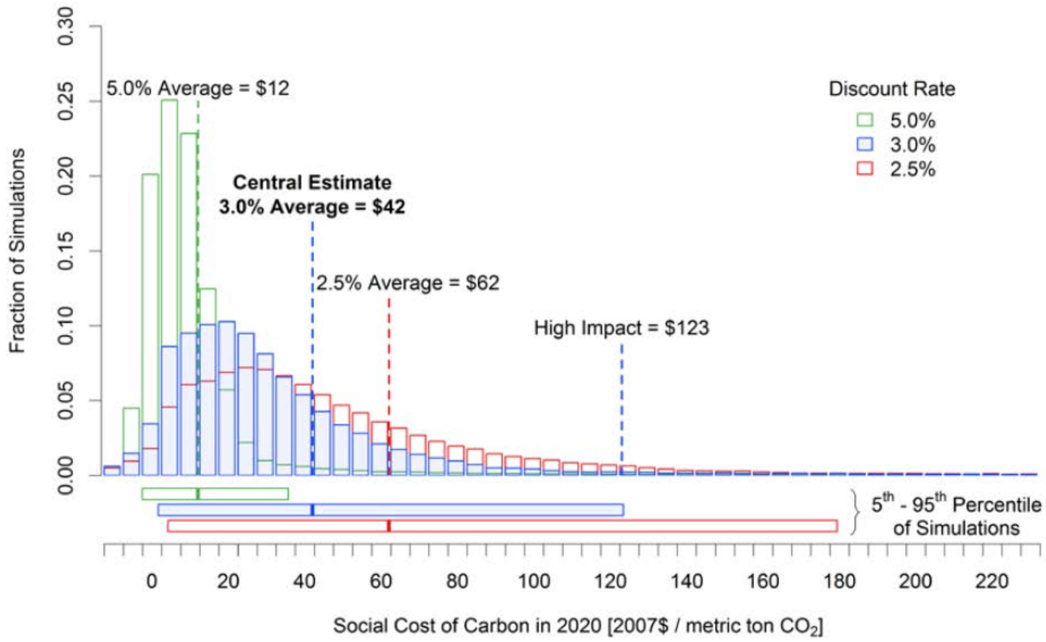
Table 5. Lifetime CO_2 emissions from each of the three fossil fuel projects in the current AIIB portfolio and the hypothetical coal power plant.

Project	Lifetime emissions ($MtCO_2$)
Myingyan Power Plant	18
TANAP gas pipeline	900
Bangladesh gas infrastructure	53
Ultra-supercritical coal power plant	179

From these emission burdens, it is then possible to estimate the resulting climate impacts from each of the AIIB investments. Four different estimates of the social cost of carbon were used to do this: $12 per tCO_2, $42 per tCO_2, $62 per tCO_2, and $128 per tCO_2.

These values come from the US government's Interagency Working Group on Social Cost of Carbon (US IWGSCC, 2015). This study drew on three different Integrated Assessment Modelling exercises to generate estimates of climate impacts from greenhouse gas emissions for the purpose of informing regulatory analysis. Among the impacts included are 'changes in net agricultural productivity, human health impacts, property damage from increased flood risk, and the value of ecosystem services due to climate change', accounting roughly for the benefits of adaptation. The results they reached are shown in Figure 6 below, which is a histogram of results for 150,000 model runs for each of three different discount rates (2.5%, 3.0%, and 5.0%). The figure highlights the average value for each distribution, \$12 per tCO_2, \$42 per tCO_2, and \$62 per tCO_2. Also shown is an estimate based on a more precautionary 95th percentile value (rather than average value). The US government notes the importance of not just including the average values, stating: 'However, for purposes of capturing of capturing the uncertainties involved in regulatory impact analysis, the interagency group emphasizes the importance and value of including all four SCC values' (US IWGSCC, 2015).

Figure 6. Range of social cost of carbon estimates.



Source: US IWGSCC 2015

A further important point is that not all climate damages are considered in the three models used by the Interagency study to estimate climate damage costs. A subsequent study by Howard (2014) concluded that 'a thorough examination of the latest scientific and economic research shows that \$37 should be viewed as a lower bound. This is because the studies available to estimate the SCC omit many climate impacts – effectively valuing them at zero.' Howard's study documented a wide range of impacts neglected by the integrated assessment models (IAMs). Ackerman and Stanton (2012), looking carefully into the details of the IAMs and their underlying assumptions, likewise conclude that alternative entirely plausible assumptions could imply a social cost of carbon that is much higher, by an order of magnitude or more.

For the scenarios, damage costs were presented using a narrower range of damage cost estimates, based on figures presented by the World Bank High-level Commission on Carbon Pricing, chaired by Joseph Stiglitz and Nicholas Stern. In their words, 'this Commission concludes that the explicit carbon-price level consistent with achieving the Paris temperature target is at least US\$40–80/tCO_2 by 2020 and US\$50–100/tCO_2 by 2030, provided a supportive policy environment is in place.' (Stiglitz and Stern, 2017). These ranges have been used to estimate the damage costs of the three energy sector investment portfolio scenarios.

It is important to note that this is a conservative lower bound estimate of the actual damages that would be incurred. The High-level Commission issued strong caveats with respect to the estimates of the climate damages actually caused by greenhouse gas emissions: 'The Commission concluded, as did the fifth Assessment Report (AR5) of the IPCC and other review studies, that many of the impact functions used in modeling exercises to calculate the social costs of carbon are biased downward because they fail to consider many vitally important risks and costs associated with climate change—particularly the widespread biodiversity losses, long-term impacts on labor productivity and economic growth, impacts on the poorest and most vulnerable, rising political instability and the spread of violent conflicts, ocean acidification, large migration movements, as well as the possibility of extreme and irreversible changes.' (Stiglitz-Stern Commission, 2017).

Table 6. Various estimates of the social cost of carbon.

Source	**Social cost of carbon estimates ($/$tCO_2$)**
US EPA (US IWGSCC, 2015)	
discount rate = 5%; average value	$12
discount rate = 3%; average value	$43
discount rate = 2.55%; average value	$62
discount rate = 3%; 95th percentile value	$128
World Bank High-Level Commission on Carbon Pricing (Stiglitz-Stern Commission, 2017)	
2020 ('at least…')	$40–80
2030 ('at least…')	$50–100

Assuming these damage costs per tonne of CO_2, it is then possible to calculate the total damage incurred by the AIIB projects, as well as the share that might be attributed to the AIIB investment (assuming a simple *pro rata* allocation of damages). And given the global damages per tonne of CO_2 emitted, the portion of damages incurred in Asia was estimated based on the analysis undertaken for Oxfam (2015). In this analysis, which was based on the AD_RICE 2012 model, the average share of impacts incurred in Asia and the Pacific due to CO_2 emitted over the 2020–2100 period was 39%.

Table 7. Estimate of the climate damages in Asia resulting from lifetime emissions from the AIIB investments using four different values of the damage cost per tonne of CO_2 emitted. Project lifetime is 25–30 years, depending on project.

Project	**AIIB investment ($m)**	**Climate damages incurred in Asia due to AIIB investments ($m)**			
		at $12 per tCO_2	**at $43 per tCO_2**	**at $62 per tCO_2**	**at $128 per tCO_2**
Myingyan Power Plant	$20m	$30m	$110m	$150m	$310m
TANAP gas pipeline	$600m	$750m	$2,700m	$3,890m	$8,040m
Bangladesh gas infrastructure	$60m	$80m	$300m	$440m	$900m
Ultra-supercritical coal power plant	$500m	$1,350m	$4,820m	$6,950m	$14,350m

Notes

1 Details of these projects can be found at the AIIB Approved Projects page, which includes Approved Project Summaries and Project Documents: https://www.aiib.org/en/projects/approved/index.html

2 Ibid.

3 Ibid.

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