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Are Carbon Taxes Good for South Asia?

Valerie Mercer-Blackman
Lazar Milivojevic
Victor Mylonas

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Abstract

This paper estimates the effects of gradually introducing a US$25/ton CO_2-equivalent carbon tax in South Asian economies using the Climate Policy Assessment Tool (CPAT). The results for South Asia suggest that monetized welfare co-benefits net of efficiency costs from such a tax—regardless of what other economies or regions do—are resoundingly positive, at 1.4 percent of GDP in 2030. Revenues from the carbon tax are estimated at 1.3 percent of GDP in 2030, which is substantial for a region with a low tax-to-GDP ratio. Once these revenues are recycled, the Keynesian multiplier effect through increased public investment and transfers to households is associated with slightly positive net economic growth rate effects. Household incidence analysis shows that the carbon tax can be designed as an equity-enhancing policy, given net reductions in the Gini coefficient for consumption from revenue recycling. The carbon tax is also associated with a 2 percent weighted average input cost increase across economic sectors in 2030. Finally, the paper discusses selected results on and the political economy of a comprehensive energy price reform package (fossil fuel subsidy phaseout and carbon tax), with broad guidance on its implementation. Overall, the paper provides supportive evidence for the green transition, showing that there need not be a trade-off between inclusive growth and going green in South Asia..

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Valerie Mercer-Blackman[1]
Lazar Milivojevic[2]
Victor Mylonas[3]

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1/ The World Bank, email: vmercerblackman@worldbank.org; 2/ The World Bank, email: lmilivojevic@worldbank.org; 3/ International Monetary Fund (IMF) and The World Bank, email: vmylonas@worldbank.org. The authors thank Yi (Claire) Li for excellent research assistance, and Paolo Agnolucci (The World Bank), Defne Gencer (The World Bank), Dirk Heine (The World Bank), Jules Hugot (Asian Development Bank), Tom Moerenhout (The World Bank), Ian Parry (International Monetary Fund), Margaret Triyana (The World Bank), and Hans Timmer (The World Bank) for helpful comments. The authors also thank participants at: i) the ADBI Conference on the Energy Market, Energy Pricing, and Low-Carbon Transition; ii) the Development Economics Prospects Group (The World Bank) internal seminar; and iii) the South Asia Chief Economist Office internal seminar (The World Bank) for helpful discussions. This paper builds on work initiated in the context of the Spring 2022 *South Asia Economic Focus* (World Bank, 2022a). All remaining errors are our own.

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1. Introduction

Climate change poses a significant threat to development across South Asia. Appropriate adaptation and mitigation policies will be essential to embracing more green and inclusive growth in the future. However, investing in resilient infrastructure, which is key to climate change adaptation, as well as shifting to a low-carbon growth trajectory, will require considerable financing. Policy makers, thus, face difficult trade-offs amid limited resources: raising fiscal revenues is already a perennial challenge in South Asia as evidenced by its low average share of tax revenue in GDP (around 13 percent pre-COVID-19). Moreover, the region's per capita contribution to global greenhouse gas (GHG) emissions is very low: in 2021, a South Asian individual emitted 27 percent the amount of GHGs emitted by a non-South Asian, on average. This may explain why Paris Agreement pledges to reduce GHG emissions in South Asia tend to be unambitious and often dependent on external support.

This paper focuses on climate mitigation policies, specifically carbon taxes, and shows that the impact of implementing such policies in South Asia can be overwhelmingly positive for its development. Carbon taxes are associated with additional (and predictable) fiscal revenues, which can be deployed to achieve development and adaptation targets while reducing the burden of decarbonization costs. Building on recent research and data (IMF, 2019a; Parry, Black, and Vernon, 2021), this paper provides evidence that carbon taxes, particularly if combined with a phaseout of fossil fuel subsidies, could benefit South Asia regardless of what other economies or regions do.

The Climate Policy Assessment Tool (CPAT) is applied to estimate the effects of implementing a set of energy price reform measures centered around a carbon tax relative to a business-as-usual (BAU) scenario that assumes lack of new (or tightening of existing) climate mitigation policies. The results indicate that the gradual introduction of a carbon tax of US$25 per ton of carbon dioxide equivalent (/ton CO_2e) provides monetized welfare co-benefits (reduced mortality/morbidity from local air pollution, as well as reduced accidents, congestion, road damage and output losses due to global warming), net of efficiency costs, equivalent to 1.4 percent of GDP in 2030. Moreover, government revenues-to-GDP would rise by almost 1.3 percentage points in 2030. We also consider three approaches (or 'modes') under which these additional revenues are redistributed ('recycled') to help ensure a more equal income distribution and boost growth. The estimated distributional outcomes (post-'revenue recycling') in 2030 are progressive, with the Gini coefficient falling by between 1 and 5 percent depending on the economy and revenue recycling mode. Some economic sectors suffer more than others, but the overall effect on input costs is small (a GDP-weighted average input cost increase of around 2 percent), mostly because the sectors that see the highest cost increases represent a very small share of economy-wide output in the region. Real GDP growth effects are small but positive in 2030.

In addition, we consider a 'comprehensive energy price reform' (CEPR) package that includes both the US$25/ton CO_2e as well as the gradual phaseout of all existing fossil fuel subsidies, price controls and exemptions by 2030. Such a reform would lead to net monetized welfare co-benefits equivalent to 1.4 percent of GDP, government revenue gains of 2 percent of GDP, slightly higher, positive real GDP growth effects, and even more equalizing income distribution outcomes compared to just implementing the carbon tax in 2030. To check sensitivity to international commodity price and carbon tax rate assumptions, we also apply CPAT assuming international energy prices are lower at the time of the introduction of the carbon tax in 2024 as well as a CEPR scenario with a carbon tax rate of US$12.5/ton CO_2e.

Finally, we touch upon why governments are oftentimes reluctant to introduce carbon pricing or phase out fossil fuel subsidies and provide some suggestions for the successful implementation of a reform like the CEPR. This also links to the international debate on who should share the burden of mitigating climate change. Some might suggest that it is unfair to impose carbon taxes on developing economies. After all, most of them emit but a small fraction of existing GHGs into the atmosphere in per capita terms, even as they face the most severe challenges from climate change. However, an increasing body of evidence (Hallegatte, 2022; Wollburg et al., 2023) shows that there are various direct benefits to adopting a well-designed green transition strategy to ward off climate damages. Our paper contributes to this literature.

To our knowledge, this is also the first analysis that quantifies economic and distributional implications of climate mitigation policies for the South Asia region as a whole. We contribute to the literature by using updated household survey data from economies that have not been considered for this type of analysis in the past. Similar studies either focus disproportionately on large emitters (IMF, 2019b; Parry, Mylonas, and Vernon, 2019; 2021) or lack granular coverage of South Asia (Alonso and Kilpatrick, 2022). Ohlendorf et al. (2021) use an ordered Probit meta-analysis framework to examine 53 empirical studies in 39 (mostly advanced) economies and find that, in the less wealthy economies of their sample, the likelihood of progressive distributional outcomes following the introduction of mitigation policies is higher. For developing economies, the literature is sparse. A notable study on Latin American and Caribbean economies finds that up to 30 percent of revenues from carbon taxes are sufficient to compensate poor and vulnerable households on average, which makes these taxes quite effective from the point of view of redistribution (Vogt-Shilb et al., 2019).

This paper is organized as follows. Section 2 defines the energy transition requirements in South Asia.[1] Section 3 describes the data and methods. Section 4 shows the main results. Section 5 discusses political economy considerations. Section 6 concludes.

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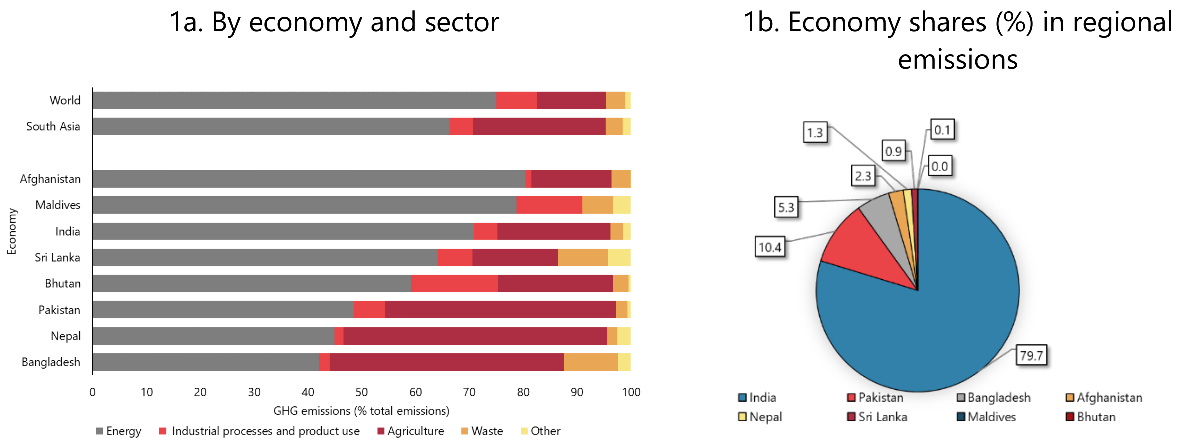
[1] South Asia includes Afghanistan, Bangladesh Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka.

2. Climate change mitigation policies in South Asia

2.1 How much energy does South Asia consume?

Most of the region's GHG emissions come from energy 'use' (either in production, or intermediate and final consumption). South Asia emits 67 percent of GHGs from energy, primarily from the use of (carbon-intensive) coal and oil, 24 percent from agriculture, and the rest from other sources (Figure 1a). The share of emissions from energy is lower than for the rest of the world, where this share is 75 percent. Commensurate with its relative size, India emits 80 percent of South Asia's GHGs (Figure 1b).

Figure 1. South Asia: composition of GHG emissions (excl. LULUCF), 2018



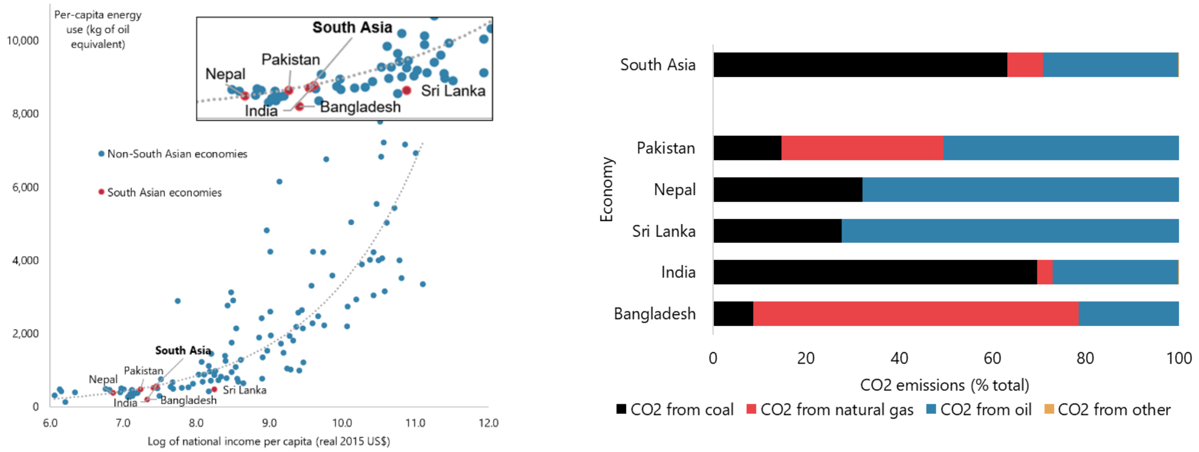
1a. By economy and sector

1b. Economy shares (%) in regional emissions

Source: United Nations Framework Convention on Climate Change (UNFCCC).
Note: GHG emissions include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and F-gases (HFCs, PFCs, SF_6, and NF_3). LULUCF stands for 'Land Use, Land-use Change and Forestry.'

The average South Asian is not a major energy consumer compared to consumers in most other regions, nor a major CO_2 emitter, but is negatively impacted by climate change. As a developing region, South Asia's per capita energy intensity is lower than that of many other regions. For example, Bangladesh, Sri Lanka, and Nepal use less energy per person than other economies with similar income levels (Figure 2a). Most GHG emissions from energy use come from coal (63 percent, reflecting India's emissions), though this number varies across economies. Bangladesh is a large natural gas producer (and now importer), as more than two-thirds of its energy consumption come from natural gas (Figure 2b).

Figure 2. Energy intensity in South Asia is low, but a sizable portion of energy use comes from coal



2a. World: per-capita energy intensity, 2018

2b. South Asia: composition of CO_2 emissions by economy and fuel, 2018

Source: Climate Policy Assessment Tool (CPAT) and World Bank World Development Indicators (WDI).
Note: In Figures 2a and 2b, 'South Asia' includes Bangladesh, India, Nepal, Pakistan, and Sri Lanka.

Reliance on carbon-intensive fossil fuels such as coal is related to environmental damages, with local air pollution being one of the key negative side effects of fossil fuel combustion in South Asia (World Bank, 2022b). Subsidized road fuels can worsen congestion, road damage, and accidents, due to higher driving rates. Moreover, the burning of fossil fuels contributes to climate change. From an economic point of view, it is optimal to account for all these 'negative externalities' in the user prices of fossil fuels, equating marginal private and social costs. Following Parry, Black, and Vernon (2021), Figure 3 shows what the 2020 socially optimal (or 'efficient') price of different fossil fuels would be in selected South Asian economies. The socially optimal price of each unit of fuel is composed of i) supply costs;[2] ii) global climate and local (outdoor) air pollution damages as well as transport-related externalities;[3] and iii) a standard value-added/general consumption tax.[4]

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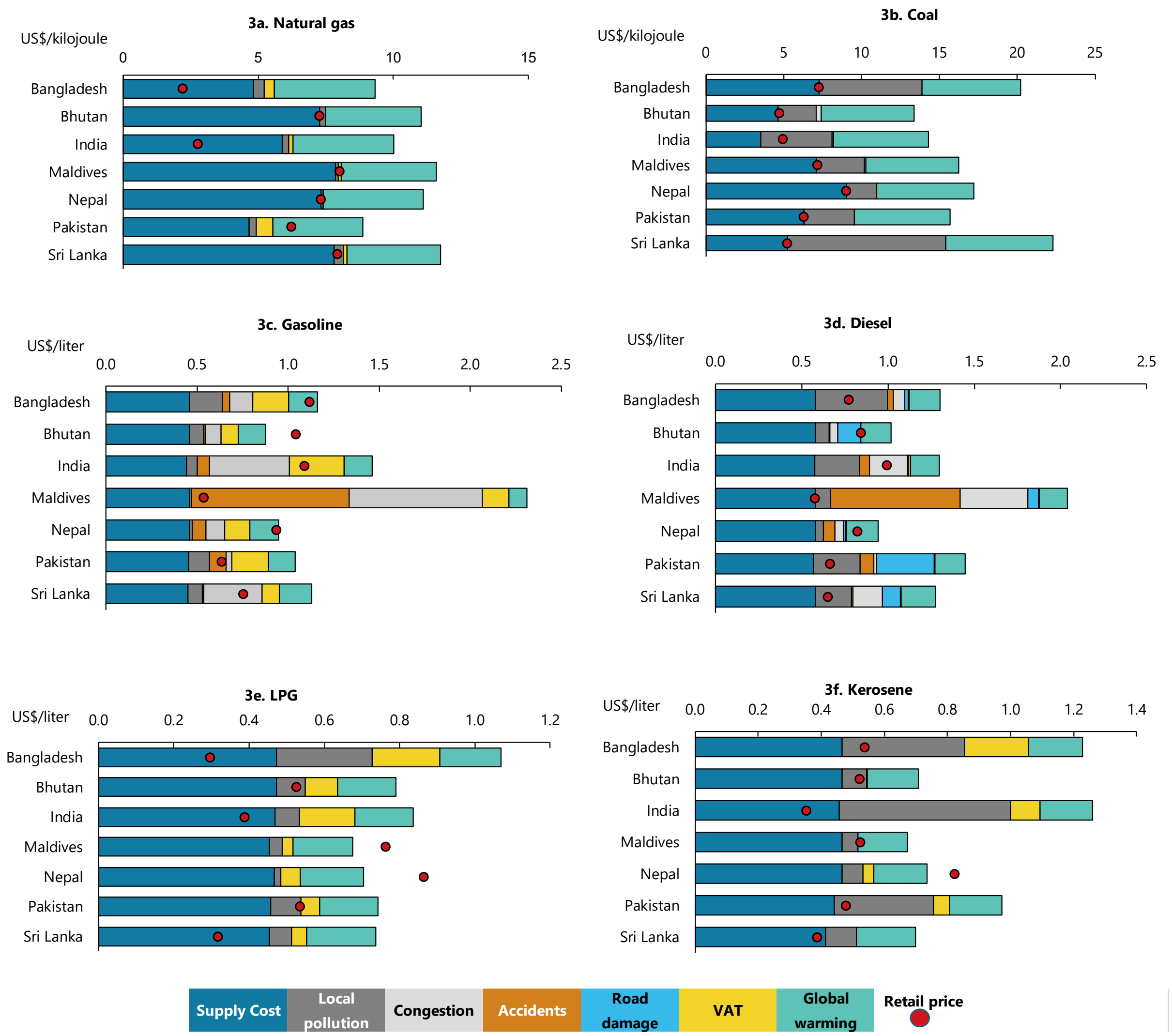
[2] For non-tradeable fossil fuels, these consist of total production costs. For tradeable fossil fuels, these equal the opportunity cost of home consumption (as opposed to sale abroad), which is quantified via the import-export parity price (based on whether an economy is a net importer or exporter of the fuel) and adjusted for home margins.

[3] The calculations assume a social cost of carbon (SCC) of US$75/ton of CO_2. Per the Report of the High-Level Commission on Carbon Prices, estimates were that the SCC should be somewhere between US$50 and US$100 in 2030 (Stiglitz et al., 2017). Figure 3 uses the midpoint of these two estimates (discounted to 2020), applying an annual discount factor of approximately 4 percent.

[4] See Parry, Black, and Vernon (2021) for detailed explanations of these components.

Figure 3. South Asia: retail vs. optimal unit prices by economy and fuel, 2020



Source: Authors' estimates based on data and methods in Parry, Black and Vernon (2021). Afghanistan is not shown, due to lack of available data.

Currently, retail prices in most South Asian economies are far below these optimal prices, in many cases not even covering supply costs because of direct subsidies. In other words, governments are setting domestic fossil fuel prices below international reference prices. Especially in India, Bangladesh, and Sri Lanka, natural gas and coal prices are considerably below their optimal levels, while Nepal's prices (especially LPG and kerosene) are generally closer to these levels (World Bank, 2022a). As a result, raising retail prices to achieve this efficient price will require both reducing the explicit subsidy component, and imposing a direct price tag on carbon-equivalent GHG emissions (i.e., a carbon tax).[5] This will allow for gradual substitution across energy types and provide an incentive for producers to transition to low-carbon technologies.

2.2 South Asia's climate mitigation commitments

All South Asian economies have committed to reducing GHGs as specified in their Nationally Determined Contributions (NDCs) towards climate mitigation announced in the 26th United Nations Climate Change Conference of the Parties (COP26). Table 1 summarizes the NDCs of the economies in the region that have specified mitigation pledges.[6] Appendix 1 provides details on the pledges under COP26, and policies undertaken so far. Each of these NDCs comes with a set of proposed actions, detailed in the official UNFCCC NDC Registry.[7]

Table 1. South Asia: NDCs and NDC-consistent carbon taxes by economy, 2030

Economy	NDC description	2030 NDC-consistent carbon tax (US$/ton CO_2e)	NDC achievable in BAU?	Income group
Afghanistan	13.6 percent reduction in emissions against the baseline (conditional on external financing).	50.0	No	IDA
Bangladesh	Limit of 381.85 mt CO_2e including LULUCF.	0.0	Yes	IDA
Bhutan	Remain carbon neutral.	Unquantifiable NDC	n.a.	IDA
India	45 percent reduction in emissions intensity of GDP.	0.0	Yes	MIC
Maldives	Limit of 2.43 mt CO_2e by 2030 excluding LULUCF.	8.5	No	IDA
Nepal	Reduce fossil fuel dependency by 50 percent via various renewables/sectoral targets.	Unquantifiable NDC	n.a.	IDA
Pakistan	Limit of 1362.55 mt CO_2e including LULUCF.	0.0	Yes	IDA
Sri Lanka	4 percent reduction in emissions (14.5 percent conditional on external financing) against the baseline.	23.7	No	IDA

Source: UNFCCC (https://di.unfccc.int/time_series), and authors' estimates using CPAT.
Note: Nationally Determined Contributions (NDCs) are assumed to be unconditional on external financing, except for Afghanistan. '2030 NDC-consistent carbon tax' assumes a gradual introduction of the carbon tax rate (in equal increments) between 2024 and 2030, as well as absence of consumer/producer fossil fuel subsidy or price control phaseouts. If NDCs are assumed conditional on external financing the '2030 NDC-consistent carbon tax' would be equal to 36.9 US$/ton CO_2e for Bangladesh and 40.2 US$/ton CO_2e for Sri Lanka, respectively. International Development Association (IDA) countries are more likely to be eligible for grants to finance mitigation and/or adaptation. Bhutan and Maldives borrow on small economy terms. Bangladesh borrows on blend credit terms. As of 2022, Sri Lanka has been reclassified as an IDA country, to allow for concessional financing. MIC=middle-income country under the World Bank's country income and lending group classification. LULUCF= Land Use, Land-use Change and Forestry. CO_2e = carbon dioxide emissions-equivalent; BAU = Business-As-Usual; NDCs = (voluntary) NDCs for COP26, at most consistent with 2.5-3 degrees Celsius warming above pre-industrial levels.

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[5] See Parry, Black and Vernon (2021) for a definition of explicit subsidies.

[6] Bhutan is already a net negative carbon emitter, Maldives contributes a miniscule amount to global warming, and Afghanistan faces major fragility and conflict-related challenges that impede playing an active role in the Paris Agreement. See also Jha (2021) for a succinct analysis of the Paris Agreement pledges of South Asian economies.

[7] See: https://unfccc.int/NDCREG.

Using the Climate Policy Assessment Tool (CPAT), we estimate the required level of the carbon tax for each economy to reach its NDC in 2030.[8] Under the policies implicit in the latest NDCs, most South Asian economies will easily reach their Paris targets (i.e., the required level of the carbon tax is essentially zero or quite low). However, this could also reflect relative lack of ambition in these economies' mitigation pledges.[9]

As of end-2022, no South Asian economy had adopted pure market-based carbon pricing schemes, including Emissions Trading Systems (ETSs) and feebates. India's special tax on coal is the closest to a direct carbon price in the region. Pakistan's government is considering some form of monitoring. A few emerging markets (Argentina, Colombia, Chile, Mexico, and South Africa) have experimented with moderate carbon taxes (less than US$10/ton CO_2e as of 2019; World Bank 2022c). In our analysis we will assume the carbon tax is introduced domestically, covering all sectors/fuels (i.e., power, industry, transport, residential/buildings – see also Section 3 below). Refer to Pryor et al. (2023) for a more detailed discussion of these issues.

3. Data and methods

3.1. Simulating carbon tax implementation

The most efficient way to reduce GHG emissions is through a comprehensive adoption of carbon taxes (Nordhaus, 2015). A carbon tax is a per-unit charge on the carbon content (emissions per unit of use) of fossil fuels. Carbon taxes, unlike regulations, incentivize businesses and individuals to switch to greener fuel consumption options. This is also true for ETSs. However, ETSs are generally limited to the power sector and large industry[10] and require significant administrative capacity to monitor compliance (Table 2).

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[8] This calculation implicitly assumes that the only new policy applied is an economy-wide carbon tax. In this sense, the calculation is illustrative and aims to gauge the amount of mitigation 'effort' that South Asian economies' NDCs would require. The NDCs could, however, be met via a combination of measures including green investments and the provision of research and development (R&D) subsidies for the renewables sector, etc. This calculation only focuses on fossil-fuel CO_2 emissions (e.g., excluding methane and LULUCF emissions).

[9] Taken together, economy-specific Paris pledges are at most consistent with warming of 2.5-3 degrees Celsius (which is not in line with the overarching goal of the Paris Agreement to limit warming to below 2-1.5 degrees Celsius (see also discussion in Parry, Mylonas, and Vernon, 2021).

[10] However, some ETSs (e.g., Germany) apply midstream to, for example, buildings/transport fuels, with the EU ETS being expected to cover these sectors as of year 2027. See: https://www.europarl.europa.eu/news/it/press-room/20221212IPR64527/climate-change-deal-on-a-more-ambitious-emissions-trading-system-ets.

Table 2. A carbon tax is preferable compared to alternative mitigation approaches in terms of its breadth, ease of implementation and market efficiency implications

Feature of alternative mitigation approaches	Carbon Tax (*)	Emissions Trading Systems	Feebates	Regulations
Potential for exploiting mitigation opportunities	Full, if applied comprehensively	Full, if applied comprehensively (in practice often limited to power/large industry)	Similar to regulations	Can exploit some key opportunities but not all (for example, reductions in vehicle use)
Use of price/market mechanism	Yes	Yes, but price only predictable if price floors or similar mechanisms included	Yes	No
Efficiency and incentive for innovation from mitigation responses induced by policy	Yes, people and firms choose most efficient way of reducing emissions	Yes, people and firms choose most efficient way of reducing emissions	Yes, firms choose most efficient approach	No automatic mechanism, but can avoid energy price increases
Price predictability	Yes (if clearly specified trajectory)	No (unless includes price floors or similar mechanisms)	Yes (if clearly specified trajectory)	No (implicit prices vary with technology costs, energy prices, etc)
Revenue generation and administrative burden	Yes, and easy to build into existing fuel or royalty tax systems	Maybe (if allowances auctioned, but revenue base may be limited in South Asia)	No, since best design is revenue neutral, but new administrative capacity to apply fees/rebates to power generation	No, though capacity needed to enforce regulations

Source: Authors' adaptation for South Asia based on IMF (2019a; 2019b).
Note: (*)=A border carbon adjustment could be part of a broader carbon tax system. Color scheme refers to the desirability of each feature: green=yes, yellow=maybe, red=no. 'Regulations' include policies like requirements for renewable generation shares, which are typically less efficient than feebates.

3.2 Modeling framework

We employ the Climate Policy Assessment Tool (CPAT).[11] CPAT is a tool developed jointly by the IMF and World Bank, allowing for simulations of climate mitigation policies for over 175 countries under user-specified scenarios. The model provides estimates and country-specific projections of fossil fuel CO_2 emissions and assessments of the environmental, fiscal, economic, public health, other externality and distributional impacts of carbon taxes and fossil fuel subsidy reform, among other policies. The model decomposes fossil fuel and other (e.g., renewables, electricity, biomass) energy use into the power, industrial, transport, and residential sectors, projecting it forward by: i) GDP forecasts; ii) assumptions about the income and own-price elasticity of demand for fuels; iii) assumptions about the rate of technological change affecting energy efficiency; and iv) changes in international energy prices, with pre-existing fuel taxes and levies being held constant in real terms. The impacts of mitigation policies on fuel use and emissions depend on i) their effect on future energy prices; ii) fuel switching within the power generation sector; and iii) price elasticities of electricity and other fuel demand across sectors.

The tool is parameterized using fuel use and emissions factors by country-sector from the International Energy Agency (IEA, 2021). Data on energy taxes, energy subsidies and prices by product

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[11] CPAT is forthcoming and will be available for public use at: https://www.worldbank.org/en/topic/climatechange and https://www.imf.org/en/Topics/climate-change/CPAT

and country is obtained from the IMF.[12] Prices are projected forward using this data in tandem with an average of IMF World Economic Outlook (WEO) and World Bank Commodity Markets Outlook (CMO) forecasts of international energy prices. Fuel price responsiveness is broadly consistent with standard empirical and energy model parameters and results. Refer to Black et al. (forthcoming) for more details on model parametrization and data sources.[13]

The analysis within CPAT is subject to some limitations and caveats. First, the model does not explicitly incorporate gradual turnover of energy capital. This assumption overstates the short-term responsiveness of fuel use to carbon pricing but is reasonable, given the focus on medium-term scenario simulations (by 2030 in our case – see Section 3.3 below). Second, CPAT abstracts from the possibility of additional mitigation actions (beyond those implicit in current country-level price data) under the Business-As-Usual (BAU). Specifically, the BAU scenario is used as a 'benchmark' against which the performance of any modeled mitigation instruments is measured (a standard approach in the literature). Intuitively, the BAU scenario assumes absence of new (or tightening of existing) climate mitigation policies. Third, the fuel price response parameters in the model are plausible for marginal price changes. In other words, model elasticities may not apply under drastic price hikes that could cause major technological developments or non-linear adoption of technologies. Fourth, the model assumes flat (perfectly elastic) supply curves, absence of general equilibrium effects, and no changes in international fuel prices that might result from multiple countries introducing mitigation policies at the same time.[14]

The incidence on household consumption deciles d = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10} from higher retail prices following the introduction of a climate mitigation policy is calculated as:

$$\text{(A)} \qquad \sum_g \pi_t^{dg} \cdot \rho_t^{dg}$$

where g stands for the main categories of goods/services consumed by households in each decile, π_t^{dg} is the share of decile d's total consumption spent on good/service g at time t, and ρ_t^{dg} is the relative price increase for good/service g caused by the climate mitigation policy. For example, for a good with a budget share of 2 percent of total household consumption, expression (A) implies that a 5 percent increase in said good's price will reduce decile d's consumption by 0.1 percentage points.

We perform distributional analysis within CPAT for five South Asian economies (Bangladesh, India, Nepal, Pakistan, and Sri Lanka) using data on household budget shares obtained from the following Household Budget Surveys (HBSs): i) 2016-2017 Household Income and Expenditure Survey (HIES)

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[12] See, for example: https://www.imf.org/en/Topics/climate-change/energy-subsidies.

[13] Detailed documentation on the CPAT methodology is available here: https://cpmodel.github.io/cpat_public/

[14] Though parameterization is broadly consistent with the modeling literature, which (to varying degrees) incorporates these factors. See further discussion of these issues in IMF (2019b), Parry, Mylonas, and Vernon (2021) as well as Black et al. (forthcoming).

for Bangladesh;[15] ii) 2018 Consumer Pyramids Household Survey (CMIE) for India;[16] iii) 2010-2011 Living Standards Survey (LSS) for Nepal;[17] iv) 2018-2019 Household Integrated Economic Survey (HIES) for Pakistan;[18] and v) 2016 Household Income and Expenditure Survey (HIES) for Sri Lanka.[19] After the data is aggregated into eight (8) energy and fourteen (14) non-energy, CPAT-compatible good/service categories,[20] households are grouped into population-weighted, per-capita consumption deciles, and budget shares are computed by dividing total consumption expenditure on each CPAT good/service category by each household's total consumption expenditure across all goods/services.

Sector-specific percent price increases from the simulated carbon tax are obtained directly from CPAT for each fossil fuel (Table A.2). The fossil fuel-specific price changes and budget shares can be used to estimate the loss in consumption from price increases of fossil fuels (e.g., electricity, gasoline, diesel, natural gas, etc.) following the introduction of a carbon tax (that is, the 'direct' incidence effect). Price increases for other consumer goods (due to higher energy and fossil fuel input prices for each sector) are calculated assuming full passthrough of producer cost increases onto consumer prices domestically (that is, perfectly elastic supply curves).[21] Non-fuel sector price increases are obtained as the sum-product of: i) each sector's fossil fuel intensity; and ii) the price increase of each fossil fuel induced by the climate mitigation policy. Sectoral fossil fuel intensities are obtained from direct requirements matrices of input-output tables. These tables are sourced from the GTAP-10 database,[22] which includes 2014 data for 65 sectors[23] that are, in turn, mapped to the CPAT non-fuel consumption good/service categories mentioned above to recompute equation (A). Summing the estimates across all non-fuel goods and services yields a measure of the loss in consumption from price increases of non-fossil fuel products (for example, food, clothing, housing, etc.) following the introduction of a carbon tax (that is, the 'indirect' incidence effect). Adding up the direct and indirect effects yields an estimate of the total incidence effect. We further adjust the total incidence effect downwards to

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[15] See: http://data.bbs.gov.bd/index.php/catalog/182

[16] See: https://consumerpyramidsdx.cmie.com/

[17] See: https://microdata.worldbank.org/index.php/catalog/1000

[18] See: https://www.pbs.gov.pk/content/household-integrated-economic-survey-hies-2018-19

[19] See: http://www.statistics.gov.lk/IncomeAndExpenditure/StaticalInformation

[20] To facilitate relative cross-country comparability of results, CPAT uses a standardized classification of goods and services across all countries, distinguishing among eight (8) fuel (coal, electricity, natural gas, oil, gasoline, diesel, kerosene, LPG) and fourteen (14) non-fuel (appliances, chemicals, clothing, communications, education, food, health services, housing, other, paper, pharmaceuticals, recreation and tourism, transportation equipment, public transportation) good/service categories. This classification is, in part, informed by the implicit carbon intensity of non-fuel goods/services (i.e., goods/services with similar carbon intensities are classified under the same category).

[21] This assumption is less realistic for Emissions Intensive Trade Exposed (EITE) industries competing in world markets with limited ability to pass cost increases forward to final consumers.

[22] See: https://www.gtap.agecon.purdue.edu/databases/v10/index.aspx. Given that the GTAP-10 input-output tables are relatively outdated, they are scaled such that their implicit revenue flows from a hypothetical climate mitigation policy match those of CPAT (which are primarily based on IEA (2021) data).

[23] These cover the following five fossil fuels: coal ('coa'), electricity ('ely'), oil ('oil'), natural gas ('gas', 'gdt') and petroleum products ('p_c').

account for household behavioral responses to higher consumer prices.[24]

3.3 Simulated scenarios

We use CPAT to simulate the impacts of an economy-wide carbon tax that, from 2024 onwards, gradually increases to reach US$25/ton of CO_2e in 2030, in real 2021 United States dollars (US$). This (moderate) US$25/ton CO_2e carbon tax is assumed to apply upstream to all sectors and fuels and in addition to any pre-existing taxes or subsidies. It is also considered as a reasonable price floor and yardstick for low-income developing economies (Chateau et al., 2022). Under this main scenario, we focus entirely on the carbon tax effects, assuming that fossil fuel subsidies, price controls and exemptions are phased out in both the BAU and carbon tax scenarios.

In Section 4.5, we consider a 'comprehensive energy price reform' (CEPR) package, which evaluates the aggregate impact of both: i) the gradual introduction of the US$25/ton CO_2e carbon tax by 2030; and ii) the gradual (but complete) phaseout of fossil fuel subsidies and related price controls and exemptions (assumed, in this case, to not take place in the BAU).

The use (or 'recycling') of revenues from climate mitigation policies for compensation will be a key component of such policies because it can significantly enhance the transition by boosting buy-in from the population. The choice of what to do with the revenue proceeds is context specific. In some economies, the optimal strategy may be to allocate these revenues towards general fiscal adjustment. In the case of South Asia, the money could be used to strengthen social safety net systems or for adaptation (e.g., better insurance against weather-related disasters in rural areas, or greater renewable energy production, including via new energy infrastructure). Two revenue recycling 'modes' are simulated under both the US$25/ton CO_2e carbon tax and CEPR in this paper:

(a) targeted cash transfers to households in the bottom 70 percent of the consumption distribution;[25] and

(b) public investment in the form of infrastructure access provision (e.g., to support Sustainable Development Goals, SDGs), based on household access to the following infrastructure types: electricity, water, sanitation, Information and Communications Technology (ICT), and public transport.[26]

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[24] All incidence effects are adjusted downwards using decile-consumption item-specific price elasticities of demand (assuming a constant elasticity of substitution household utility function) from the United States Department of Agriculture (USDA). See: https://www.ers.usda.gov/data-products/commodity-and-food-elasticities/.

[25] This revenue recycling 'mode' may not be as efficient (e.g., relative to cutting distortionary taxes on labor), but may be required to guarantee crucial support for reform from most of the population (particularly the middle class). See also Section 5 below.

[26] Household-level access to the infrastructure types mentioned above is also obtained directly from HBSs. The associated revenue recycling 'mode' is set up as follows: if, for example, the average infrastructure access rate of the poorest (e.g., bottom 10 percent) individuals is equal to 30 percent, climate mitigation policy revenues are allocated to the remaining 70 percent of these individuals and so on for subsequent segments of the population. The gains from

In Section 4 below, unless otherwise stated, we simulate an additional revenue recycling mode as an equal split of revenues between modes (a) and (b) above, namely:

> (c) 50 percent of revenues recycled towards targeted cash transfers to the bottom 70 percent, and 50 percent to enhancing household infrastructure access.

For the modeling of different modes of revenue recycling, the total amount of revenues (adjusted by the proportion chosen to be recycled) is used as a proxy for the gross (monetary) household gain from revenue recycling. For the modeling of new, targeted cash transfers, recycled revenues were divided by the population of the targeted deciles (e.g., first seven deciles for targeting of the bottom 70 percent of the distribution, assuming no leakage or under-coverage) and, subsequently, expressed in percent of decile-specific household per-capita consumption.

The distributional analysis described above is subject to several shortcomings. First, in projecting the distributional analysis forward to 2030, the fossil fuel intensities (as yielded by the input-output matrices) and decile-specific household budget shares are assumed to remain constant in the BAU. This means that the use of input-output matrices likely overstates consumer price changes for non-fuel goods and services, since the fossil fuel intensity of production would decrease due to higher energy prices and energy efficiency improvements as the capital stock turns over. Second, some of the incidence of climate mitigation policies could be passed backwards into lower producer prices, assuming upward-sloping supply curves in the medium-to-long run. Some of the incidence could be borne by capital owners (improving progressivity) or even workers (worsening progressivity). See also additional commentary in Parry, Mylonas, and Vernon (2019) and Shang (2023).

4. Results

We examine effects[27] of the US$25/ton CO_2e carbon tax along different dimensions: net monetized welfare co-benefits (Section 4.1); fiscal revenues (Section 4.2); real GDP growth (Section 4.3); and distributional implications across industries and households (Section 4.4). We also present selected results for the 'comprehensive energy price reform' (CEPR) package (Section 4.5) and consider sensitivity of these results (Section 4.6).

4.1 Welfare co-benefits from averted damages

The introduction of the US$25/ton CO_2e carbon tax is associated with GHG emissions reductions of over 20 percent below BAU in South Asia (Figure A.1). Likewise, net welfare co-benefits from carbon

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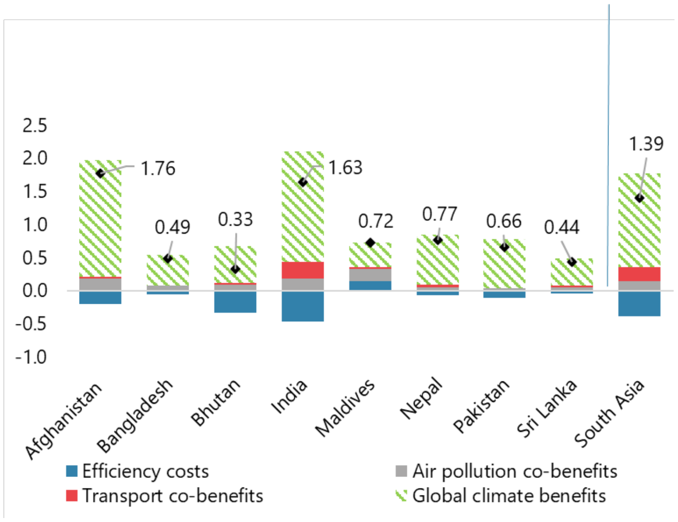
revenue recycling under this specific 'mode' are, hence, relatively understated, since they do not account for the likely positive efficiency gains from public investment (i.e., assuming projects have benefits greater than their costs as opposed to the zero efficiency gains from direct cash transfer payments).

[27] These are presented for individual South Asian economies. Results for the entire South Asia region are calculated as the 2030, applicable policy scenario (carbon tax, fossil fuel subsidy phaseout or CEPR) GDP-weighted averages of the economy-specific results shown in each figure or table below.

taxation are significant, at 1.4 percent of GDP in 2030 (Figure 4)**.** These are calculated as the difference between gross welfare co-benefits and efficiency costs. The efficiency costs measure the deadweight losses/Harberger's triangles from the imposition of the carbon tax, plus the loss in consumer surplus from higher fossil fuel prices as in Parry, Mylonas, and Vernon (2021). Gross welfare co-benefits consist of the following: i) climate benefits (the global warming benefits from reduced emissions due to fossil fuel taxation); ii) air pollution co-benefits (averted local air pollution mortality and morbidity);[28] as well as iii) transport co-benefits (averted road accidents, reduced road damage and reduced congestion).

The process of reducing GHG emissions will entail households responding to an incentive of gradually moving towards cleaner sources of energy to save money, using public transportation. For example, there will be greater incentives to build more pedestrian walkways and provide flexible work arrangements for those who can work from home. This will create significant savings in terms of averted deaths from accidents, will lessen exposure to PM2.5 (mostly in urban areas),[29] reduce required spending on road repair, and lead to less congestion with fewer passenger vehicles on the road—so-called transport co-benefits—particularly in India (where these represent around 0.3 percent of GDP in 2030). There may also be greater demand for walkable green spaces in urban areas, and lower traffic will reduce time spent commuting. Outdoor air pollution will also decline, reducing average sick days per worker, as well as increasing life expectancy and the ability of the average South Asian to contribute their full human capital to the economy.

Figure 4. Net welfare co-benefits (% GDP) from US$25 carbon tax/ton CO$_2$e by economy, 2030



Source: Authors' estimates using CPAT, based on data and methods in OECD (2012), Parry et al. (2014) and Parry and Small (2005).

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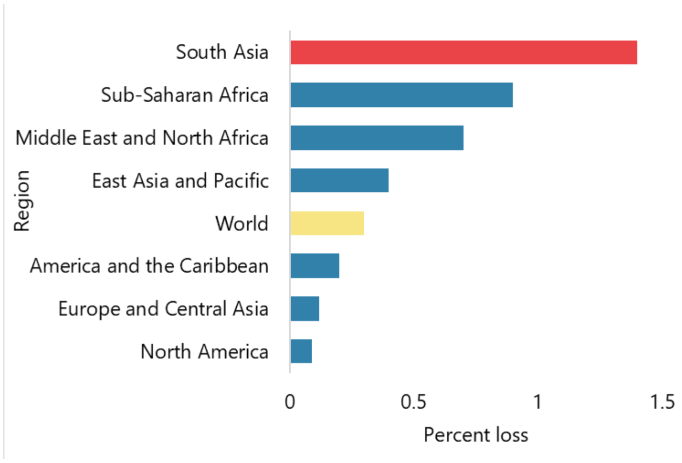
[28] In CPAT, the welfare co-benefits from reduced local air pollution are monetized by using Values of Statistical Life (VSLs) based on OECD (2012). Forgone wage income from morbidity is also included but does not represent a large portion of the total health-related co-benefits. See also further discussion in Black et al. (forthcoming).

[29] Nine (9) out of the world's 10 cities with the worst air pollution are in South Asia. South Asians are exposed to extremely unhealthy levels of ambient air pollution: nearly 60 percent of the population lives in densely populated areas, where concentrations of PM2.5 exceed by many times the level recommended by the World Health Organization (World Bank, 2022b).

Global climate benefits are social benefits from emissions reductions following imposition of the carbon tax (valued at a social cost of carbon of US$47 per ton of CO_2e in 2019, rising at approximately a 4 percent annual rate to reach roughly $75 per ton CO_2e in 2030,[30] all in real 2021 US$ terms). Since the measured benefit accrues globally—though it corresponds to the South Asian contribution to reduce GHG emissions—it is represented as the patterned component in Figure 4.

The welfare co-benefits incorporate the idea that people's ability to be more productive will increase amid lower levels of carbon emissions, while health costs from illnesses will fall. World Bank (2021a) estimates that the loss of human capital per person in South Asia solely attributable to air pollution in 2018 was 1.4 percent, significantly higher than in other regions (Figure 5).

Figure 5. The relative loss of human capital per person due to premature deaths attributable to air pollution is almost five times higher in South Asia compared to the global average



Source: World Bank (2021a). Note: Data refers to the year 2018.

4.2 Fiscal revenues

The simulated carbon tax raises GDP-weighted average fiscal revenues for the region of approximately 1.3 percent of GDP in 2030 (Figure 6.a), providing funds for compensating those negatively affected or for easing the green transition.[31] These revenues are independent of the monetized welfare co-benefits shown in Figure 4. The fuel source of these revenues (Figure 6.b) is strongly correlated with the main tax base and carbon intensity of fossil fuel consumption in each economy, for example, coal in India and natural gas in Bangladesh and Pakistan (Table A.3).

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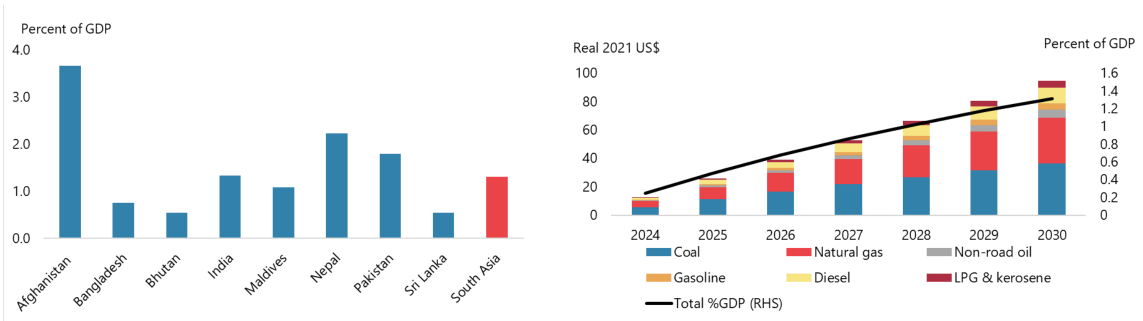
[30] This value is consistent with the midpoint estimate in Stiglitz et al. (2017), which is also used in Parry, Black, and Vernon (2021) (see Figure 3).

[31] These estimates are net of tax base erosion (broadening) from pre-existing taxes (subsidies), and account for gradual base erosion over time following the introduction of the carbon tax.

Figure 6. Fiscal revenue gains from a US$25/ton CO_2e carbon tax by 2030 are substantial


6a. Revenues by economy, 2030

6b. Revenues by fuel source and year, South Asia

Source: Authors' estimates using CPAT. Note: Shows additional (above BAU) fiscal revenues from the policy net of renewable energy subsidies. LULUCF for Bhutan influences revenue levels, so its marginal abatement for a given US$ of the carbon tax is very small.

Because a carbon tax corrects an externality, its success is measured, not by its buoyancy, but in its ability to move consumption away from carbon-intensive fuels, implying that the tax base should shrink over time. This is reflected in the results. Figure 6.b. shows that revenue rises every year but at a decreasing rate as the tax base erodes, even though the carbon tax rate is assumed to increase in equal annual increments to 2030. Moreover, as the carbon tax corrects for the externality, it also partially offsets the effect of any pre-existing fossil fuel subsidies on carbon-intensive fuels (the retail price rises above the supply costs and sales tax shown in Figure 3).

4.3 Economic growth

Revenue recycling approaches matter for the overall growth effects of the US$25/ton CO_2e carbon tax. The size of the multipliers associated with different policy measures determines the impact of a carbon tax on economic activity. The multipliers' values come from CPAT's estimates for low- and middle-income countries as per the World Bank's Macro-Fiscal Model (MFMod).[32] Assuming half of the revenues are redistributed as cash and half as infrastructure investment (revenue recycling mode (c) as described in Section 3.3), the results show almost neutral effects on real GDP growth rates.[33] Assuming the carbon tax is slowly phased in to reach US$25/ton CO_2e by 2030, real annual GDP growth rates could see an initial downward trend (compared to BAU), as efficiency costs from the carbon tax weigh on production. However, revenue recycling in the form of more funds for public investment and a boost to consumption from cash transfers would almost offset these negative effects (Figure 7). Afghanistan and Nepal would see the largest positive net effects from revenue recycling.

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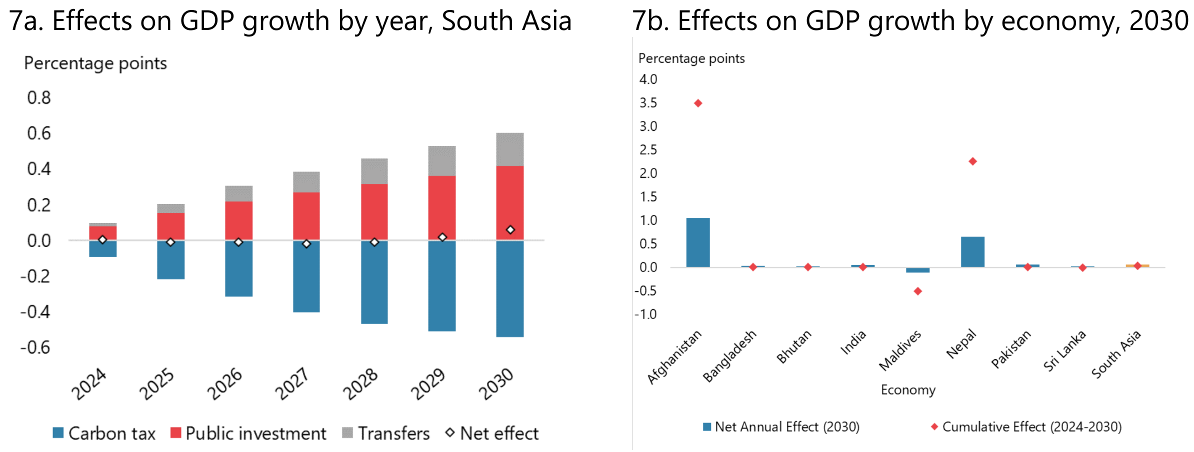
[32] See Schoder (2022) and Black et al. (forthcoming) for more details.

[33] If revenues are recycled entirely into infrastructure investment (cash transfers), the growth effects are larger (smaller).

Figure 7. Carbon taxation is not expected to diminish the region's real GDP growth rate


7a. Effects on GDP growth by year, South Asia

7b. Effects on GDP growth by economy, 2030

Source: Authors' estimates using CPAT. Note: Figure shows estimated deviations from projected real GDP growth rates relative to BAU for the US$25/ton CO_2e carbon tax, assuming revenue recycling via mode (c) as described in Section 3.3.

4.4 Distributional impacts

4.4.1 Incidence across households

Broadly speaking, our results suggest that income distribution improves moderately with the introduction of a carbon tax. Figure 8 shows the percent change in the consumption-based Gini coefficient from the US$25/ton CO_2e carbon tax, with the left-most set of bars showing a small but positive effect on the income distribution for three South Asian economies: Bangladesh, Nepal, and Pakistan. Hence, even without accounting for revenue recycling, income equality improves a small amount in some economies relative to BAU.[34]

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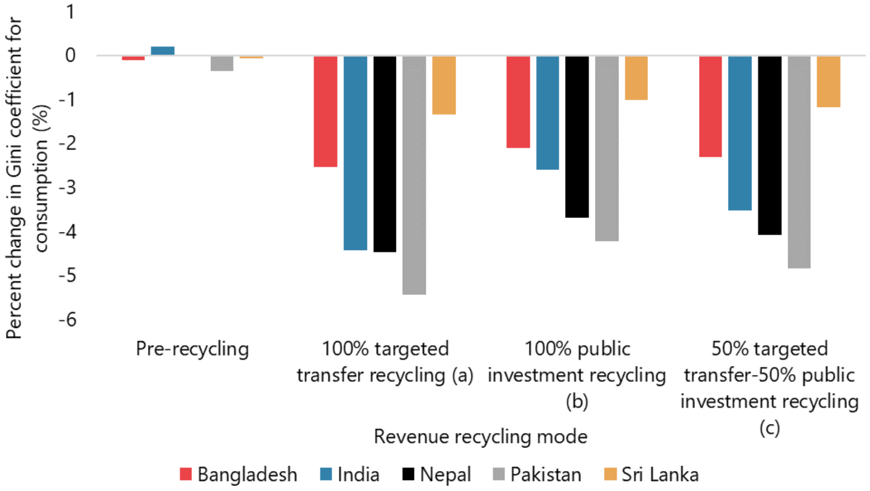
[34] This is the case not least because poorer households in the region are largely disconnected from the electricity grid. They also consume a significant amount of biomass (the price of biomass is not affected under the simulated carbon tax). However, this effect could attenuate as incomes grow and poorer households become more fossil-fuel-intense in their consumption (see further discussion in Parry, Mylonas, and Vernon, 2019).

Figure 8. Percent change in consumption-based Gini coefficient from US$25/ton CO₂e carbon tax relative to BAU by economy and revenue recycling mode, 2030



Source: Authors' estimates using CPAT. Note: Figure shows the percent deviation in the household consumption-based Gini coefficient for each economy following the introduction of a US$25/ton CO₂e carbon tax relative to BAU. The set of bars under 'Pre-recycling' shows percent deviations assuming no carbon tax revenues are recycled to households. Subsequent bars show percent deviations assuming carbon tax revenues are fully recycled via modes (a), (b), and (c) as described in Section 3.3.

Revenue recycling significantly enhances income equality relative to BAU. Specifically, the three right-most bar clusters in Figure 8 show improvement in the Gini coefficient under different revenue recycling modes. India and Pakistan would see an important improvement in equality from such policies - almost 4-5 percent decline in the Gini, on average, over less than a decade.

Since the US$25/ton CO₂e carbon tax directly impacts the prices of different energy sources, our results show that its incidence will be larger for households that consume relatively more carbon-intensive fuels (Figure 9).[35] In South Asia, the incidence of carbon taxation turns out to be progressive. In other words, the share of tax revenues raised is relatively higher for wealthier South Asians because poorer households' share of effective carbon consumption is lower.

More detailed results on the distributional impacts of carbon taxation and revenue recycling approaches depend on household spending patterns. The individual economy charts in Figure 9 assume carbon tax revenues are recycled via mode (c) as described in Section 3.3. Absent revenue recycling, consumption losses from the introduction of the carbon tax are (mildly) progressively distributed across deciles, mirroring the findings observed in terms of the Gini coefficient in Figure 8

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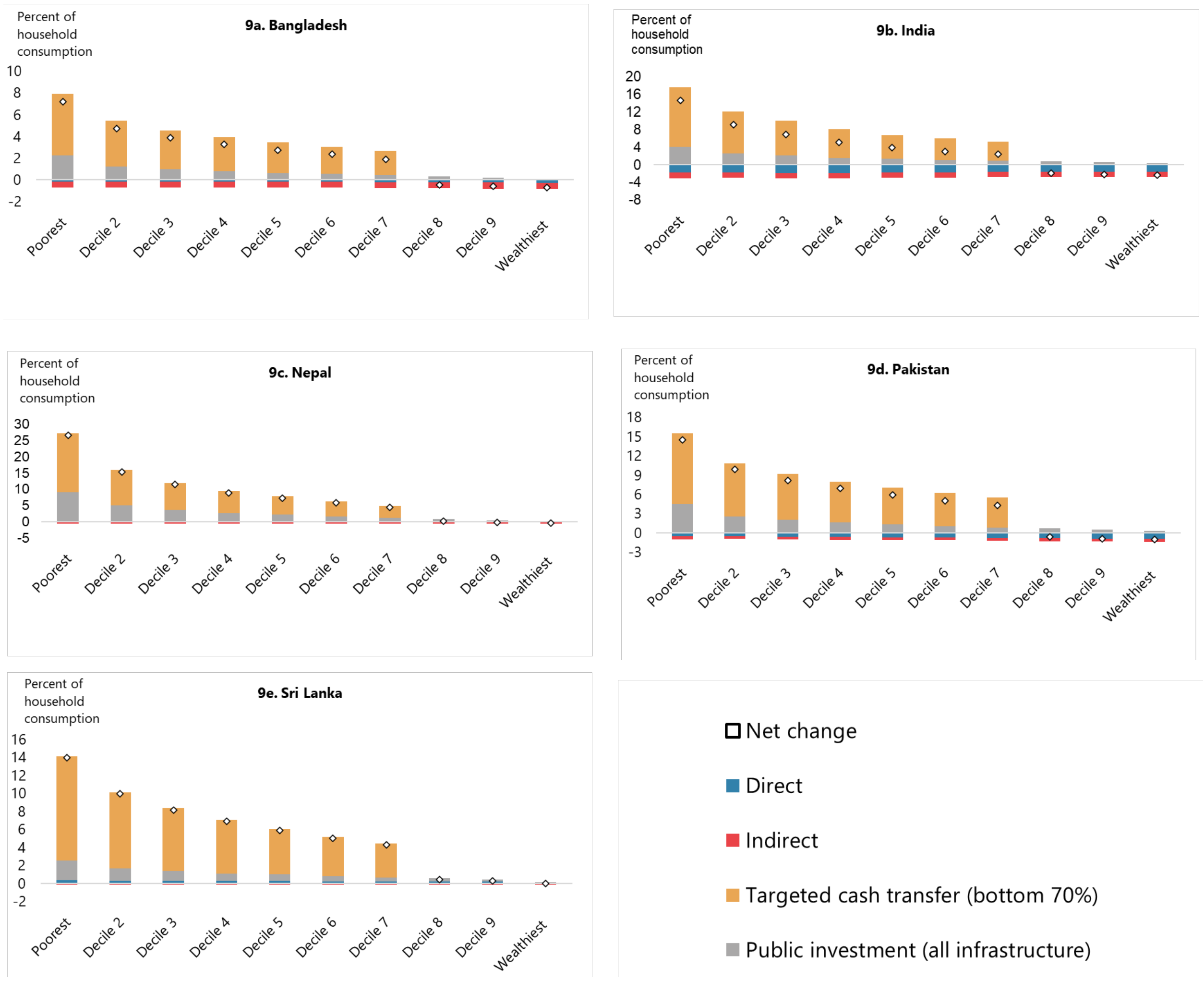
[35] In many advanced economies, a carbon tax would hurt the poorest income decile(s) of the population more than the wealthiest, given the higher share of fossil fuels in their consumption baskets (see also Ari et al., 2022 and Arregui et al., 2022). For example, in the United States, lack of access to public transportation for most people means that a vehicle is an essential good, particularly for rural and semi-rural low-income populations. Earlier estimates for the United States show that the wealthiest quintiles would be less affected than the poorest quintiles from a US$50/ton CO₂e carbon tax (IMF, 2019b).

above.[36] On average, approximately 40 percent of the incidence is due to increases in the direct cost of energy for households (that is, the 'direct' effect), while the rest is due to an increase in the prices of non-fuel goods/services that use (the now costlier) fossil fuels as an input into their production process (the 'indirect' effect). Once revenue recycling is considered, the bottom seven consumption deciles receive net gains ranging, on average, between approximately 4 percent (Bangladesh) and 11 percent (Nepal) of total household consumption.[37]

Figure 9. In 2030, the direct vs. indirect household consumption losses from the US$25/ton CO₂e carbon tax in selected South Asian economies represent a small portion of total household consumption and are mildly progressively distributed



Source: Authors' estimates using CPAT. Note: Individual economy charts present the total incidence effects from a US$25/ton CO₂e carbon tax in 2030 by (population-weighted) per-capita household consumption decile, assuming

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[36] Mean incidence effects (pre-revenue recycling) across all consumption deciles range between 0.6 (Nepal) and 2.9 (India) percent of total household consumption.

[37] This is by design, given that the targeted cash transfer is assumed to apply only to the bottom 70 percent of the consumption distribution.

revenues are recycled via mode (c) as described in Section 3.3. All reported values are population-weighted averages and adjusted for behavioral responses to higher consumer prices (see also Section 3.2).

4.4.2 Incidence across economic sectors

As economic activity transitions, there is a corresponding transition in the production structure, with fossil fuel-intensive sectors losing and energy-efficient or renewable-intensive sectors gaining. This may directly impact firms and workers to the extent that firms see cost increases—given more expensive after-tax energy inputs. To quantify these cost increases for non-fossil fuel/electricity sectors, we assume away full passthrough of producer cost increases onto consumer prices (i.e., producers bear the full incidence of the carbon tax[38]) and use the same input-output data and methods outlined under Section 3.2 above.

The impacts of the US$25/ton CO_2e carbon tax on industry input costs are moderate, except for a few sectors in a few economies (Figure 10). While the sectors with the highest cost increases in 2030 vary by South Asian economy, the general pattern is that the largest sectors - in terms of their share in total output - are the least likely to experience substantial cost increases. Cement and aviation see the highest average cost increases in 2030 (aviation is linked to tourism which is an important exporting sector for the smaller economies such as Maldives and Nepal).

In particular, the largest cost increases are seen in India, at around 11 to 12 percent (iron/steel and cement), given its heavy use of coal. Pakistan and Nepal also see relatively large cost increases in these sectors (at around 2-4 percent), while economic sectors in Bangladesh, Bhutan, Maldives, and Sri Lanka experience negligible cost increases overall. In fact, the 2030 average effective input cost increase for South Asia, weighted by the share of the sectors in regional output (and each economy's share in regional GDP), would only be around 2 percent relative to BAU.

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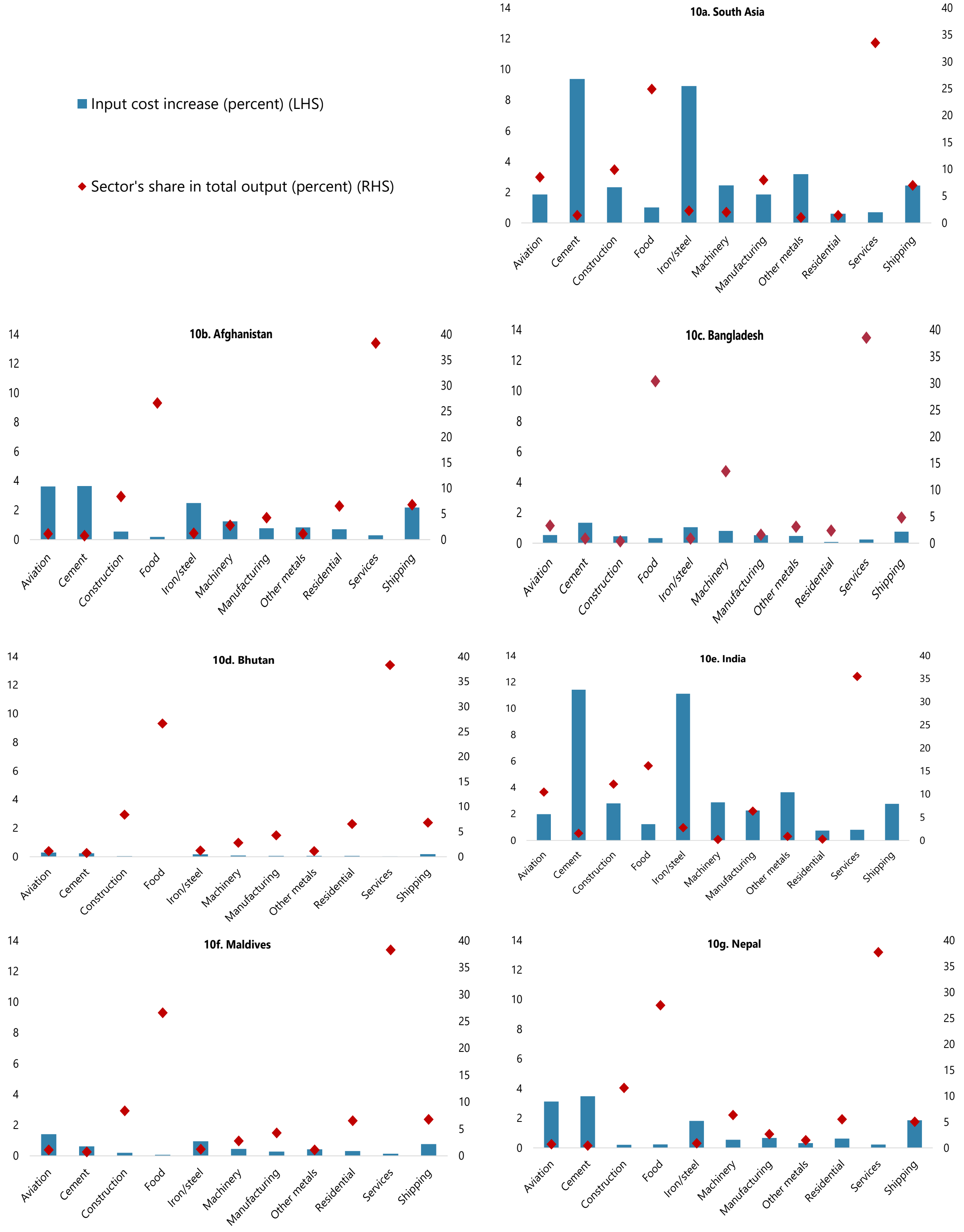
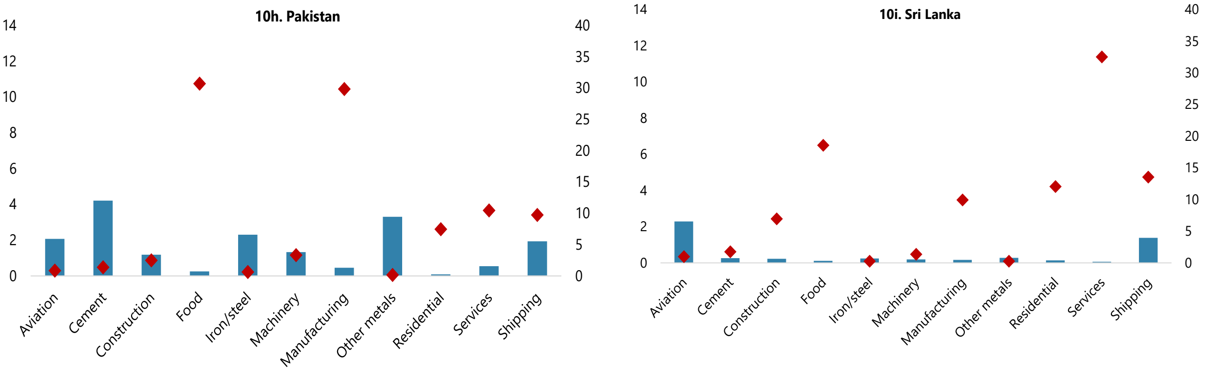
[38] As discussed under Section 3.2 above, this assumption is particularly relevant for EITE (or heavy industry) sectors competing in world markets (and not being able to pass higher prices forward to households), since these sectors are a focal point of international competitiveness (as well as carbon leakage)-related concerns surrounding (and potentially impeding) the adoption of climate mitigation policies (Dolphin et al., 2020).

Figure 10. Percent input cost increases by economy and sector from the US$25/ton CO_2e carbon tax, 2030





Source: Authors' estimates using CPAT and GTAP-10 data (see also Section 3.2).

4.5 Comprehensive energy price reform

The previous results look solely at the effects of a carbon tax. However, Figure 3 makes it evident that to achieve the optimal price for all fuels, governments will need to remove both explicit and implicit subsidies (the latter achieved mostly through the introduction of the carbon tax). It would defeat the purpose of rationalizing prices if governments introduced a carbon tax, on the one hand, while spending on fossil fuel subsidies on the other. Only the complete removal of fossil fuel subsidies would provide clear price signals, given their distortionary nature. We, therefore, show a 'comprehensive energy price reform' (CEPR) scenario, under which all fossil fuel subsidies, price controls and exemptions are gradually phased out along with the introduction of the US\$25/ton CO_2e carbon tax by 2030. Section 5 below discusses how to overcome some policy implementation challenges.

In terms of net monetized welfare co-benefits, the results for South Asia of implementing the CEPR are still resoundingly positive (Figure 11.a). The larger portion of these net welfare co-benefits comes from the carbon tax, with just phasing out fossil fuel subsidies coming in at a non-negligible 0.31 percent of GDP in 2030. The welfare co-benefits (net of efficiency costs) of the CEPR amount to 1.4 percent of GDP in 2030.[39]

In terms of government revenue gains from the CEPR package, South Asia could receive an additional 2.0 percentage points of GDP on average, split about equally between the carbon tax revenues and the forgone expenditure on subsidies (Figure 11.b). However, there are important differences in composition across economies. In the case of Nepal, which does not have explicit, direct fossil fuel subsidies, most (if not all) of the revenue would come from the carbon tax. In the case of Bhutan, which depends on subsidies on LPG from India but consumes very little carbon, the revenue would indirectly come from the fossil fuel subsidy phaseout.[40] The Maldives and Pakistan (both of which are considering

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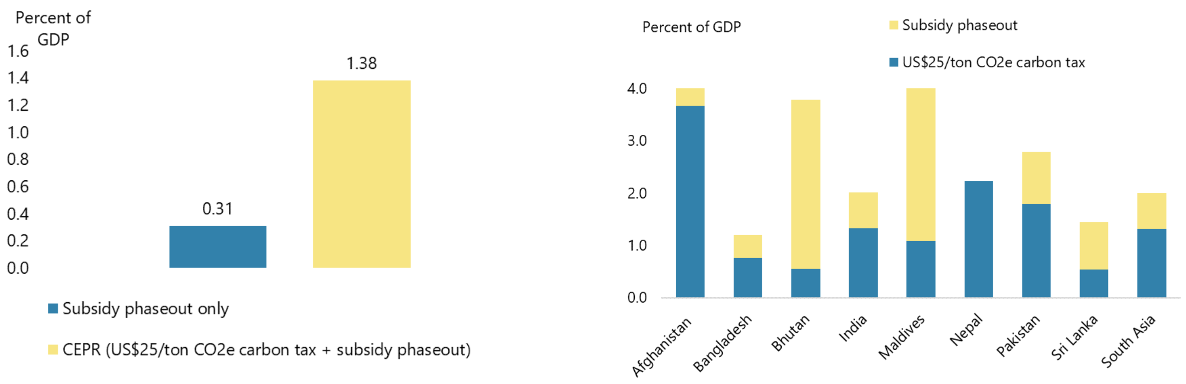
[39] In other words, similar to the net welfare benefits of the US\$25/ton CO_2e carbon tax in 2030 (Figure 4). This is because the combined introduction of a carbon tax and phaseout of fossil fuel subsidies, price controls and exemptions under the CEPR disproportionately increases efficiency costs (e.g., due to larger consumer surplus losses from lower fossil fuel consumption). However, said efficiency cost increases are more than compensated by the positive gross welfare co-benefits to yield a positive net benefit estimate under this scenario as well.

[40] Bhutan imports LPG from India at subsidized prices. Removing the LPG subsidy would thus accrue to the Indian (as opposed to the Bhutanese) government.

a reduction in fossil fuel subsidies), as well as Sri Lanka, see significant revenue just by phasing out fossil fuel subsidies by 2030.

Figure 11. Net monetized welfare benefits and government revenues from the CEPR, 2030



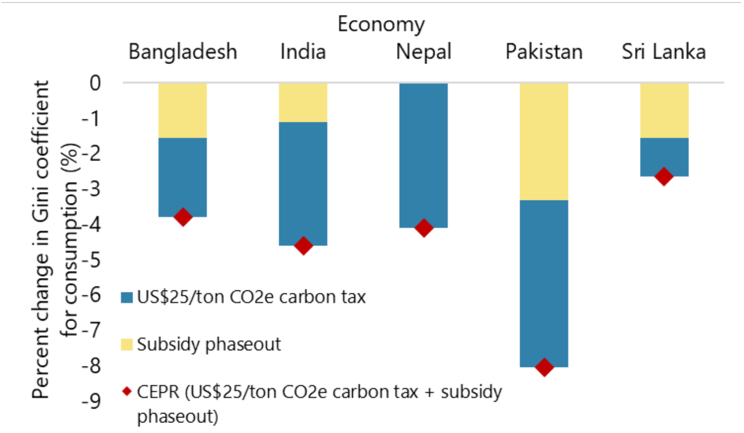
11a. South Asia net welfare benefits

11b. Government revenues by economy

Source: Authors' estimates using CPAT. See Figure 4 for the calculation of net monetized welfare co-benefits.

We also examine the impacts of the CEPR on the consumption-based Gini coefficient, post-revenue recycling (Figure 12). Assuming that revenues are recycled as per mode (c) (see Section 3.3), we observe that: i) these impacts are larger than the ones estimated solely for the carbon tax (given the availability of more revenues for recycling purposes); and ii) the impact is roughly split 30-70 between the phaseout of fossil fuel subsidies and the carbon tax, except for Nepal which does not currently grant fossil fuel subsidies.

Figure 12. Percent change in consumption-based Gini coefficient from the CEPR relative to BAU by economy, 2030



Source: Authors' estimates using CPAT. Note: Figure shows the percent deviation in the household consumption-based Gini coefficient under the CEPR relative to BAU. Deviations in the consumption-based Gini coefficient are calculated assuming all revenues are recycled under mode (c) as described in Section 3.3.

4.6 Sensitivity analysis

We consider several changes in the main parameters of the model to evaluate the robustness of our conclusions.[41]

4.6.1 Energy price assumptions

Crude oil and other substitutes such as coal and natural gas have seen increasingly higher price levels and volatility in recent years. Specifically, the average annual price of energy commodities (oil, natural gas, and coal) reached its highest level ever in real terms in 2022 (World Bank, 2023). The price of Brent crude oil averaged US$100/barrel (bbl) in 2022 and is expected to remain high according to IMF and World Bank forecasts used in the CPAT model (Table 3). This is already a substantial burden on South Asia in terms of rising import costs and the implications for inflation through the passthrough of imported food and fuel price changes. If just to improve energy security and reduce fiscal vulnerability as budgets grapple with oil price uncertainty, reducing the consumption of fossil fuels would provide a welcome benefit to South Asia.

To illustrate this point, we apply the CPAT model assuming the initial oil price in 2023 is at a lower bound (the level in Q2 2020) of US$35/barrel ('"Low Price" Scenario' section of Table 3). We then, apply the same annual changes for future years as those in the policy scenario above to produce a new hypothetical energy price path to 2030. Other fossil fuel prices follow the same path too (see last five rows of Table 3). We compare this path to the path assumed in the CEPR (actual forecast), with the 2022 initial year showing record-high prices (first five rows of Table 3). The gap between these two forecasted price paths represents the range of fossil fuel prices that could be reached over the next 10 years, and thus a confidence band for how sensitive the model is to assumptions about global fossil fuel prices.

Table 3. Global fossil fuel price assumptions

"Comprehensive Energy Price Reform" Scenario		**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Crude Oil	$/bbl nom	87.0	78.5	76.3	74.6	73.2	72.1	72.1	72.1
Coal	$/ton nom	278.0	232.9	229.1	228.5	228.4	228.6	228.6	228.6
Natural Gas - LNG	$/MMBtu nom	26.7	23.6	21.7	19.9	19.7	19.5	19.5	19.5
Natural Gas - North America	$/MMBtu nom	4.8	5.0	5.1	5.1	5.2	5.2	5.2	5.2
Natural Gas - Europe	$/MMBtu nom	18.7	18.2	16.1	14.1	13.6	13.6	13.6	13.6
"Low Price" Scenario		**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Crude Oil	$/bbl nom	26.83	24.23	23.54	23.01	22.58	22.26	22.26	22.26
Coal	$/ton nom	43.27	36.25	35.66	35.56	35.55	35.57	35.57	35.57
Natural Gas - LNG	$/MMBtu nom	7.06	6.23	5.72	5.26	5.20	5.15	5.15	5.15
Natural Gas - North America	$/MMBtu nom	1.26	1.30	1.33	1.33	1.34	1.36	1.36	1.36
Natural Gas - Europe	$/MMBtu nom	1.21	1.18	1.04	0.92	0.88	0.88	0.88	0.88

Source: Authors' estimates using CPAT. Note: The forecasted price path in the CEPR is an average of World Bank Commodity Markets Outlook (October 2022): www.worldbank.org/commodities; and IMF WEO (October 2022): https://www.imf.org/en/Research/commodity-prices data.

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[41] In the sensitivity analysis, we only examine the five economies for which we conduct the distributional analysis (see Section 4.4 above).

The results are shown in Table 4. In this ‘Low Price’ specification, the path of the carbon tax phase-in is the same as under our main policy scenario of US$25/ton CO_2e by 2030, but lower energy costs raise industry energy demand, and thus help the economy grow faster. Real private consumption is also higher in the first few years under the BAU and CEPR scenarios (also fueled by higher energy demand). Given that the region is a net energy importer, the cost of imports is lower. Consumption would, hence, be more responsive to price-based climate mitigation policy (either in the form of carbon taxes or fossil fuel subsidy phaseouts), implying a larger reduction in GHG emissions under the low-fossil fuel price scenario.

Compared to the CEPR package, lower energy prices lead to a much faster transition (see the third row of Table 4 for every economy). Fiscal revenues-to-GDP in 2030 are, thus, about 10 percentage points higher for Nepal and Pakistan. The net monetized welfare co-benefits are significantly larger: more than twice as large as in the CEPR scenario above (India, Pakistan, Sri Lanka). However, GDP is almost the same compared to the CEPR scenario (except for Sri Lanka, where it is higher). Furthermore, except for India (post-revenue recycling), the Gini coefficient falls faster for most economies (both pre- as well as post-revenue recycling), meaning that the income distribution becomes more equal as a result of the policy when initial energy prices are lower.

Table 4. Sensitivity analysis of selected impacts relative to comprehensive energy price reform (CEPR) by economy and assumption, 2030

Economy	Scenario | Impact	Revenues	Net welfare co-benefits	Real GDP	Gini coefficient decline (pre-recycling)	Gini coefficient decline (post-recycling) *
Bangladesh	Comprehensive energy price reform (CEPR), baseline energy price forecast	100.0	100.0	100.0	100.0	100.0
	CEPR, US$12.50 carbon tax	75.2	75.2	101.9	85.8	71.0
	CEPR, low energy prices (lower bound) **	102.8	128.6	101.8	111.4	107.1
India	Comprehensive energy price reform (CEPR), baseline energy price forecast	100.0	100.0	100.0	100.0	100.0
	CEPR, US$12.50 carbon tax	83.9	93.3	102.7	98.2	54.4
	CEPR, low energy prices (lower bound) **	98.6	188.5	102.7	246.2	75.5
Nepal	Comprehensive energy price reform (CEPR), baseline energy price forecast	100.0	100.0	100.0	100.0	100.0
	CEPR, US$12.50 carbon tax	78.6	73.1	98.0	49.9	52.2
	CEPR, low energy prices (lower bound) **	109.2	143.3	98.9	172.9	111.9
Pakistan	Comprehensive energy price reform (CEPR), baseline energy price forecast	100.0	100.0	100.0	100.0	100.0
	CEPR, US$12.50 carbon tax	75.3	75.0	95.9	86.9	74.4
	CEPR, low energy prices (lower bound) **	108.7	178.4	95.9	131.7	120.4
Sri Lanka	Comprehensive energy price reform (CEPR), baseline energy price forecast	100.0	100.0	100.0	100.0	100.0
	CEPR, US$12.50 carbon tax	65.4	61.9	137.4	86.3	72.4
	CEPR, low energy prices (lower bound) **	106.6	181.1	137.3	171.9	117.6

Source: Authors’ estimates based on CPAT. Notes: Unless otherwise stated, the Table shows comparisons relative to CEPR (=100) (first row for every economy). * Deviations in the consumption-based Gini coefficient are calculated assuming all revenues are recycled via mode (c) as described in Section 3.3. ** The ‘low energy prices’ rows assume prices in 2024 remain at their lowest level this decade, namely, their value in the second quarter of 2020.

4.6.2 Lower carbon tax rate assumption

As shown in Table 1, the level of the carbon tax consistent with the stated NDC pledges varies substantially, from over US$23/ton CO_2e in Sri Lanka to US$0/ton CO_2e in Bangladesh, India, and Pakistan. We, therefore, estimate the results assuming the carbon tax rate is half as large as under our main policy scenario, at US$12.50/ton CO_2e. As briefly discussed in Section 2.2 above, this is slightly higher than the rate introduced in some emerging markets and developing economies (EMDEs; World Bank, 2022c). This scenario illustrates a very gradual phase-in of the tax and would only be beneficial if, for example, economies are able to access a new technology in the outer years that would, at the same time, significantly lower costs from inaction in the early years (in net present value terms).[42] Still, risks from waiting to introduce carbon pricing reform may be quite serious due to threshold effects.[43]

The second row for each economy in Table 4 shows the results of phasing out fossil fuel subsidies, price controls and exemptions and, contemporaneously, introducing a US$12.50 carbon tax. For most economies, the revenues are only about 75-80 percent of what they would have been under the CEPR, though the benefits of a higher carbon tax also increase beyond 2030 (Table 4 only reports values in 2030). Additionally, monetized welfare co-benefits are more than three-quarters the value of the CEPR package, in large part because mitigation action in India has an important impact on results for the region. It is worth noting that the GDP estimate in 2030 under this scenario is about the same as in the CEPR scenario for most economies, except for Sri Lanka (where the US$12.50/ton CO_2e carbon tax yields a 37 percent higher GDP compared to the original CEPR scenario). Comparing the outcomes for income distribution, inequality falls but by much less (about 70-80 percent compared to the CEPR scenario). This is true pre- and post-recycling of revenues (last two columns of Table 4). Because Nepal does not have fossil fuel subsidies, inequality improves by only around half compared to the CEPR scenario.

In sum, a lower assumed carbon tax rate slows the energy transition, and, thus, entails less favorable distributional impacts. In contrast, lower assumed energy prices between 2023 and 2030 lead to higher government revenues, a greater amount of redistribution and, thus, a larger improvement in the post-recycling Gini compared to the BAU and the CEPR (Figure 13). This last sensitivity scenario also helps explain why high global fossil fuel prices are detrimental to South Asian economies: they adversely impact economies' terms of trade (as the region is a net energy importer), reducing real incomes as a result.

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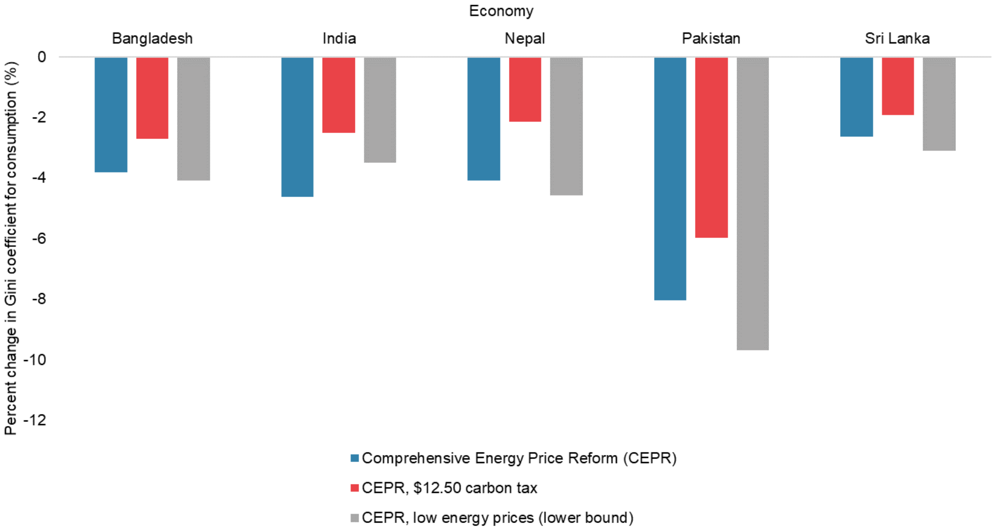
[42] That said, South Asian economies are already embracing innovative programs like battery exchanges in India, off-grid solar electrification in the rural areas of Bangladesh, and floating solar panels across the region.

[43] See: https://news.un.org/en/story/2021/09/1099992

Figure 13. Percent change in consumption-based Gini coefficient relative to BAU by economy and sensitivity analysis assumption, 2030



Source: Authors' estimates using CPAT. Note: Figure shows percent deviations in the household consumption-based Gini coefficient relative to BAU for each economy following recycling of revenues under mode (c) (see Section 3.3) for three cases: i) a US$25/ton CO_2e under the CEPR; ii) a US$12.50/ton CO_2e under the CEPR, and iii) the CEPR under point i) but using the lower-bound global energy price forecasts presented in Table 3 (see '"Low Price" Scenario' section).

5. Political economy and implementation considerations

There are countless cases of attempts to reduce fossil fuel subsidies in developing countries, many of which have been met with backlash against the ruling government. There are even fewer initiatives to introduce carbon taxes. This is, in large part, because there is a misconception that fossil fuel subsidy phaseout is a simple elimination of a budget line from one day to the next. Often, such reforms are implemented when the government is under pressure to reduce its fiscal deficit, and removal of fossil fuel subsidies occurs as a last resort measure under an austerity program (e.g., Sri Lanka and Pakistan in late 2022; World Bank 2022d). Therefore, political support could be very weak in these cases. In contrast, the comprehensive energy price reform (CEPR) package illustrated in this paper must be well-planned at all levels of government, and gradually phased in to enable households and firms to adjust to the new relative prices.[44] The lessons learned from the successful phaseout of fossil fuel subsidies are exactly those that should be applied when introducing a carbon tax: the tax needs to be part of a broader policy package which includes redistribution to vulnerable households, infrastructure

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[44] The gradual nature of the package ensures that there are no 'stranded assets' and does not require energy producers or energy-intensive industries to do anything different. As with an ETS, the incentive is for the firms to gradually find fewer polluting technologies as they see fit to produce their goods and services, but unlike an ETS, monitoring and coordination requirements by the government are minimal.

investments, and employment compensation and retraining for those most affected, such as workers in a coal-mining community.[45]

The distributional analysis in Section 4.4 above considered the case of cash transfers benefitting a wide segment of the population (70 percent), not just the poor. The reason is that it may be counterproductive to shift all revenues to the poorest quintile, as the support of the middle class could be critical. Broad-based and adequate compensation methods are necessary: if benefits are diffuse, it can be much harder to identify and manage the political coalition needed for reforms (Clements et al. 2013; Inchauste and Victor, 2017). Moreover, it can minimize the public discontent of a few which could very well lead to the reversal of reforms (Moerenhout, 2017). Specifically, under revenue recycling 'mode' (a) in Figures 8 and 9, proportional redistribution of climate mitigation policy revenues to the poorest 70 percent of households may help increase reform acceptability. Of course, the broader coverage should be re-assessed over the years, given the limited fiscal resources and the 50-50 share between cash transfers and infrastructure investment ('mode' (c)) is context-specific: other economies with a more urgent need for basic infrastructure, including for adaptation, may prefer to shift more into public investment.[46]

Most economies in the region have some form of fossil fuel subsidy, though they have been slowly moving away from such subsidies towards better-targeted cash transfers out of necessity, given tight post-pandemic fiscal space (see World Bank, 2022a, Table 1.1). Still, explicit fossil fuel subsidies in 2021 averaged 0.8 percent of GDP in South Asia, varying widely (from insignificant amounts in Nepal, to 2.5 percent of GDP in Pakistan - see Figure 14). What is more, universal price subsidies for fossil fuels are typically untargeted and benefit wealthy households in absolute terms, which is associated with weak redistributive outcomes (see Clements et al., 2013; Abdallah et al., 2015; Coady et al., 2015).

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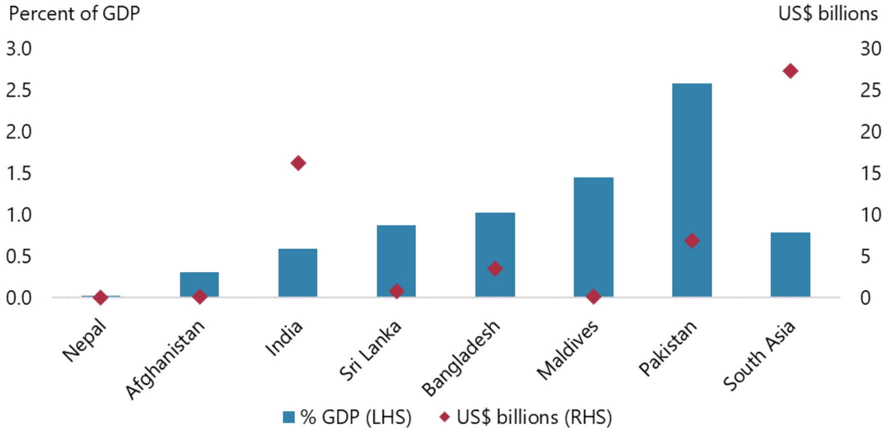
[45] Recent empirical work by Hille et al. (forthcoming) explores the employment effects of various policies such as a fossil fuel subsidy phaseout. They find that the net employment effects are small but positive. However, having the ex-ante knowledge of these quantitative effects can facilitate compensatory actions for workers. Vagliasindi (2013) also discusses in-depth experiences in various countries, including India, in eliminating fossil fuel subsidies.

[46] South Asia is highly exposed to climate-related extreme events. According to the Global Climate Risk Index and the IMF Climate Change Dashboard, most economies in the region are ranked as the most climate-vulnerable globally (Germanwatch, 2021). The frequency and severity of climate impacts have intensified and are projected to worsen, due to gradual global warming - South Asia will see hotter weather, longer monsoon seasons, and increased droughts in upcoming decades (IPCC, 2018).

Figure 14. South Asia: explicit fossil fuel subsidies (cost minus price) by economy, 2021



Source: Authors' estimates based on data and methods in Black, Parry, and Vernon (2021).

To reap the potential benefits from carbon taxation, broad consensus and integration into budget planning are required because the scheme must remain in place and not change following every political cycle.[47] Revenue mobilization capacity across the region is low, with tax revenues-to-GDP at 13.1 percent, on average, between 2015 and 2019 (World Bank, 2021b). Nonetheless, carbon taxes should be generally easier to collect when applied upstream, since producers and distributors of energy are mostly large, formal, and (sometimes) state-owned companies (IMF, 2019a; IMF, 2019b). The phasing in of carbon taxes would ideally occur when global commodity (e.g., oil) prices are falling to soften the price change.

Though the carbon tax and fossil fuel subsidy phaseout should be part of the same comprehensive package (CEPR) as discussed in Section 4, a positive carbon tax rate should not be phased in until after the fossil fuel subsidy phaseout is complete. Otherwise, the carbon tax will likely create a partial and distorted correction on already price-distorting subsidies. This is because subsidies on fossil fuels are a negative tax on energy consumption (both renewable and non-renewable), whereas the base of the carbon tax is the consumption of carbon, not of energy. Since fossil fuel subsidies spur import demand and higher energy consumption, this would contribute to balance of payments pressures in South Asia, as it occurred in 2022 when energy prices rose (World Bank, 2022d). This can undermine the success of the reform's implementation. The best option is to introduce the carbon tax at a zero rate and increase the rate once fossil fuel subsidies are fully eliminated.[48]

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[47] For example, India's 2022-2023 budget, presented in February 2022, incorporated, for the first time, such a long-term strategy. Climate action was framed as one of the pillars of the budget, including plans for low-carbon and climate-resilient development (Jha, 2021).

[48] The legal and institutional structure of the reform (fossil fuel subsidy phaseout and carbon tax) should be set up at the same time, as a single package of measures. However, the actual speed of the fossil fuel subsidy phaseout and carbon tax phase-in will also depend on energy prices at the time of implementation as discussed in Section 4.6.1. If energy prices are falling or low at implementation, reform acceptance by the public may be more likely.

It will also be important to ensure that all fossil fuel subsidies and inter-agency arrears are first eliminated so that energy companies are not making losses for uncompensated wholesale price schemes. For example, if Bangladesh's state-owned oil and gas company (PetroBangla) is paying high import prices for LNG, selling at stipulated subsidized prices, and not being compensated by the budget for the per-unit subsidy (as was the case in 2022), then it may choose to reduce carbon price payments. In other words, the explicit subsidy component of energy pricing must be eliminated first, so that producers are able to cover their operating costs. This means that tax administration and agreements across government entities should be transparent. One way to increase transparency is to explicitly provide estimates in the budget of the contingent liabilities and arrears across government entities, as well as estimates of the forgone funds due to insufficient income to utility companies.

Cash transfers and infrastructure funding should be frontloaded to increase political support for the reform. For example, cash transfers could be provided at the beginning of the year at fixed annual sums. The amount of cash transfer(s) would be dependent on the revenue collected from the policy package, which would imply an increase in the transfer(s) per household every year. Incentives for switching to clean energy should also be offered early in the process.

Eliminating fossil fuel subsidies could be packaged as a well-marketed program that offers something to the public that is equivalent to or better than what they received in the BAU. For example, in addition to linking the recycling of revenues, a targeted and means-tested cash transfer system could be expanded, or discount vouchers provided to passengers who use 'green' public transport (an electric tuc-tuc fare would be lower than the fare for a fossil fuel-run one).

There will be start-up costs associated with setting up cash transfer schemes in South Asia, as informality in the region is high and not everyone is registered or tied to the social protection system (World Bank, 2020). This could be an incentive: South Asian governments have been introducing unique citizenship IDs using biometric technology to deliver services, including subsidies, and many social safety-net systems expanded during the pandemic with the help of digital technologies and FinTech (World Bank, 2022d). Increasing cash transfers at scale is the best way to strengthen them, and thus make the support sustainable.

A proper communication strategy would clearly explain the link between cash transfers and the removal of fossil fuel subsidies or the introduction of a carbon tax (Worley et al., 2018). Some of the most effective fossil fuel subsidy elimination schemes around the world, which are always politically difficult to implement, have used effective communication approaches (Ghana, Jordan, Indonesia—see IMF, 2008). Other initially well-designed programs quickly lost popular support because the absence of proper communication by the government left a void (soon filled by disinformation). Notable examples are the El Salvador natural gas subsidy reform in 2011 (Calvo-Gonzalez et al., 2015) and the rebates on carbon taxes in Canada in 2020, and Switzerland in 2008 (Mildenberger et al., 2020). A highly successful fossil fuel subsidy removal program was Iran's 2010 reform. In particular, the success of this reform is credited largely to the explicit linkage to cash transfers as part of the same policy package. Yousefi and Farajnia (2022) show that own-price elasticities of energy use by enterprises, as well as cross-price elasticities, increased after the reform in Iran, suggesting that firms and households did respond to the new relative prices by switching to energy-efficient technologies.

As countries incorporate the costs of climate change into their medium-term expenditure frameworks, for example, by using the CPAT model, it will be easier to quantify the forgone benefits of transitioning to renewables, including through a program like the CEPR package. For example, in 2022, Nepal incorporated such accounts in its medium-term expenditure framework as part of the 2021 Green, Resilient, and Inclusive Development-Strategic Action Plan (GRID-SAP).

Appendix 3 shows a roadmap of steps that could be taken to depoliticize explicit fossil fuel subsidies and roll in a carbon tax. Such a scheme would be in line with good public expenditure practices. McCulloch (2023) also discusses in detail sensible approaches to reducing fossil fuel subsidies.

6. Conclusion

This paper argues that the gradual introduction of a moderate (US$25/ton CO_2e), economy-wide carbon tax is an effective climate change mitigation policy for South Asian economies to adopt. If coupled with a fossil fuel subsidy, price control and exemption phaseout, it would increase revenues by 2 percent of GDP on average for the region in 2030. If these additional revenues are used to compensate households and invest in infrastructure, they would lead to progressive policy outcomes (as measured by resulting reductions in the consumption-based Gini coefficient) and could create incentives for greater use of the region's low-cost and abundant renewable energy (Bloomberg, 2021). Investments in decarbonization can also help limit the extent of lock-in to carbon-intensive investments in the energy sector as the region develops. Such a reform would also reduce health- and transport-related externalities from fossil fuel use, leading to monetized welfare co-benefits (net of any efficiency costs) equivalent to 1.4 percent of GDP in 2030. It would, hence, be in South Asia's interest to proceed with the sort of energy price reform analyzed in this paper, regardless of what other regions or economies do.

Mainstreaming climate change into macro-financial policies that foster sustainable growth will also reduce the region's dependence on imported fossil fuels. The traditional macroeconomic objectives of price stability, robust external and fiscal balances, and a sustainable economic growth plan are still equally important, but their design should reinforce the path towards a greener development model. The findings from this paper reinforce the notion that pricing carbon is good for the region's development even if South Asia is not a major global GHG emitter in per capita terms. Adaptation will be necessary for the region, but mitigation can catalyze successful green development. Although many developing economies are reluctant to unilaterally commit to mitigation targets because these are perceived as an obstacle to their development, the effects of climate change and innovation in green technology stand to alter this trade-off. South Asia does not have to reduce energy consumption—which is required for economic development—but it can reduce the carbon content of said energy consumption as it transitions to renewables. The policy discussion should shift to how (as opposed to whether) to facilitate the transition to a green economy while minimizing associated short-term costs.

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Appendix 1. Climate mitigation policies and NDCs in South Asia

At COP26, South Asian economies made substantial progress in their strategies for decarbonization. Table A.1 summarizes their NDC pledges as of March 2023.

Table A.1. South Asia: Paris Agreement NDCs pledged at COP26

Area	Bangladesh	Bhutan	India	Nepal	Pakistan	Sri Lanka
Energy efficiency	-25% in overall energy consumption of the commercial sector below the BAU; (unconditional): Use energy-efficient appliances in household and commercial buildings (achieve 5% and 12% reduction in emission respectively); (conditional): Use energy-efficient appliances in household and commercial buildings (achieve 19% and 25% reduction in emission respectively) GHG Reduction by Mitigation (2030) for the Households Sub-sector (combined unconditional and conditional): 6.3%; GHG Reduction by Mitigation (2030) for the Commercial Sub-sector (combined unconditional and conditional): .94%; Switching to 100% super-critical coal power generation; GHG Reduction by Mitigation (2030) for the Power Sub-sector (combined unconditional and conditional): 48.9%				Increase energy efficiency with combined sectoral targets to achieve a total of 1.5% annual improvement in energy efficiency; Increase energy efficiency with combined sectoral targets to achieve a total of 1.5% annual improvement in energy efficiency	2025 target: Realize energy saving of 2,603 GWh by phasing out incandescent bulbs as a conditional measure 2030: Realize energy saving of 5,189 GWh by introducing efficient lighting, fans, refrigerators, and chillers as a conditional measure 2022 target: Implement Energy Efficiency Building Code on a mandatory basis 2030 target: Transmission and distribution network efficiency improvements (Loss reduction of 0.5% compared with BAU by 2030) as an unconditional measure (Target: Approximately 1,848 GWh energy savings)
General energy	- Reduce energy intensity (per GDP) by 20% by 2030 compared to 2013 levels (E&CC Master Plan); - GHG Reduction by Mitigation (2030) for the Energy Sector (combined unconditional and conditional): 96.1%	Offset 22.4 MtCO2e per year by 2025 through export of		Reduce its dependency on fossil fuels by 50%.		Reduce the GHG emissions against Business-As-Usual (BAU) scenario by 20% (approximately 36,010.2 Gg) in energy sector.
Renewable energy	- 5% of energy from renewable sources by 2015, and 10% by 2020 (2008Renewable Energy Policy); - 1000 MW of utility-scale solar power plant - 400 MW of wind generating capacity by 2030		- 175 GW by 2022: renewables: - 10 GW by 2022 biofuels; - 100 GW hydro; - 100 GW by 2022 solar; - 60 GW by 2022 wind	- 80% electrification through renewable energy sources having appropriate energy mix by 2050 - By 2020, increase the share of renewables in energy mix by 20% and diversifying its energy consumption pattern to more industrial and commercial sectors. - Develop 130,000 household biogas systems - Develop 1,000 institutional biogas plants - Develop 200 community biogas plants - Additional 220 MW of electricity from bio-energy by 2030 - Increase the share of biogas up to 10% as energy for cooking in rural areas; - Develop Mini and Micro Hydro Power to reach 15 MW - Improve 4000 water mills - Develop a electrical (hydro-powered) rail network by 2040 to support mass transportation of goods and public commuting. - 4,000 MW of hydroelectricity by 2020 and 12,000 MW by 2030 - Additional 50 MW of electricity from small and micro hydropower plants; - Develop 1,500 institutionalsolar power systems (solar PV and solar pumping systems) - 2,100 MW of solar energy by 2030 with arrangements to distribute it through the grid - By 2030, ensure 15% of the total energy demand is supplied from clean energy sources. - By 2030, expand clean energy generation from approximately 1,400 MW to 15,000 MW, of which 5-10 % will be generated from mini and micro-hydro power, solar, wind and bio-energy.	At least 20% RE generation by 2025 and at least 60% by 2030; ARE Policy (2019): The policy sets the specific target of at least 20% RE generation by 2025 and at least 30% by 2030	- Increase the share of renewable energy from the existing 50%, to 60% in 2020; - Establishment of 105 MW of biomass power plants; - Establishment of 176 MW of mini hydro power plants - Establishment of 115 MW of solar power plants - Establishment of large-scale wind power plants of 514 MW
Clean cooking & heating	- 70% market share of improved biomass cookstoves, reaching 20 million households in 2030; - 40% market share of improved gas cookstoves; 10% market switch from biomass to LPG for cooking compared to the business as usual - More than 1.5 million Improved Cook Stoves (ICS) - 14-47% emission reduction through Banning Fixed Chimney kiln (FCK), encourage advanced technology and non-fired brick use - GHG Reduction by Mitigation (2030) for the Brick Kilns Sub-sector (combined unconditional and conditional): 12.47%			- Increase the share of biogas up to 10% as energy for cooking in rural areas - Improve 475,000 cooking stoves - Equip every households in rural areas with smokeless (improved) cooking stoves (ICS) by 2030		
Gas & gas flaring	GHG Reduction by Mitigation (2030) for the Fugitive Sub-sector (combined unconditional and conditional): 4.78%					- 2026 target: Conversion of existing 600 MW of fuel oil-based combined cycle power plants to NG - 2027 target: Establishment of new combined cycle power plants in place of anticipated coal power capacity additions in the BAU and gas turbines with approximately 700 MW of capacities to be operated from NG

Source: CPAT and UNFCCC.

Progress on climate change mitigation is at an early stage for the four largest economies in the region.

- **Bangladesh** has had disorderly urbanization which threatens its development objectives. Among the reasons why Dhaka is considered so unlivable according to livability indices are its traffic, congestion, and urban pollution. While some of these problems need to be resolved through active institution-building and urban policies, incentives to the private sector and those dealing with day-to-day commute can also help. With this in mind, the country's pledges towards mitigation are quite impressive.
- **India** is the third largest economy in terms of overall GHG emissions in the world (though much less in per capita terms). As such, it will be important to examine its NDC. India made an eagerly awaited announcement of new climate action targets at the COP26 summit in Glasgow. This included: i) installing non-fossil fuel electricity capacity of 500 GW by 2030; ii) sourcing 50 percent of energy requirements from renewables by 2030; iii) reducing 1 billion tons of projected emissions by 2030; iv) achieving carbon intensity reduction of 45 percent over 2005 levels by 2030; and v) achieving net-zero emissions by 2070. India is also the world's fifth largest solar photovoltaic market with almost 50 GW of total installed capacity and has the world's cheapest solar resources. Its roadmap will build upon this success with country-specific strategies to accelerate the decarbonization of electricity through investment in hydropower, solar, and wind energy production, with the aim of increasing affordability, reliability, and efficiency and reducing energy imports.
- **Pakistan** has an ambitious cumulative GHG emissions reduction target of 50 percent below their projected 2030 level under a BAU scenario , with an unconditional reduction of 15 percent financed from the country's own resources and a conditional reduction of 35 percent subject to the provision of international grant finance that would require an estimated US$ 101 billion just for energy transition (GoP, 2021). This is a substantial upgrade relative to Pakistan's 2016 NDC. Pakistan also joined the global pledge to cut methane emissions, launched at COP26.
- **Sri Lanka** has pledged to improve energy efficiency standards at the consumption level and is on target to have 15 percent of its total energy demand supplied from clean energy sources, including 5 to 10 percent of that generated from mini- and micro-hydro power, solar, wind and bioenergy. At the time of writing, Sri Lanka's economy was in debt distress, so expanding new programs will be a challenge.

Other economies in the region are among the most negatively affected from climate change. **Nepal** has included pledges on all fronts and incorporated them into its national plan for green growth as of 2021. **Bhutan** has green growth embedded in the constitution, and it continues to make great efforts towards decarbonization, despite already being a negative emitter (a carbon sink). **Afghanistan** and **Maldives** did not make specific pledges at COP26. Both are highly vulnerable to climate change (especially Afghanistan through food insecurity amid lost crops). Maldives emits a miniscule amount of GHGs (though it has a strong sea wildlife conservation program, which it has made part of sustainable tourism).

Appendix 2. Primary energy use, energy prices and emissions

Table A.2. Selected South Asian economies: price increases for household fossil fuels, 2030

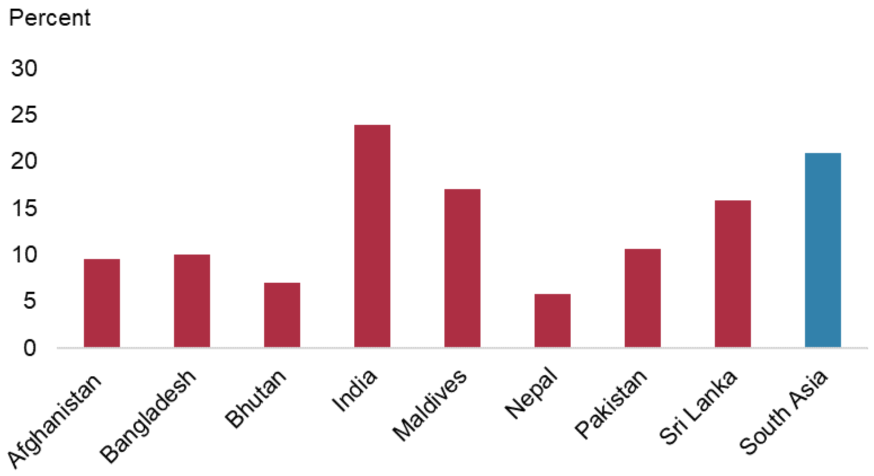
(In percent vs. BAU for US\$25 carbon tax/ton CO_2e by product and economy)

Economy | Product	Coal	Electricity	Natural Gas	Non-Road Oil	Gasoline	Diesel	Kerosene	LPG
Bangladesh	17.7	6.6	9.8	20.6	6.0	10.8	10.7	14.9
India	35.9	23.2	7.5	20.6	5.9	7.5	21.8	9.2
Nepal	14.7	0.1	5.0	20.6	6.8	9.3	7.6	5.4
Pakistan	17.2	4.4	10.3	20.6	10.5	11.8	16.6	8.7
Sri Lanka	14.8	-21.8	5.3	20.6	8.5	12.2	18.4	7.4
South Asia (Simple Average)	20.1	2.5	7.6	20.6	7.5	10.3	15.0	9.1

Source: Authors' estimates using CPAT. Sri Lanka is a negative outlier, due to substantial (generation) fuel switching to (cheaper) renewables in the power sector, which is associated with a net reduction in residential sector electricity prices (the 2030 share of renewables in Sri Lanka's power sector is estimated to increase by 10 percentage points in response to the US\$25 carbon tax/ton CO2e carbon tax).

Figure A.1 South Asia: Reductions in GHG emissions (excl. LULUCF), 2030

(In percent vs. BAU for US\$25 carbon tax/ton CO_2e by economy)



Source: Authors' estimates using CPAT.

The most important fuels in terms of economy-wide energy demand are coal in India and natural gas in Bangladesh and Pakistan. Nepal and Sri Lanka rely more on biomass, which includes firewood.

Table A.3. Selected South Asian economies: total primary energy use, 2019

(In percent of total primary energy use by energy source and economy)

Energy Source | Economy	Bangladesh	India	Nepal	Pakistan	Sri Lanka	Total
Coal	9.5	47.3	6.6	12.1	13.0	41.3
Natural gas	55.8	3.1	0.0	24.0	0.0	7.2
Non-road oil	4.5	6.8	-0.3	8.1	9.9	6.8
Gasoline	1.5	4.0	2.9	7.7	12.9	4.3
Diesel	9.1	8.9	9.9	7.5	14.9	8.9
LPG	0.1	3.3	3.6	0.9	5.9	3.0
Kerosene	0.3	0.8	0.3	0.2	0.1	0.7
Nuclear	0.0	1.4	0.0	2.4	0.0	1.4
Non-biomass renewables	0.2	3.2	6.0	2.5	3.8	3.0
Biomass	19.0	21.3	71.0	34.5	39.6	23.4
Total	100	100	100	100	100	100

Source: IEA (2021). Note: ‘Biomass’ includes firewood.

Appendix 3. Roadmap for energy price reform

1) Create estimates of energy production costs and profitability of firms in the sector, especially state-owned firms. Understand who bears the (full) incidence of subsidies. Make the scheme more transparent, so that it is eventually entirely financed from the budget.

2) During the budget process, in addition to tax expenditures, delineate not only how many resources are allocated to subsidies (share of budget), but also who benefits and who loses from said tax expenditures. Advertise alternative purposes that funds could be used towards—particularly health, education, and infrastructure transfers.

3) 'Depoliticize' subsidies: pass a budget law that specifies a formula for determining subsidy rates. Said formula should be made publicly available and difficult to change.

4) Take advantage of high oil prices to devise a formula via which the subsidy rate falls with the price of the corresponding fuel.

5) Announce a carbon price (tax), which will be part of the same reform infrastructure as the subsidy scheme. In other words, the government should also show how the price change is directly using revenues from the carbon price (tax) to pay for funding new renewable energy infrastructure or targeted cash transfers to households. It is very important that this advertising campaign be an integral part of any (fossil) fuel subsidy reform scheme.

6) At first, frontload payments to households (i.e., cash transfers should be paid at the beginning of each period).

7) Actively support energy producers who may be left with stranded assets (such as coal mines). This can be done through labor retraining and reallocation of funds, feebates and assistance in decommissioning assets. The most affected communities should be immediately identified, and training/job relocation programs initiated early on.

See McCulloch (2023), Coady et al. (2015) and Vagliasindi (2013) for further discussion of these issues.