POTSDAM-INSTITUT FÜR KLIMAFOLGENFORSCHUNG

Mobilizing Domestic Resources for the Agenda 2030 via Carbon Pricing

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Abstract

The 21st century is characterized by an *underprovision* of basic public goods, such as public health, education, infrastructure, etc., and an *overuse* of the atmosphere as disposal space for greenhouse gases. Carbon pricing could address both problems simultaneously: a transition from negative carbon prices (fossil fuel subsidies) to positive levels could generate revenues to finance progress towards the Sustainable Development Goals. Given the scarcity of private sources of finance in many lower income countries, carbon pricing could be a particularly attractive policy option. Our analysis identifies countries where domestic revenues from carbon pricing consistent with the 2°C target could contribute substantially to financing the SDGs.

Keywords: Sustainable Development, Financing for Development, Economic Development, Carbon Pricing

In the 21st century, two large-scale global challenges have taken center stage. There is a widespread *underprovision* of basic public goods: The number of people without adequate access to education, public health systems, clean water, and other key services by far exceeds the aspirations expressed in the United Nation's Sustainable Development Goals (SDGs). Secondly, the atmosphere as a global commons is in danger of a massive *overuse* as disposal space for greenhouse gas (GHG) emissions.[1] In response, the global community has taken

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important steps in 2015 to address these global challenges. First, the world's nations, almost in their entirety, adopted the Paris Agreement, aiming for a policy regime to reduce and ultimately phase out greenhouse gas (GHG) emissions globally. Second, they initiated the Agenda 2030 for Sustainable Development to end the underprovision of public goods at the UN Sustainable Development Summit in New York. Third, at the UN Conference on Financing for Development in Addis Ababa, the participants committed themselves to first steps of effectively financing and implementing the Sustainable Development Goals (SDGs).

In the resulting Addis Ababa Action Agenda (AAAA), the conference participants agreed that a successful implementation must integrate all available sources of finance, i.e. public as well as private funds, and both international and domestic finance.[2] Despite a promised ramp-up of official development assistance (ODA), the primary cost burden of the SDG agenda will rest with developing countries, as expected ODA volumes lie two orders of magnitude below the SDG financing needs.[3] Domestic resource mobilization, in particular by raising tax revenues, will thus play a central role.

In this Perspective, we argue that carbon pricing as part of the implementation of the AAAA could create synergies between development and climate policy by raising public funds for SDG investments while at the same time reducing CO_2 emissions. Therefore, we take a country specific look at both financing needs and sources of finance to show where carbon pricing could make a substantial contribution to sustainable development. We differentiate SDG financing needs for each country according to SDG investment areas (health, education, infrastructure, etc.), and distinguish between the expected public and private financing contributions. We contrast these numbers with the national revenue raising potential of carbon pricing consistent with the 2°C target as well as fossil fuel subsidy removal.

The extent to which carbon pricing can contribute to countries' respective SDG agendas is highly specific. Countries differ with regard to the SDG areas that require the most financing and also with regard to the expected availability of private finance. Moreover, the potential to raise revenue via carbon pricing varies with the emission intensity and scale of each country's economic activity. Our analysis identifies many countries, for example Asian nations such as India, Indonesia, and Pakistan, in which carbon pricing can cover a substantial share of the public revenues needed to finance SDGs. Carbon pricing is particularly valuable in countries

where the potential for private sources to finance SDGs is low, for example in several African countries such as Nigeria, Senegal, and Uganda.

Country-level financing needs for the SDGs

A recent report on sustainable infrastructure assessing multiple studies reveals a large spread among individual estimates of between US$ 20 trillion and US$ 100 trillion in total for the years 2015-2030.[4–9] Our analysis uses estimates by the United Nations' Sustainable Development Solutions Network (SDSN)[10], which indicate that for lower and lower-middle income countries the costs of achieving the SDGs by 2030 amount to US$ 1.5 trillion per year on average. Approximately half of these costs originate from investments in sustainable infrastructure. While the SDSN's estimate of infrastructure investment needs is at the low end of the spectrum of available estimates, it provides the only comprehensive cost estimates for the *entire* SGD agenda, including, for instance education, health, food security, and biodiversity.

To break down the total financing needs to the national scale, we employ the analytical framework introduced by the SDSN study (see the Supplementary Information). In particular, we follow the SDSN by consolidating the 17 SDGs to seven integrated investment areas, namely Health, Education, Food Security, Infrastructure, Biodiversity, Data for the SDGs, as well as Emergency and Humanitarian Aid. Our unified data set (see SI), draws on the key studies for each investment area. Complete records covering all SDG investment areas are available for 68 countries. In Figure 1, we visualize the per capita financing need projected for the entire SDG agenda – that is, the sum of the annual per capita costs of all SDG investment areas as average of the period from 2016 to 2030. We distinguish between costs that will likely have to be financed by public sources and those that can be covered by private sources.

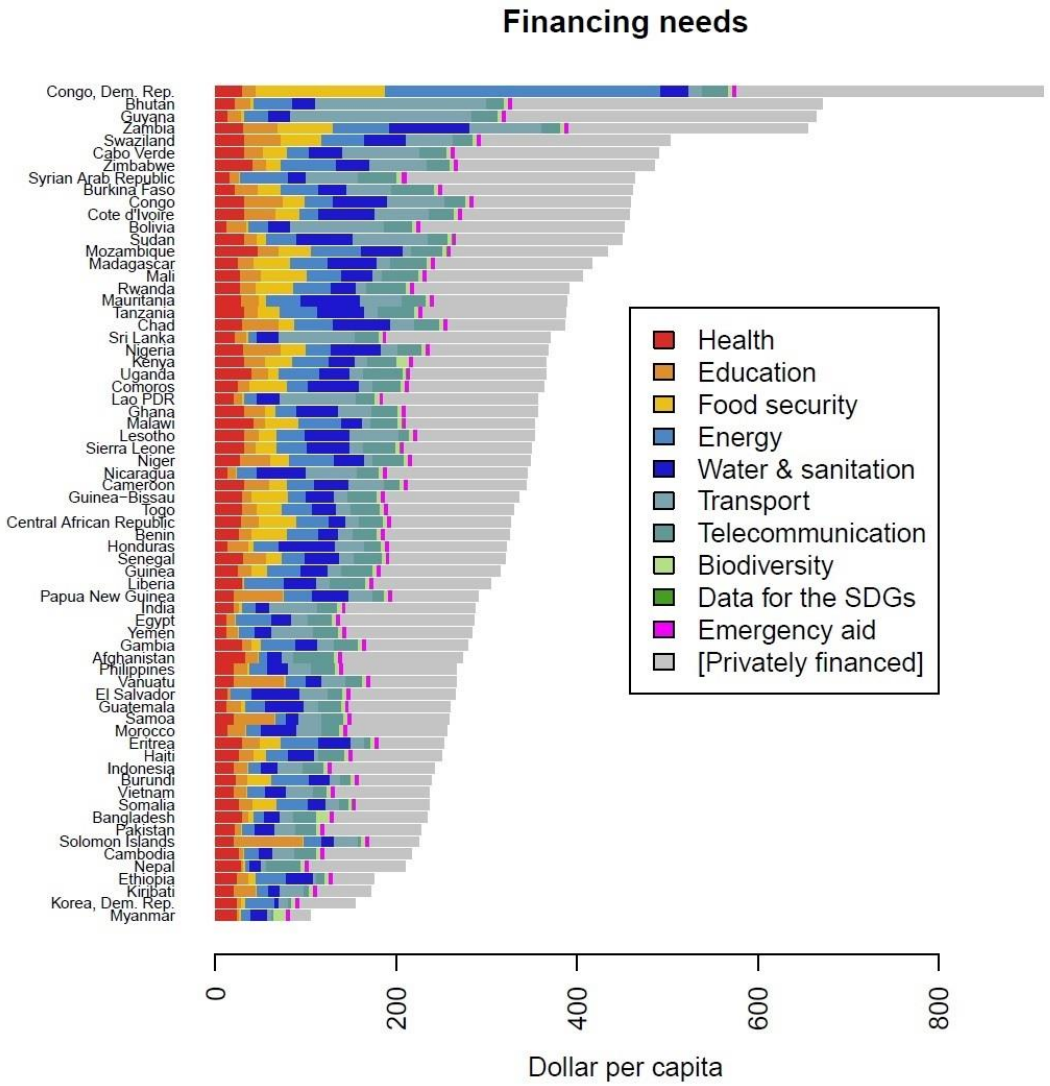

Figure 1: Per capita annual costs of countries' respective SDG agenda. Financing needs of the different SDG investment areas (Health; Education; Food Security; Infrastructure of the categories Energy, Water and Sanitation, Transport, and Telecommunications; Biodiversity; Data for the SDGs; Emergency Response and Humanitarian Aid) that has to be covered by public sources is distinguished using different colors. The needs that can be financed by private sources are aggregated and displayed in grey.

Not surprisingly, we find large variations in financing needs. In per capita terms (current population), the total national financing needs range from US$ 105 (Myanmar) to US$ 916 (Democratic Republic of Congo) per year. Relative to GDP (in 2015), financing needs range between 6% (Indonesia) and 223% (Democratic Republic of Congo). Except for the general pattern that infrastructure investment needs constitute the largest share of total financing needs, the needs per SDG investment area vary strongly across countries. After reviewing sources of finance in the next section, we subsequently develop a typology to classify countries with respect to their SDG financing needs and possible sources of finance.

Sources of finance for sustainable development

To finance the SDGs, the literature typically classifies funding sources along the dimensions private vs. public, and domestic vs. external. Whether goods and services required to achieve the SDG agenda are provided by the private or the public sector crucially depends on the targeted area as well as country-specific factors, such as the regulatory environment. For instance, there is a consensus in the international health community that finance for achieving universal health care should be publicly.[11–15] High fixed costs and network externalities may cause certain activities to be only profitable beyond a critical mass of customers, resulting in insufficient incentives for initial investment by the private sector.[16] Further, many types of infrastructure, such as railroads and power grids, bear characteristics of natural monopolies. Especially in settings with weak regulatory environments, public provision may be used to compensate for a lack of appropriate competition policy. Finally, issues such as education, food security, and emergency aid are commonly regarded as a fundamental right. Providing access to those who could not afford to acquire them on the free market is seen as the primary responsibility of the state.[17–19] This is of particular importance in situations in which transfer payments, which recipients could otherwise use to obtain access from private providers, are hard to implement and target, for example due to informational constraints. Empirical observations suggest that while private sector participation is relatively common for telecommunication and power generation, it is significantly less widespread for water, sanitation, and electricity distribution, especially in low-income countries.[16] Hence, even though private finance in the form of foreign direct investment, loans from foreign banks, or portfolio investments could make an important contribution towards reaching the SDG agenda, they are unlikely to be sufficient to fully cover SDG investment needs in developing

countries.[20]

External sources of public finance include multilateral agencies, such as the World Bank, as well as bilateral donors. Those sources, however, appear unlikely to substantially contribute to the SDG agenda. First, most industrialized countries still fail to meet their Monterrey pledge of providing 0.7% of their GDP as official development assistance.[21] Second, even if all countries spent the pledged amount, the volume would still fall far short of the SDG financing needs.[3] Some studies have discussed alternative sources of SDG finance, such as a tax on international financial transactions.[22,23] Even though this proposal might have theoretical appeal, the associated costs will eventually have to be borne predominantly by industrialized countries, and it is not clear why such an approach should be politically more feasible than increasing aid budgets directly. As recent discussions in this direction do not seem to have produced major advances, additional domestic revenues will likely need to be mobilized, in line with the AAAA[2].

Public finance can thus be expected to play a central role for sustainable development.[4] It can also help to mobilize additional private finance, for example by de-risking investments into the power sector by means of loan guarantees, political risk insurance, and public equity co-investments.[24,25]

Integrating supply of and demand for finance for development

The sources of finance best suited for SDG investments (supply) and the specific financing needs per SDG investment area (demand) are linked. According to the literature, some SDG investment areas are more suitable for private investments (e.g. infrastructure and food security), while others are less (e.g. public health, biodiversity, education, etc.). Hence, those countries in which, for example, infrastructure needs dominate are also likely to profit more from private investments, while countries in which non-infrastructure investments would be relatively more important to achieve the SDG agenda will need more finance from public sources, as Figure 2 illustrates. The national SDG agendas in Egypt, Bhutan, and Bolivia, for example, consist mainly of investments in core infrastructure (transport, telecommunication, water and sanitation, energy). Here, infrastructure investment needs make up around 90% of total investment needs. Accordingly, the fraction of total investments that must be covered by

public sources is relatively low at around 50%, while opportunities for private investments are relatively high. As the color coding of Figure 2 shows, the countries with the highest relative infrastructure investment needs, and hence the most opportunities for private investments, are lower middle income countries (lower right segment). Low income countries tend to have a lower share of infrastructure investment needs and hence a higher need for public financing sources (upper left segment). In countries such as Myanmar, Ethiopia, Eritrea, Burundi, Chad, and Somalia, the opportunities for private SDG finance are comparatively scant. In these countries, new sources of domestic public revenues such as carbon pricing could be of particular interest as a policy option for achieving the goals of the Agenda 2030.

For a more detailed description of the link between supply and demand of SDG finance, please see the supplementary information, Section A.2. In the following, we discuss the domestic public revenue potential of carbon pricing in the countries of our data set in greater detail.

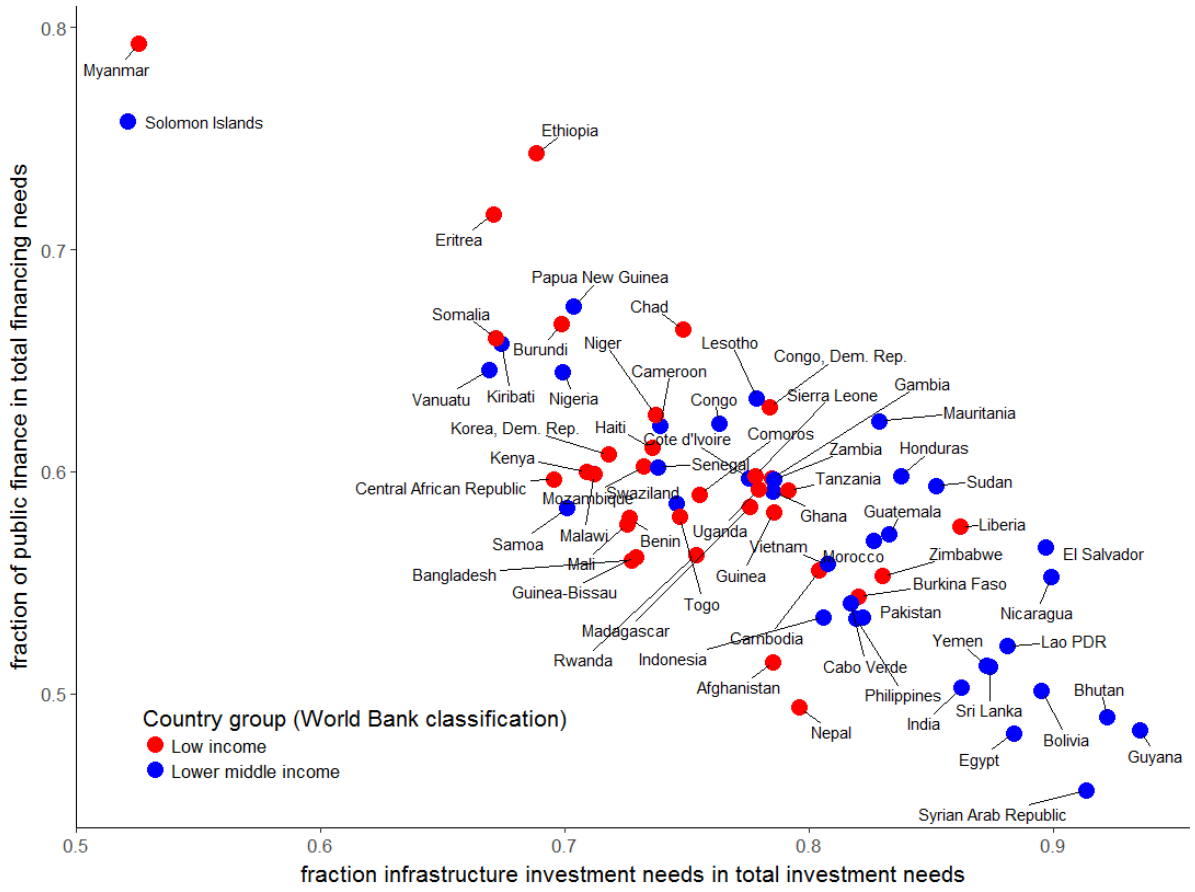

Figure 2: The fraction of the national SDG financing needs that have to be covered by public sources correlates negatively with the fraction of the investments required for infrastructure.

Domestic public revenue potential of carbon pricing

Due to the limited potential of private sources and external public sources of finance, governments have a strong incentive to raise domestic funds to finance the SDGs. However, developing countries frequently display low tax revenues as a share of GDP, despite substantial investment needs. In addition, due to low institutional and administrative capacities, public revenues are often generated through taxes that entail sizable economic distortions, for instance in the form of import tariffs.[26] Recent analyses have recommended raising additional public revenues by improving administrative capacities to handle less distortionary taxes, such as corporate, income and value-added taxes, and reduce the extent of tax evasion.[27,28] A different strand of literature emphasizes the potential of taxes on natural resources and GHG emissions as an efficient source of public finance.[29–32] For instance, it has been argued that carbon pricing would increase the efficiency of the tax system in countries with a large informal sector, as taxes on energy used in this sector are much more difficult to evade than taxes on labor or capital.[33,34]

However, many countries not only lack a carbon price, but on the contrary, subsidize fossil fuel use, thus effectively putting a negative price on carbon emissions. There is a broad consensus in the international community that subsidizing fossil fuels is a major roadblock for sustainable development.[35–37] Accordingly, Paragraph 31 of the AAAA states:

> *"We reaffirm the commitment to rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities."*

Hence, removing economically inefficient and environmentally harmful subsidies is not only a plausible first step towards implementing positive carbon prices. It would also already free public funds to be used elsewhere, for example, to alleviate extreme poverty. For this reason,

we first analyze the public revenues that would be generated by fossil fuel subsidy reforms before including carbon pricing consistent with a 2°C scenario. More precisely, our analysis consists of two comparisons. First, we compare a business-as-usual scenario (BAU) without any form of climate policy with a scenario in which all subsidies on fossil fuels are removed. Second, we compare the BAU scenario with a policy scenario in which fossil fuel subsidy removal is combined with carbon pricing consistent with the 2°C target. Compared to the BAU scenario, additional revenues are available in both policy scenarios. In the following, we illustrate the magnitude of the additionally available public funds in terms of the financing needs of the SDG agenda. Moreover, we identify countries in which opportunities for private investment are rather scarce, thus rendering carbon pricing a particularly valuable instrument to foster sustainable development.

Fossil fuel subsidy reform

Governments subsidize fossil fuel use to support certain industries and to keep fuel prices low for consumers. These expenditures can reach up to almost one fifth of GDP, as in the cases of Libya and Iran, respectively, for the year 2014.[38] Total global expenditures for subsidizing fuels over the years 2012 to 2015 ranged between 300 and 680 billion U.S. dollars per year. Annual per capita expenditures for subsidizing fossil fuels in countries that actually had subsidies in place between 2012 and 2015 amounted to as much as US$ 700 in Cabo Verde (on average US$ 200 with median US$ 36).

We estimate the potential to cover SDG financing needs if all subsidies on fossil fuels were removed and the resulting additional public budget redirected appropriately (for details, see SI). Generally we can observe that in South- and Southeast Asia the SDG financing needs are relatively low while the revenue potential is relatively high. African countries, in contrast, tend to have a larger gap between the financing needs and the potential to mobilize their own domestic financial resources (Figure 3). The figure also provides information about how much of the total investment will likely have to be covered by public sources. Most of the countries in which public finance would have to cover a relatively high share of total financing needs are located in Africa (with Myanmar, Haiti, and Honduras as exceptions outside the continent).

When looking at specific countries, Vietnam, Bangladesh, and Pakistan, for example, hold a high potential for mobilizing public funds to finance the SDGs. Vietnam and Bangladesh, with annual per capita subsidies of approximately US$ 35, and Pakistan, with per capita subsidies of around US$ 40, could finance between a quarter and a third, respectively, of their SDG needs that cannot be financed by private investment. Cabo Verde (not displayed in Figure 3) and Egypt stand out in Africa, as they would be able to completely cover their public financing needs for the SDGs using only the revenues from subsidy removal. In fact, the level of subsidies for fossil fuels in Cabo Verde is more than twice its public financing needs for the entire SDG agenda. Other countries where fossil fuel subsidy reforms could cover a large part of the SDG agenda are Togo (73%), Bolivia (60%), the Republic of Congo (60%), Senegal (49%), and El Salvador (45%).

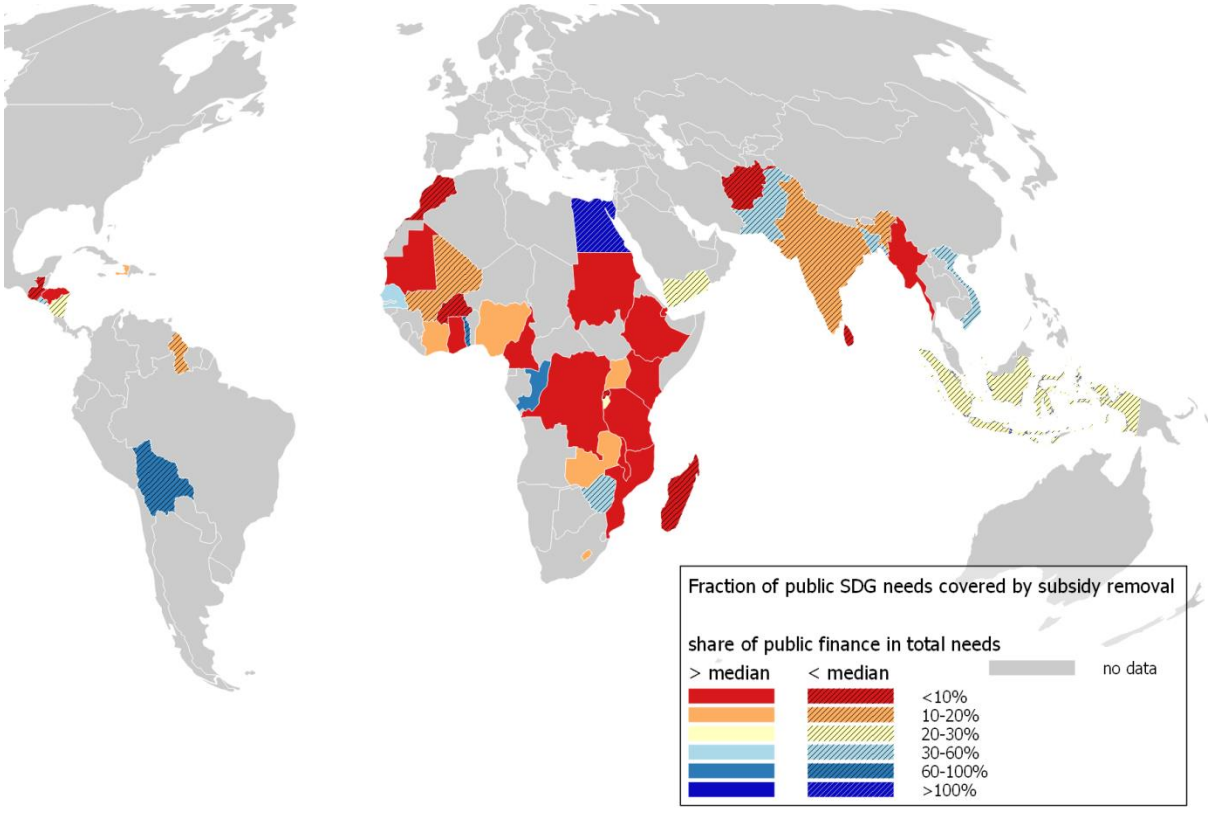

Figure 3: Fraction of the national public *investment need for the SDG agenda that could be financed by freeing up funds that are used so far for subsidizing fossil fuels. Shading indicates that investment needs that can be financed by* private *sources are higher than in the median country (Swaziland: 41% of required SDG investments could come from private sources).*

Carbon pricing

While eliminating subsidies on fossil fuels is an important first step towards sustainable development, it is not sufficient. Economic and environmental goals can be achieved most efficiently, if governments put positive instead of negative prices on GHG emissions.[39,40] To determine the potential public revenues from a carbon price that would be consistent with the 2°C target, we use the scenarios provided by the EMF 27 model comparison.[40–42] The 18 models included in the EMF 27 are either general or partial equilibrium models, and are solved either with a recursive dynamic or an intertemporal optimization algorithm. Regarding the assumed implementation of climate policy, we use a scenario of atmospheric greenhouse gas stabilization at 450 ppm, full availability of technology options, and a globally implemented carbon price.

In accordance with Jakob et al.[31], we use the carbon price path reported by the model that represents the median among all models assessed in the IPCC AR5[43]. The median carbon price is US$ 40 per ton of CO_2 in 2020 and rises to US$ 175 in the year 2030. These prices are significantly above rates currently applied. One might argue that other policy instruments, such as standards or subsidies, may be politically more feasible, as their costs are less salient. However, these instruments also have higher economic costs[44], which will eventually have to be borne by someone, which may also raise substantial political resistance. In addition, recycling carbon pricing revenues to finance the SDG agenda could yield benefits for the broad population, and hence increase public support for carbon prices. Finally, it should be noted that when implicit carbon prices arising from taxes on energy use are taken into account, numerous countries already feature carbon prices of more than US$ 100, especially in the form of fuel taxes. For instance, in the 42 OECD and G20 nations, almost half of the emissions from road transport have implicit carbon prices of US$ 50 or higher.[45]

As the integrated assessment models upon which these price projections are based do not consider subsidies, we further assume that fossil fuel subsidies are phased out prior to the introduction of a carbon price. We thus add the revenues from a positive carbon price to the revenues from subsidy reform discussed above. To focus on the domestic revenue raising potential, we assume that the carbon prices are implemented on a national level, and do not consider any international transfers or burden sharing schemes, such as the Green Climate

Fund. Such transfers could increase the potential to finance the SDGs in poorer countries beyond what is considered here. The average annual per capita revenues generated by the considered carbon price over the period from 2015 to 2030 range from less than US$ 1 in Lesotho to around US$ 2950 in Trinidad and Tobago. In the median country it lies at US$ 170, while the mean over all countries is US$ 266.

In the median country the potential revenues of such a carbon price make up about nine percent of total tax revenues. Taking into account that the median country in our dataset currently has total tax revenues of 13% of GDP, the potential carbon price revenues would amount to about one percent of GDP. For comparison, the average budget for education in the OECD countries is about five percent of GDP.[46] If we consider citizens rather than countries, we find that the median citizen lives in a country in which the potential carbon pricing revenues would make up about 19% of total tax revenues (see SI for details). In most cases, we find that revenues from carbon pricing consistent with the 2°C target are substantially higher than those that would accrue from a reform of fossil fuel subsidies. However, exception include countries with very low per-capita emissions, such as Lesotho, Burundi, Cabo Verde, and Mali, with potential revenues from subsidy removal being more than ten times as high as potential revenues from a carbon tax.

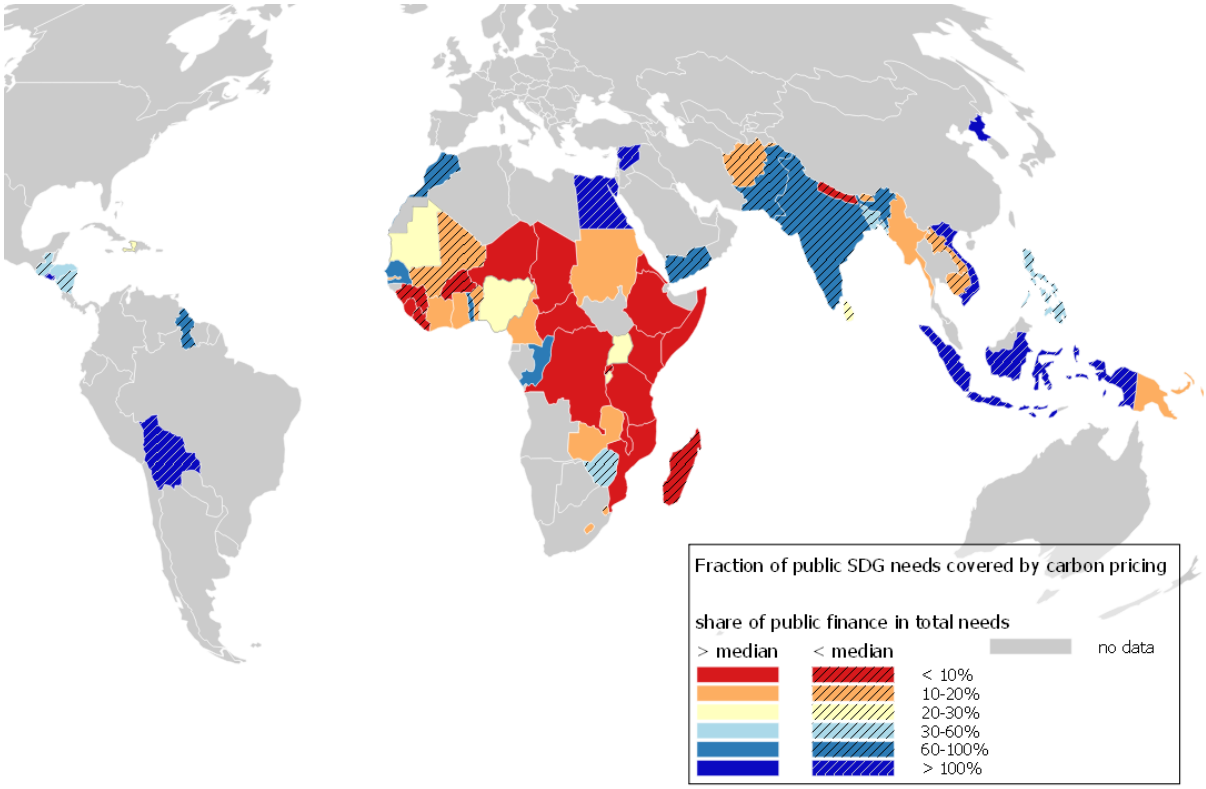

Figure 4: Fraction of the national public investment need for the SDG agenda that could be financed by replacing negative by positive national carbon prices consistent with the 2°C target. Shading indicates that private investment needs are higher than in the median country, Swaziland, in which 41% of the required total SDG investments can be financed by private sources.

Figure 4 shows the fraction of the public financing need for the SDG agenda that could be financed by a national fiscal reform that removes fossil subsidies and instead implements a positive carbon price consistent with the 2°C target. For several countries in South- and Southeast Asia the projected revenues of such a fiscal reform would be sufficient to provide more than two thirds of the public funds required for the SDG agenda. For instance, the revenues in India could cover 95% of the entire public funds required to achieve the SDGs. The fact that several countries in Sub-Saharan African are depicted in dark red sheds a more pessimistic light on this continent with respect to the financing potential of climate policy for sustainable development. However, there are a number of countries in which the considered carbon price could cover more than 20% of the public funds required for financing the SDGs. These countries include Swaziland (20%), Uganda and Mauritania (21%), Burundi (22%), Nigeria (23%), Zimbabwe (47%), Senegal (67%), the Republic of Congo (72%), and Togo (81%).

The countries whose SDG needs profile requires a relatively high share of public finance (more than in the median country) and in which also carbon pricing consistent with the 2°C target could cover more than 20% of the SDG financing needs are Burundi, the Republic of Congo, Haiti, Honduras, Mauritania, Nigeria, Senegal, and Uganda. In these countries carbon pricing is a particularly valuable instrument to finance the SDGs. In comparison with the other countries in our data set, there are fewer opportunities for private investments that could foster sustainable development.

Implementing carbon prices

Our analysis shows how to exploit the synergy of financing the SDGs with domestic public resources and implementing ambitious climate policy. For instance, in several countries in South- and Southeast Asia the projected revenues of the carbon price would be sufficient to finance more than two thirds of the entire public SDG financing needs. While in most African countries the potential is substantially lower, there are nevertheless several countries in which carbon pricing could finance at least 20% of the entire public SDG financing needs. Moreover, we have identified a group of countries in which carbon pricing should be considered as a particularly valuable policy option, as the need for public finance to cover the SDG agenda is relatively high while private investments opportunities fostering sustainable development are rather scant.

Technically, implementing a scheme to recycle revenues from carbon pricing into SDG finance could be realized by an upstream carbon tax. Such a tax could be administered at the point at which fossil fuel is either extracted or imported without major difficulties, which is generally believed to be institutionally feasible also in developing countries.[26] Numerous studies suggest that in developing countries, carbon prices would likely result in progressive impacts on the distribution of income.[47–49] Possible deficits in the capacity to collect the carbon tax could be addressed in the effort to improve the tax system in developing countries in general, as emphasized by the AAAA agenda, and agreed to by its signatories. Finance for such capacity building can come through expanded ODA or be mobilized by a reformed approach to climate finance.[50]

Introducing carbon prices will likely imply additional interactions with the SDG agenda as well as the fiscal system.[51–54] This is also relevant for revenue generation. For example, in economies that strongly depend on oil and gas exports, potential additional public revenues from climate policies will likely be accompanied by falling revenues from fossil fuel exports. On the other hand, additional investments in SDGs could trigger positive effects on the economy as better education, better health, less poverty, more and better infrastructure, more sustainable ecosystems services are often found to trigger positive effects on economic growth, which could in turn result in additional public revenues.[55] Even though our approach cannot capture all possible interaction effects, it provides a reasonable first estimate of the potential contribution of carbon pricing that does not require introducing additional arbitrary and empirically unproven assumptions.

Our estimates evaluate the full potential of our proposal by assuming economically efficient carbon prices and full recycling of the associated revenues to finance the SDG agenda. In reality, policy makers may not solely rely on carbon pricing, but employ a mix of policy instruments. Other conceivable policy instruments include standards, quantity instruments, or sector specific taxes that do not explicitly focus on CO_2 emissions. While they would also put a price on carbon, at least implicitly,[45] in contrast to taxing schemes they do not necessarily generate revenues. In a similar vein, pricing instruments are often accompanied by other measures, e.g. subsidies for renewable energies, potentially reducing the price level,[56] hence also leading to lower revenues.

In addition, some part of the revenues may be used to compensate societal stakeholders who are most negatively affected by a carbon price and have the power to veto reforms.[57] These include, for example, workers in fossil fuel industry and mines, fossil fuel owners, or energy users (both households and industry) that potentially suffer from increasing energy prices.[58] Countries that have successfully implemented reforms in the past have generally found ways to manage the impacts on negatively affected interest groups.[59] A wide variety of measures and policies is conceivable, including wage subsidies for impacted workers, compensatory subsidies to affected industries, or direct cash transfers to most affected parts of the population, to mention just a few.[60,61] Those measures, however, can consume a significant

share of the potential revenues; for example, in Iran 80 percent of the revenue from price increases was redistributed to households as bi-monthly cash transfers.[59] The EU, to give another example, gives a certain fraction of the emission permits to firms for free (grandfathering) to alleviate competiveness concerns. It will hence not only be politically challenging to administer the discussed reforms, revenues will also not fully be available to be invested into SDGs. However, targeted measures to mitigate adverse impacts on the most affected groups have often included expansion of public works, education, and health programs in poor areas,[35] arguably well in line with investments to foster the SDG agenda.

Being aware of the political difficulties, in this Perspective we have mapped out the policy option space. Our approach demonstrates the potential gains that could be achieved by integrating climate policy in line with the climate stabilization targets formulated in the Paris Agreement and the SDGs in one holistic policy framework. As the approach of putting revenues in relation to spending needs is linear in nature, our results can easily be scaled down to represent different assumptions regarding policy design. For instance, assuming that carbon prices are only half of those used for our calculations, or that only half of revenues are spent on SDG finance would simply reduce all numbers shown in Figure 4 correspondingly. Hence, we conclude that national carbon prices constitute a promising possibility for low-income countries to mobilize the domestic resources called for in the AAAA. Our analysis provides support for a global development policy that puts emphasis on building local capacities for strengthening tax administrations, in particular with the aim of implementing carbon pricing. If such a policy succeeds on the national level, a common commitment to carbon pricing might also be achieved internationally, which could ultimately help to promote global cooperation.[62]

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Author contributions

All authors conceived the project. M.F. constructed the data set with inputs by M.J. and K.L. M.F. and K.L. analyzed the data, with input from M.J. and J.S. M.F., K.L., M.J., J.S. wrote the paper with inputs by O.E.