INTERNATIONAL MONETARY FUND

Promising Domestic Fiscal Instruments for Climate Finance

Background Paper for the Report to the G20 on“Mobilizing Sources of Climate Finance”

Prepared by staff of the International Monetary Fund

November 2011

Contents Page

EXECUTIVE SUMMARY

At the 2010 global climate talks in Cancun, Mexico, developed countries re-affirmed a pledge to raise $100 billion per year by 2020, and $30 billion in total between 2010 and 2012, to finance climate mitigation and adaptation projects in developing countries.[1] The focus of this paper is how some of the $100 billion funding target might be mobilized through fiscal instruments.[2]

The case for carbon pricing

In general, the least costly (or least distortive) instruments for revenue purposes are broad fiscal instruments,[3] but carbon pricing instruments have a critical role to play in mitigating climate change. Taxes with a relatively narrow base tend to cause greater distortions in the economy than broad fiscal instruments (e.g., taxes on labor income or general consumption) because the former are easier for households and firms to avoid by altering consumption decisions. Moreover, it is generally better to tax final consumption goods rather than tax an input (e.g., fuels) as the latter distorts production decisions and raises production costs. Up to a point however, well-designed carbon pricing policies levied on fossil fuel inputs are more efficient than broader instruments, because they also correct for a huge market failure—excessive global emissions of greenhouse gases (GHGs). Roughly speaking, carbon pricing policies should be set to reflect environmental damages in the price of fuel and energy and remaining general government revenue needs should be met through broader fiscal instruments.

The revenue generated by such carbon-pricing policies need not be earmarked for climate finance. In fact, most of the revenue could be used for deficit reduction. The case for using carbon pricing as a tool for addressing externalities is quite distinct from that for using it to generate climate finance. However, earmarking part of carbon tax revenue can be a commitment device for developed countries and may reduce the risk of crowding out other aid to developing countries. Conversely, there is no reason why climate finance has to come from "innovative sources". Some funds might be raised through broader fiscal instruments that have no direct benefits in terms of climate mitigation.

Comprehensive carbon pricing policies in developed countries are crucial for reducing emissions, leveraging private finance, and promoting clean technology development. Pricing GHG emissions in developed countries should ideally occur through carbon taxes or auctioned cap-and-trade systems. Reasonably scaled carbon taxes might yield annual revenues of around

---

[1] All $ figures refer to U.S. dollars.

[2] The limited data available suggest that climate finance is currently around $10–15 billion a year from grants and concessional loans through bilateral and multilateral channels and credits from the Clean Development Mechanism (OECD 2011a).

[3] Some commodities of course may be suitable for heavy taxation because of relatively inelastic demand and/or perceived externality or self-control problems—notable non-climate related examples being cigarettes and alcohol.

$25 billion, if governments earmarked 10 percent of total revenues for climate finance.[4] In addition, however, there are important channels through which carbon pricing—either carbon taxes or cap-and-trade—can powerfully leverage private finance. These include enhanced returns for clean technology investments and flows through carbon markets as developed countries purchase emissions offsets from developing countries.

Taxes on electricity and motor fuels could raise significant revenue but are far less effective at reducing emissions than carbon pricing. Simple per kilowatt-hour (kWh) taxes ("wires charges") are quite common in developed countries, but are much less effective at reducing emissions than a carbon tax and could be more costly than broader fiscal instruments. A surcharge on motor fuels could make sense, but only in a limited number of countries like the United States where fuel taxes currently under-charge for adverse side effects of vehicle use (e.g., pollution, congestion).

A modest levy on petroleum consumption could raise significant revenue. The base of a petroleum tax is about three times as large as that for a gasoline tax, implying much greater revenue potential. And this tax more effectively addresses concerns about oil dependence (e.g., macroeconomic vulnerabilities to oil price volatility), though it fails to exploit the majority of CO_2 reduction opportunities.

Overcoming obstacles to carbon pricing

Carbon pricing can face stiff political opposition. Recycling revenues in economically productive ways (e.g., alleviating distortions from the broader fiscal system) keeps down the overall policy costs. At the same time, these revenue transfers are reflected in higher energy prices, which can meet fierce opposition from households and industry (especially in trade sensitive sectors).

International cooperation can greatly improve the efficiency of carbon pricing policies and reduce the need for compensation measures. Equalizing marginal abatement costs across countries (by imposing a uniform emissions price) minimizes the costs of emission reductions. Moreover, cooperation reduces the risk of industry relocation and carbon leakage, thus reducing the pressure to exempt certain industries or impose (contentious) border tax adjustments. Thus, international cooperation raises the chance that governments collect significant revenue from carbon pricing policies.

Without international coordination, domestic opposition to carbon pricing might be overcome by providing compensation to target groups—but that can be costly. Compensation, for example in the form of transfers to households and industry, has an economic cost by diverting revenue from more productive (economically efficient) purposes. Moreover,

[4] See also OECD (forthcoming).

compensation could be excessive: for example, free allowance allocations in the initial phases of the EU ETS grossly over-compensated power companies (e.g., Sijm and others, 2006).

Alternatively, some compensation might be provided by scaling back relatively ineffective policies as carbon pricing is introduced. In some developed countries, using some of the domestically retained revenue from carbon taxes to cut electricity excise taxes would go at least some way in neutralizing the increase in electricity prices for households and industry, while the overall tax shift still reduces GHGs (and other pollution emissions). Similarly, the burden of carbon pricing on motorists could be alleviated by scaling back (environmentally-ineffective) taxes on vehicle ownership.

If broad carbon pricing is infeasible, "feebates" are a possible alternative source of finance. Feebates impose taxes (fees) on relatively dirty products and production processes and provide subsidies (rebates) for relatively clean products and production processes. They can be used to promote de-carbonization of the power sector, and improvements in the efficiency of major energy-using products, in a cost-effective way, while (with appropriate provisions) promoting international carbon markets and raising some climate finance revenue. Unlike carbon taxes and cap-and-trade policies, feebates can be designed to have a small impact on energy prices. This would likely increase their acceptability, but there is a tension with environmental effectiveness (which requires higher energy prices) and revenue needs (which also imply higher energy prices).

Non-carbon related revenue sources

While carbon pricing is critical in efficiently curbing emissions, there is no need to earmark funds from carbon pricing for climate finance. Indeed, the revenue from carbon pricing could flow into national budgets instead, and climate finance can be based on other criteria than carbon emissions.

Taxes on general consumption, labor income, and recurrent property taxes on real estate are thought to be the most efficient broader fiscal instruments for raising revenue. In contrast, corporate income taxes are often seen especially harmful for economic growth. Moreover, with increased international mobility of capital and people, uncoordinated tax-setting can lead to collectively inefficient outcomes. However, greater reliance on taxation of mobile sources may be appropriate if countries coordinate over tax policy.

New taxes on the financial sector have been proposed as a way to raise money for climate finance. These include most prominently Financial Transactions Taxes (FTT)—levied on the value of a wide range of financial transactions—and Financial Activities Taxes (FAT)—levied on the sum of the wages and profits of financial institutions. Both were considered and compared extensively in the IMF's 2010 report to the G20 on financial sector taxation.[5] Broadly speaking,

---

[5] IMF (2010a).

the FTT has acquired greater political momentum (notably with the recent proposal from the European Commission), while the FAT has acquired greater support from tax policy specialists (as a way to redress distortions arising from the exemption of most financial services from VAT). Both, nonetheless, are technically feasible—with the appropriate degree of international cooperation—and both could raise significant revenues.

There are a number of further options that would be worth studying. These include, for example, scaling back agricultural protection programs, taxing satellite launches to reduce the accumulation of space debris, and taxing other sources of externalities like road congestion, excessive fishing, and household waste. Moreover, mineral rights in offshore areas that are outside any countries' territory or in the Antarctic may offer opportunities for climate finance. These options are beyond our scope, however.[6]

[6] For some discussion, see Atkinson (2004) and World Bank-IMF (2005).

I. INTRODUCTION

1. **This paper responds to a June 2011 request by the G20 Finance Ministers and Central Bank Governors to conduct an analysis of the economic, environmental, social, and distributional implications of public instruments for climate change financing**. Domestic, climate-related instruments are examined, as well as broader fiscal options, as potentially applicable to developed countries.[7] Taxes on international aviation and shipping fuels, which are potentially borne in part by developing countries, are discussed in a separate paper (IMF, 2011). Options for leveraging other (non-public) sources are finance, and removing fossil fuel subsidies, are discussed in World Bank/IMF (2011).

2. **The paper extends aspects of the work of the high-level Advisory Group on Climate Finance (AGF) established by the UN Secretary-General**. This evaluated a wide range of carbon-related and other fiscal instruments and multiple criteria and provided an approximate sense of the revenue potential of different instruments. This paper builds on and extends the AGF report by providing more analysis of the environmental effectiveness, revenue, costs, incidence, and effects on competitiveness of certain instruments and considering some instruments not addressed there.[8] In addition, innovative ways to improve the feasibility of carbon pricing instruments are considered. Promising instruments (i.e., those that raise revenue without a burden on developing countries, that are environmentally effective, and that have limited effects on competitiveness) are identified. Table 1 provides a brief summary of the main findings.

3. **The paper is organized as follows**. Section II briefly provides the conceptual rationale for environmentally-motivated taxes. Section III discusses carbon pricing, other (less effective) carbon-related domestic instruments, and possibilities for improving the feasibility of carbon pricing. Section IV discusses broader (non-carbon-related) fiscal instruments. Section V concludes.

[7] Developed countries are taken in this paper to be the members of the European Union and other Annex II countries, all of which have pledged to provide fast start finance. This includes the 27 EU Member States as well as Australia, Canada, Iceland, Japan, New Zealand, Norway, Switzerland, and the United States.

[8] Carbon pricing policies, taxes on electricity use or electricity emissions, “feebates”, motor fuel taxes, vehicle taxes, petroleum levies and various broader fiscal instruments are discussed.

II. Conceptual Rationale for Carbon-Pricing

4. **If there were no environmental considerations, revenue objectives should be met by broad fiscal instruments**. A key principle of tax design is that (leaving aside distributional, environmental, or other goals) revenue should be raised from broad-based taxes, ideally on final consumption or labor income, and not on intermediate inputs. Although taxes on labor earnings or general consumption, for example, reduce the returns to work effort (i.e., the amount of goods that can be purchased with take-home pay), and thereby discourage labor force participation and

Table 1. Summary Comparison of Carbon-Related Fiscal Instruments

Fiscal Instrument	**Effectiveness** (at reducing CO_2 and promoting carbon markets)	**Revenue** (approximate annual revenue potential for climate finance in 2020)	**Cost-effectiveness** (relative to broad labor tax and accounting for environmental or other benefits)	**Competitiveness Effects and Cross-country Incidence**	**Overall Assessment**
\$25 per ton CO_2 price (carbon tax or auctioned cap and trade)	Most effective policy	\$25 billion (if 10 percent of revenue allocated)	More cost-effective (if revenues used productively)	Potentially significant. May require innovative ways to compensate for higher energy prices	Highly promising technically, but liable to resistance
Per kWh tax on power generation	Limited effectiveness	Fairly large (even if minor fraction allocated)	About the same or worse	Same issues as above	Inferior to emissions pricing
\$25 per ton tax on CO_2 emissions from power generation	Fairly effective	\$10 billion (if 10 percent of revenue allocated)	Between feebate and carbon tax (if revenues used productively)	Same issues as above	Promising alternative to carbon tax, but high electricity prices may reduce acceptability
Feebates	Fairly effective	\$10 billion (but only if *all* revenue allocated)	More cost effective though less so than carbon tax	Modest impacts (though increase as more revenue is raised)	Promising alternative if carbon pricing resisted
6 cents per liter surcharge on motor fuels	Limited effectiveness	\$5 billion (if 10 percent of revenue allocated)	Can be very cost effective, but only in limited cases where fuel is currently under-taxed	Opposition to higher fuel prices might be offset by lowering vehicle taxes	Inappropriate in many countries
2 cents per liter levy on all petroleum consumption	Limited effectiveness	\$5 billion (if 10 percent of revenue allocated)	Can be very cost effective if energy security important	Relatively modest	Promising complement to carbon pricing

effort on the job, they tend to cause less distortion to the economy than narrow-based taxes. For comparable revenues, taxes on dirty energy sources generally cause similar employment effects to those from broader-based taxes (through the effect of higher energy prices on contracting economic activity). However, they also cause a shift towards more expensive (albeit) cleaner fuels, as well as inducing households and firms to consume less energy than they would otherwise.

5. **Up to a point however, raising revenue from carbon pricing can be far more efficient than raising the same revenue through broader fiscal instruments**. This is because carbon taxes generate large benefits through reducing future climate change and by providing (otherwise inadequate) incentives for clean technology development. To balance the environmental benefits and costs of emissions abatement, carbon prices should approximately reflect the marginal environmental damages per ton of CO_2, and further revenue needs met through broader fiscal instruments (e.g., Goulder, 2002, Part III).

6. **Comprehensive carbon taxes, or cap-and-trade systems, are by far the most effective instruments for cutting CO_2 emissions**. Pricing the carbon content of fossil fuels upstream in the fossil fuel supply chain (e.g., at the wellhead, minemouth, or point of importation) drives up the prices of fuels and electricity and thereby exploits all (energy-related) emission reduction opportunities across the economy. This includes (a) reducing the emissions intensity of power generation, for example, by switching from high-carbon-intensity coal to intermediate-carbon-intensity natural gas and fuel oil, from these fuels to zero-carbon nuclear (though of course safety concerns arise) and renewables, and also improving plant efficiency; (b) reductions in residential and industrial demand for electricity; (c) reductions in the use of, and fuel consumption rate of, transportation vehicles; and (d) reductions of direct fuel use in homes, offices, factories, and shops (e.g., for heating). Fuel switching in power generation usually provides the biggest source of low-cost options for reducing CO_2, at least in countries with significant shares of (carbon-intensive) coal generation.

7. **Taxes on electricity use, vehicle ownership, or industrial CO_2 emissions are poor substitutes for comprehensive carbon taxes**. Pure electricity taxes are a blunt climate instrument because they exploit only one of the four main channels for CO_2 emissions reductions described above. Taxes on vehicle ownership are even more problematic—not only do they miss out on three out of the four emissions reduction channels, but they also, within the transport sector, fail to reduce miles driven per vehicle and (depending on their design) may have little to no effect on vehicle fuel economy. Pricing major industrial sources of CO_2 emissions as they are released into the atmosphere, as in the EU ETS, is far more effective from an environmental perspective than a pure tax on electricity. However, this approach still fails to cover emissions

from households, transport, and small-scale industry, which account for about 50 percent of CO_2 emissions in the EU ETS.[9]

8. **Regulatory policies (at least on their own) are also poor substitutes for carbon taxes—and do not raise revenues**. For example, mandates for renewable generation fuels will not reduce emissions beyond the power sector and will not reduce the emissions intensity of the remaining generation mix (e.g., it will not encourage shifting from coal to natural gas or nuclear power). Regulatory combinations may do a lot better—for example, combining a CO_2 per kWh standard (which reduces the emissions intensity of generation) with miles per gallon standards for vehicles, building codes, and energy efficiency standards for appliances, will exploit most of the emissions reductions exploited under a carbon tax (e.g., Krupnick and others, 2010). However, not all opportunities (such as reduced use of vehicles and appliances) are exploited and regulatory combinations could involve a considerable loss of cost effectiveness, unless there are comprehensive credit trading provisions.[10]

9. **Cap-and-trade systems are reasonable carbon-pricing instruments, if they are designed to mimic carbon taxes**. As discussed in Box 1, cap-and-trade systems can be as effective as carbon taxes at reducing emissions, and can be designed to raise revenue, and limit emissions price volatility.

10. **Using (domestically-retained) revenue from carbon pricing to reduce broader tax distortions (e.g., labor tax distortions) produces significant economic benefits.** With this recycling, the overall costs of carbon pricing (excluding environmental benefits) are likely modest. But even if domestic revenues are used in this way, the overall impact of carbon pricing is unlikely to have a big impact on overall employment, either way, given the offsetting, adverse employment effects of higher energy prices (Goulder, 2002, Part III). On the other hand, if retained revenues are not used productively (e.g., for other tax reductions)—or a large portion of allowances in a cap-and-trade system are given away for free—the offsetting revenue-recycling benefit is forgone, and the overall costs of the policy to the economy can be considerably higher.

11. **Carbon pricing policies are effective instruments for promoting the development and deployment of clean energy technologies.** With the price of CO_2 reflected in fuel and energy prices, incentives are provided across the economy for innovative activity to develop energy-saving and clean-fuel technologies that are ultimately needed to halt rising global

[9] A qualification is that, given the ETS promotes (relatively low-cost) fuel switching opportunities in the power sector, it exploits a lot more than 50 percent of the reductions that would occur if the same price were extended to all CO_2 emissions. A downstream system also automatically encourages adoption of carbon capture and storage technologies at coal plants and other facilities, if and when those technologies become economically viable. However, an upstream system can also reward adoption of these technologies through crediting provisions.

[10] These provisions help to equate the cost of the last ton reduced across emissions sources within a sector and across different sectors.

Box 1. Emissions Taxes versus Cap-and-Trade

Emissions taxes and cap-and-trade systems are potentially equally effective at reducing emissions, so long as they are applied to the same base. As the price of emissions allowances is (at least in part) passed forward into higher prices for fuels, electricity, and so on, a cap-and-trade system would exploit the same behavioral responses across the economy for reducing emissions (reductions in energy demand, shifts towards clean power generation fuels, etc.) as under an emissions tax.

Carbon taxes directly raise government revenues. Using this revenue productively (e.g., to lower other distortionary taxes or for climate finance) is important for keeping down the overall costs of the policy to the economy. Cap-and-trade systems can raise comparable revenues if all allowances are auctioned and revenues accrue to a finance ministry.

Emissions price volatility can be problematic under cap-and-trade systems. Under cap-and-trade, allowances prices are determined in the market and will vary with energy demand, changes in the relative price of clean and dirty fuels, technological advances, etc. This price volatility raises program costs over time and can deter clean technology investments (which often have high upfront costs and provide emissions savings over many years).[1] Usually, price stability provisions (e.g., allowance banking and borrowing, price ceilings and floors) are recommended to make cap-and-trade systems behave more like a carbon tax (which fixes the emissions price).

Carbon taxes are additive to other emissions reduction efforts, while cap-and-trade systems may not be. If emissions are rigidly fixed by a cap, other measures (e.g., energy taxes, efficiency standards) that cover the same emissions sources are environmentally ineffective (they only change the allowance price). In contrast, under a carbon tax other mitigation efforts can still be environmentally effective.

[1] For example, citing uncertainty over future US carbon prices, American Electric Power announced in July 2011 the cancellation of a major project to construct a coal-fired generation plant with carbon capture and storage technology.

temperatures (e.g., Eyraud and others, 2011). Regulatory policies in isolation, or taxes that do not cover all CO_2 emissions, focus on a much narrower range of technological opportunities. (Nonetheless, carbon pricing policies may need to be complemented by additional technology policies—such as technology prizes—where there are market barriers to clean technology development and deployment).

12. **Comprehensive carbon pricing in developed countries can, via international carbon markets, promote emissions mitigation in, and technology transfer to, developing countries, though monitoring and verifying emissions reductions in those countries is challenging**. In the absence of comprehensive emissions pricing in developing countries, mitigation projects (e.g., adoption of clean technologies) can still be encouraged, if sources in developed countries subject to pricing are credited for funding such projects. The demand for offsets (and hence the flow of carbon market funds) is maximized when all, rather than just a portion, of developed country emissions are priced. However, establishing whether mitigation projects in developing counties would have occurred anyway (in the absence of offset programs) can be difficult. Measuring carbon reductions can also be challenging (for example, accurate estimates of the carbon contained in many forested areas are not available at present). And mitigation projects

may also lead to offsetting emissions (as, for example, when forest preserved in one area is offset by forest clearance elsewhere). Carbon markets should therefore be expanded progressively, as institutional capacity for monitoring and verifying emissions reductions improves.

13. **Carbon emissions pricing policies to date often exempt a large portion of emissions and generate revenues below their potential**. The EU ETS prices about 50 percent of CO_2 emissions in the European Union, or about 15 percent of developed country CO_2 emissions and the huge bulk of allowances were given away for free in the initial phases of the EU ETS. However, in the next phase of the ETS (from 2013 to 2020) fifty percent or more of allowances will be auctioned, and most allowances will be auctioned in Australia's prospective cap-and-trade system (scheduled to begin in 2012).

III. SPECIFIC CARBON PRICING PROPOSALS AND OTHER DOMESTIC, CARBON-RELATED ALTERNATIVES

14. This section begins by evaluating specific carbon pricing policies based on environmental effectiveness, revenue potential, cost-effectiveness, incidence, and feasibility. Other carbon-related instruments that might be implemented domestically, including taxes on the electricity, and on the domestic transport sector, are then evaluated. Finally, options for improving the feasibility of carbon pricing are discussed.

Carbon pricing proposals

Effectiveness

15. **A carbon price of $25 per ton is considered for a central case, applied to all sources of energy-related CO_2 emissions in 2020 for developed countries**. Based on a recent study (US IAWG, 2010), $25 per ton (in current dollars), rising at about 2–3 percent a year in real terms, seems a reasonable price to put on CO_2 emissions in 2020 from the perspective of charging for environmental damages, though others (e.g., Stern, 2007) would recommend a much higher figure.[11] However, even if widely implemented in major emitting countries, and ramped up steadily over time, many believe that these emissions prices would not be high enough to limit eventual mean projected global warming to 2° Celsius above pre-industrial levels (the official target of the UN Framework Convention on Climate Change).[12] Following the AGF, carbon prices of $15 and $50 per ton are also considered.

16. **For EU countries, carbon taxes on the content of fossil fuels would have no effect on emissions already covered by the Emissions Trading Scheme (ETS), unless the cap is tightened**. For a given emissions cap, any reductions in ETS emissions in one member country, in response to new carbon taxes, will be offset ton-for-ton by additional emissions elsewhere in the EU as the allowance price adjusts to keep the total quantity of EU emissions equal to the cap. Under these circumstances, taxing ETS emissions is essentially equivalent to auctioning

---

[11] US IAWG (2010) evaluated the discounted value of worldwide damages from the additional climate change over the next 100 years or so, caused by an additional ton of emissions. Estimates reflect (rudimentary) attempts to measure, for example, future impacts on world agriculture, costs of protecting against rising sea levels, non-market effects like human mortality and species loss. Damage estimates are much disputed however, due to different perspectives on the appropriate rate at which to discount damages imposed on future generations and how to incorporate the risks of more extreme warming scenarios.

[12] See Clarke et al. (2009) and IEA (2010). Limiting projected long-run arming to 2° Celsius would require stabilizing global atmospheric concentrations of CO_2 and other greenhouse gases (where the warming potential of the latter gases is expressed in CO_2 equivalents) at about 450 parts per million (ppm). Current CO_2 equivalent concentrations, already around 440 ppm, will overshoot this long-run target, requiring extensive use of negative emission technologies (e.g., co-firing biomass in power generation and capturing and storing its CO_2 emissions) to stand any chance of bringing concentrations back down to 450 ppm.

allowances. It is conceivable however, that that policymakers will tighten the cap in response to a carbon tax in which case, effectively, there is some impact on emissions.

17. **Although difficult to project, a $25 per ton CO_2 price applied in OECD countries might reduce their emissions by around 10 percent in 2020 (relative to 2020 baseline emissions)**. Gauging the impact of carbon pricing on future emissions is challenging because this will depend on the costs of carbon-intensive versus non-carbon-intensive fuels, the availability of energy-saving technologies, expectations about emissions prices in the more distant future (that affect current investment behavior), other emissions-abatement policies (e.g., renewable fuel mandates) that might affect baseline emissions, and so on. A large number of models of the global economic and energy system are regularly used to project the impact of pricing on future emissions. Based (loosely) on results from the typical model it is assumed here that emissions prices of $15, $25, and $50 per ton would reduce developed country CO_2 emissions by 6, 10, and 18 percent respectively, below levels that would otherwise occur in 2020 (e.g., Clarke and others, 2009).

Revenue

18. **A carbon price of $25 per ton applied to developed country CO_2 emissions would raise annual revenue of around $250 billion in 2020**. Carbon prices of $15 and $50 per ton would raise revenues of around $155 and $450 billion, respectively.[13] It is difficult to predict the fraction of these revenues that national governments would be willing to allocate for climate finance in 2020, especially during times of fiscal consolidation. For illustration, following AGF (2010) it is assumed that 10 percent of revenues from carbon pricing (or auctioning ETS allowances) would be earmarked for this purpose, leaving projected climate finance revenues of approximately $15, $25, and $45 billion under different pricing scenarios.

Cost-effectiveness

19. **A CO_2 tax of about $25 per ton (or more) is a more cost-effective way to raise revenue than broad fiscal instruments**. As noted above, this is because the carbon tax produces environmental benefits which (up to the point where the emissions externality is fully priced)

---

[13] From Table 1, total CO_2 emissions across developing countries in 2008 were 11.7 billion tons. Based on the "Current Policies" scenario for 2020 in IEA (2010a), OECD emissions (which are a reasonable proxy for our developed country emissions) are projected to decline by about 6 percent between 2008 and 2020 in the absence of policy. Accounting for the assumed 10 percent emissions reduction in response to pricing, this leaves projected emissions of 9.9 billion tons for 2020 under the $25 per ton scenario. Multiplying by the emissions price gives the above revenue figure. The same calculation is performed for the other emissions price scenarios, using the assumed emissions reduction for that scenario. These revenue estimates are approximately consistent with those in AGF (2010) who project that an extra $1 tax per ton on OECD CO_2 emissions will raise approximately $10 billion in revenue. The above figures do not account for offsetting revenues losses as carbon pricing reduce the base of pre-existing taxes (e.g., on motor fuels).

outweigh the inefficiency of this policy due to its relatively narrow base compared with broader fiscal instruments.

20. **Leaving aside environmental benefits, the costs of a $25 per ton price carbon price would be modest—in the order of around 0.03 percent of GDP for the average developed country—assuming all revenues are used productively**.[14] However costs rise considerably if revenues are not used to increase economic efficiency (or revenues are forgone by giving away free allowance allocations). According to Parry and Williams (2011) for the United States, costs could easily be two to four times as high depending on how much of the potential revenue recycling benefit is squandered (for the level of CO_2 reductions assumed here).

Cross-country distribution of revenues

21. **Revenue collected and hence potentially available for climate finance, as a percent of GDP would vary across countries depending on their emissions intensity**. Table 2 shows climate finance contributions as a percent of GDP for the $25 per ton CO_2 tax, had it been applied retrospectively for year 2008 to the developed country classification used here (country-level projections of emissions are not available for 2020).[15] For most countries the revenue is around 0.06 to 0.10 percent of GDP (see column 4). Contributions for Iceland, Norway, Sweden, and Switzerland are less than 0.05 percent of GDP, as their power generation sectors have relatively low CO_2 intensity. On the other hand, contributions exceed 0.10 percent of GDP for emissions-intensive countries like Australia, United States, and Canada, but also for the Czech Republic and Poland.

Impact on energy prices

22. **A $25 per ton carbon price would increase average electricity prices by about US 1 cent per kWh but only moderately increase motor fuel prices**. If carbon prices are fully passed forward, a $25 per ton carbon tax would increase electricity prices by around 0.5 to 1.5 cents per kWh across OECD countries, at least on year 2008 data (Table 3, column 2). On average this would increase residential electricity prices by about 4 percent and industrial electricity prices by about 7 percent, though price impacts are small for countries like France, Norway, and Sweden that rely very little on carbon intensive fuels (Table 3, columns 5 and 8). Motor gasoline prices would rise by 6 cents per liter, or 3 to 9 percent of (year 2009) pump

---

[14] A standard approximation for the economic costs of an emission pricing policy (i.e., the costs of the behavioral responses to reduce emissions) is one half, times the emissions reduction, times the emissions price (e.g., Harberger, 1964). Using this formula and the above assumptions gives a total cost for 2020 of $13.7 billion. GDP for OECD countries in 2008 was $41,400 billion (OECD 2011b). Assuming GDP growth of 1.5 percent a year gives GDP in 2020 of $ 49,498 billion. Dividing the cost number by this latter figure gives the above percentage.

[15] The overall economic cost to the domestic economy from carbon pricing will exceed the climate finance contribution as it also includes the costs of emissions reductions, including the broader cost to the economy from higher energy prices, less benefits from domestic revenue recycling.

Table 2. Energy-related CO_2 Emissions, Climate Finance Contributions, and GDP per Capita by Country, 2008

Country	Economy-wide CO_2 Emissions, Million tons (1)	Emissions Intensity of GDP Tons CO_2/US $1000 (2)	Climate Finance Contribution $25 tax on CO_2 $billion (3)	% of GDP (4)	GDP per Capita (PPP, year 2000$) (5)
Australia	398	0.59	0.90	0.13	31,581
Austria	69	0.25	0.16	0.06	32,892
Belgium	111	0.34	0.25	0.08	30,561
Bulgaria	48	0.63	0.11	0.14	10,000
Canada	551	0.53	1.24	0.12	31,502
Cyrpus	8	0.44	0.02	0.10	22,500
Czech Republic	117	0.54	0.26	0.12	20,673
Denmark	48	0.28	0.11	0.06	31,091
Estonia	18	0.78	0.04	0.18	17,692
Finland	57	0.34	0.13	0.08	31,698
France	368	0.21	0.83	0.05	27,317
Germany	804	0.34	1.81	0.08	28,636
Greece	93	0.34	0.21	0.08	24,464
Hungary	53	0.33	0.12	0.07	16,100
Iceland	2	0.18	0.00	0.04	36,667
Ireland	44	0.29	0.10	0.06	35,000
Italy	430	0.28	0.97	0.06	26,077
Japan	1,151	0.32	2.59	0.07	28,175
Latvia	8	0.24	0.02	0.05	14,348
Lithuania	14	0.26	0.03	0.06	15,882
Luxembourg	10	0.32	0.02	0.07	62,000
Malta	3	0.38	0.01	0.08	20,000
Netherlands	178	0.33	0.40	0.07	33,293
New Zealand	33	0.33	0.07	0.07	23,488
Norway	38	0.20	0.09	0.04	40,417
Poland	299	0.53	0.67	0.12	14,724
Portugal	52	0.28	0.12	0.06	17,736
Romania	90	0.41	0.20	0.09	10,140
Slovak Republic	36	0.38	0.08	0.08	17,778
Slovenia	17	0.35	0.04	0.08	24,500
Spain	318	0.29	0.72	0.07	24,013
Sweden	46	0.15	0.10	0.03	32,043
Switzerland	44	0.17	0.10	0.04	34,545
United Kingdom	510	0.28	1.15	0.06	30,000
United States	5,596	0.48	12.59	0.11	38,562
Total/average	11,662	0.39	26.24	0.09	30,105

Source. OECD (2011b).

Note: For illustration, it is assumed that 10 percent of revenues are allocated to climate finance. Revenue projections assume that the tax base (emissions) will fall by 10 percent in response to the emissions price.

Table 3. Impacts of Carbon Pricing on Electricity Prices, 2008

Country	Emissions Rate	Increase in Generation Cost from \$25 CO_2 tax	Residential: Current Elect. Price	Residential: CO_2 tax	Residential: Current Excise Tax	Residential: Current Total Tax	Industrial: Electricity Price	Industrial: CO_2 tax	Industrial: Current Excise Tax
	Gram CO_2/kWh	US cents/kWh	US cents/kWh	% of Electricity Price			US cents/kWh	% of Electricity Price	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Austria	183	0.5	26.2	1.7	13.2	29.9	15.4	3.0	17.2
Belgium	248	0.6	23.5	2.6	8.9	26.2	13.9	4.5	8.1
Czech Republic	544	1.4	19.2	7.1	0.8	16.7	14.8	9.2	1
Denmark	308	0.8	36.5	2.1	35.0	55.0	11.1	6.9	13
Finland	187	0.5	17.4	2.7	7.0	25.1	9.7	4.8	3.7
France	83	0.2	15.9	1.3	10.4	25.0	10.7	1.9	10.3
Germany	441	1.1	32.3	3.4	0	16.0	10.9	10.1	0
Greece	731	1.8	15.2	12.0	0.3	8.7	11.4	16.0	0
Hungary	331	0.8	20.6	4.0	0	18.4	16	5.2	0.8
Ireland	486	1.2	25.5	4.8	0	11.9	16.9	7.2	0
Italy	398	1.0	28.4	3.5	16.0	24.7	27.6	3.6	21.4
Japan	436	1.1	22.8	4.8	1.8	6.5	15.8	6.9	7.3
Luxembourg	315	0.8	23.7	3.3	7.1	12.8	13.6	5.8	9.9
Netherlands	392	1.0	25.8	3.8	12.5	17.2	14.1	7.0	13.3
New Zealand	214	0.5	15.2	3.5	0.0	11.1	7.1	7.5	0
Norway	5	0.0	13.3	0.1	13.0	33.0	5.9	0.2	20
Poland	653	1.6	16.7	9.8	3.9	21.9	12	13.6	5.4
Portugal	384	1.0	21.5	4.5	0	4.8	12.7	7.6	0
Slovak Republic	217	0.5	23.1	2.3	0	15.9	19.5	2.8	0
Spain	326	0.8	21.2	3.8	4.2	18.0	10.3	7.9	4.9
Sweden	40	0.1	19.4	0.5	17.9	38.0	8.3	1.2	0.8
Switzerland	27	0.1	16.4	0.4	2.5	9.6	9.4	0.7	4.4
United Kingdom	487	1.2	20.6	5.9	0	4.8	13.5	9.0	3.7
United States	535	1.3	6.84	19.6	0	0.0	11.6	11.6	0
Average	307	0.8	19.5	4.1	5.9	17.4	12.0	5.9	5.6

Source: IEA (2010a), pp. 73-307, 314, 343, and OECD (2011b).

Notes: CO_2 tax is calculated by multiplying the CO_2 per kWh by an assumed tax of \$25 per ton. This is an approximation, given that emissions rates would fall (moderately) in response to the tax, though on the other hand costs of switching to cleaner generation fuels would be reflected in higher prices. The total tax for residential electricity includes excise taxes and general sales/value added taxes. Some countries in Table 1 for which recent data is not available are not included in the above table. The United States does not impose taxes on electricity at the national level.

prices, with the proportionate price increase being higher in countries with low pre-existing retail prices like the United States (Table 4, columns 1 and 2). Natural gas prices would rise by about \$1.50 per one thousand cubic feet, which amounts to about 15 percent of the average OECD price projected for 2020. The price of coal would increase by about \$45 per (short) ton, which would more than double coal prices in countries like the United States (IEA, 2010a).

Table 4. Impacts of Carbon Pricing on Gasoline Prices, 2009

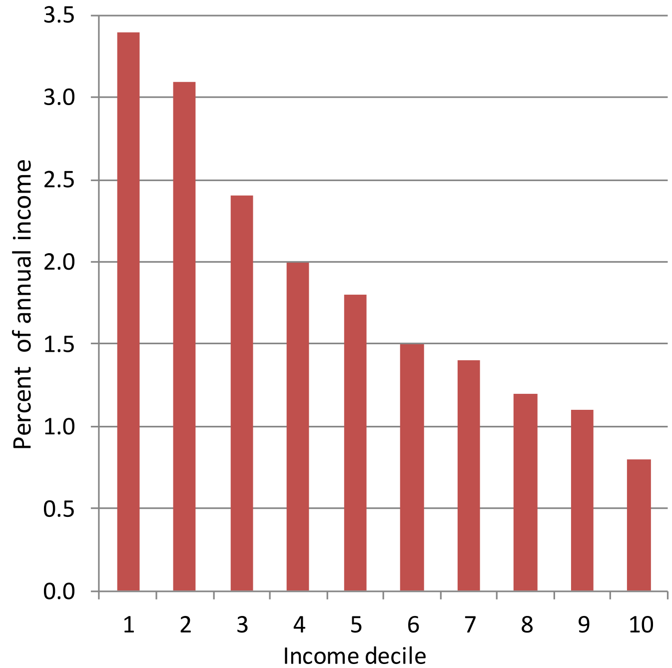
Country	Retail fuel price (unleaded gasoline) US $/litre (1)	CO_2 tax % of retail fuel price (2)	Vehicle excise tax revenue relative to fuel expenditures (3)
Australia	1.08	5.4	8.6
Austria	1.45	4.0	13.4
Belgium	1.83	3.2	14.5
Canada	0.91	6.4	4.4
Czech Republic	1.43	4.0	4.0
Denmark	1.78	3.3	28.0
Finland	1.78	3.2	17.7
France	1.68	3.4	5.7
Germany	1.80	3.2	7.0
Greece	1.40	4.1	26.5
Hungary	1.41	4.1	8.5
Ireland	1.53	3.8	34.0
Italy	1.71	3.4	10.1
Japan	1.29	4.5	22.2
Korea	1.40	4.1	11.8
Luxembourg	1.44	4.0	2.3
Mexico	0.70	8.3	1.1
Netherlands	1.87	3.1	37.8
New Zealand	1.05	5.5	24.5
Norway	1.89	3.1	29.3
Poland	1.32	4.4	0.9
Portugal	1.72	3.4	12.5
Slovak Republic	1.55	3.7	3.3
Spain	1.39	4.2	7.8
Sweden	1.59	3.6	5.3
Switzerland	1.39	4.2	35.2
Turkey	2.02	2.9	9.4
United Kingdom	1.55	3.7	11.8
United States	0.65	8.9	6.3

Source: IEA (2010b).

23. **There can be strong political opposition to these increases in energy prices**. Resistance may come from households—in their roles as electricity consumers and motorists—and also industry—including downstream energy users, intermediate producers of energy, and upstream (carbon-intensive) fuel suppliers.

24. **Higher energy prices may also undermine distributional objectives.** This is because they can impose a disproportionately large burden on poorer households, who tend to spend a relatively large portion of their income on fuels and electricity. According to one study, a $15 per ton CO_2 tax in the United States in 2015 would impose a burden of 3.5 percent of income for the lowest income decile, but only 0.8 percent of income for the highest income decile (Figure 1).

Figure 1. Distributional Incidence of Carbon Tax on US Households



Source: Metcalf (2007).
Notes: Results are for a $15 per ton tax on CO_2 in 2015, prior to recycling of revenues. The first and tenth deciles refer to the ten percent of households with lowest and highest income respectively.

25. **Higher energy prices may cause competitiveness concerns for energy-intensive firms competing in global markets (e.g., aluminum, steel, cement, plastics)**. Such firms may re-locate activities to other countries where energy is cheaper (but perhaps more emissions intensive) causing some moderate offsetting increase in emissions. This leakage problem is less of a higher concern if carbon pricing is implemented across developed countries, though this would still exempt some large competitors. Energy price impacts could always be limited by setting lower carbon prices, though this is not desirable as it would reduce environmental effectiveness and carbon market flows. Instead, policymakers may need to devise creative ways to enhance the feasibility of effective carbon pricing proposals (see below).[16]

[16] The burden of carbon prices may, in part, be borne by domestic fuel suppliers and power generators in the form of lower producer prices. At least for the United States however, evidence suggests that most of the burden is instead passed forward into higher energy prices for end-users (e.g., Bovenberg and Goulder 2001, Smith and others, 2002).

Other (domestic) carbon-related instruments

Electricity taxes ("wires charges")

26. **Taxes on electricity have significant revenue potential**. A (relatively small) direct tax of US 0.04 cents per kWh on power generation in developed countries, or a tax of $1 per ton on electricity CO_2 emissions (which would average about US 0.04 cents per kWh), would each raise projected annual revenue in 2020 of about $5 billion, though even the latter policy would have a trivial effect on emissions.[17] Alternatively, a more substantial tax of $25 per ton on power sector emissions would raise revenues of around $100 billion, or $10 billion for climate finance if 10 percent of revenues are earmarked.[18]

27. **Pure electricity taxes (levied per kWh) perform poorly on environmental grounds compared with carbon pricing**. The CO_2 reductions from electricity taxes are relatively modest because these taxes only exploit a minor portion of reduction opportunities that are exploited under carbon pricing—for example, electricity taxes do nothing to lower the emissions intensity of power generation. If the electricity tax is scaled to CO_2 emissions per kWh—effectively, this policy is a tax on CO_2 emissions from the power sector—environmental effectiveness is greatly improved, though the policy still fails to reduce emissions outside of the power sector. Neither form of electricity tax is therefore a good substitute for comprehensive carbon pricing. However, if comprehensive carbon pricing is infeasible, taxing carbon emissions from the power sector would be the next best option (combined with policies for other sectors), given that for many countries the huge bulk of the low-cost opportunities for CO_2 reduction are in the power sector (e.g., Clarke and others, 2009).

28. **If carbon emissions are priced, broader fiscal instruments may be preferable to pure electricity taxes on cost-effectiveness grounds**. As noted already, if environmental considerations are already addressed through carbon pricing, raising further revenue requirements from electricity taxes could involve higher economic costs than raising that revenue from broader fiscal instruments: both policies have a (slight) contractionary effect on overall economic activity, but in addition electricity taxes distort energy markets (once emissions externalities have been corrected).

29. **The distributional incidence of pure electricity taxes across countries is more even than for taxes scaled to CO_2 per kWh.** This is because there is greater variation in electricity CO_2 emissions than in electricity consumption across countries. For example, if applied to 2008 emissions, the burden of climate finance contributions under the pure electricity tax (assuming

---

[17] This was projected by the AGF based on an assumed electricity consumption of about 12,000 TWh in OECD countries. This projection changed little in IEA (2010a), "Current Policies" scenario, and there is only a modest difference between electricity consumption in our developed county classification and OECD consumption.

[18] This estimate assumes the policy would reduce power sector emissions by 20 percent.

Table 5. Cross-Country incidence of Electricity Taxes, Selected Countries, 2008

Country	Gross Electricity Output billion kWh	Burden of 0.04 cents/kWh tax		Burden of $1 per Ton Tax on Electricity CO_2	
		$billion	% of GDP	$billion	% of GDP
	(1)	(2)	(3)	(4)	(5)
Austria	67	0.03	0.010	0.01	0.004
Belgium	85	0.03	0.010	0.02	0.006
Czech Republic	84	0.03	0.016	0.05	0.021
Denmark	37	0.01	0.009	0.01	0.007
Finland	77	0.03	0.018	0.01	0.009
France	574	0.23	0.013	0.05	0.003
Germany	637	0.25	0.011	0.28	0.012
Greece	64	0.03	0.009	0.05	0.017
Hungary	40	0.02	0.010	0.01	0.008
Ireland	30	0.01	0.008	0.01	0.009
Italy	319	0.13	0.008	0.13	0.008
Japan	1083	0.43	0.012	0.47	0.013
Luxembourg	4	0.00	0.005	0.00	0.004
Netherlands	108	0.04	0.008	0.04	0.008
New Zealand	44	0.02	0.017	0.01	0.009
Norway	142	0.06	0.029	0.00	0.000
Poland	155	0.06	0.011	0.10	0.018
Portugal	46	0.02	0.010	0.02	0.009
Slovak Republic	29	0.01	0.012	0.01	0.007
Spain	314	0.13	0.011	0.10	0.009
Sweden	150	0.06	0.020	0.01	0.002
Switzerland	69	0.03	0.010	0.00	0.001
United Kingdom	389	0.16	0.008	0.19	0.010
United States	4368	1.75	0.015	2.34	0.020

Source: OECD (2011b).

100 percent of revenue is earmarked) is 0.029 percent of GDP for Norway, 0.015 percent for the United States, and 0.011 percent for Poland (Table 5, column 3). But if the tax is applied to electricity CO_2 emissions, Norway's burden falls to zero, while that for the United States and Poland rises to 0.020 and 0.018, respectively (Table 5, column 5).

Taxes on gasoline and petroleum consumption

30. **A surcharge on motor gasoline of 6 cents per liter in developed countries would raise annual revenues of around $5 billion, but reduce emissions only moderately**. This surcharge is approximately the tax that would be implied by a $25 per ton tax on CO_2.[19] As indicated in Table 6, if applied in 2008 the surcharge would have raised revenue of about $30 billion in the United States, but less than $20 billion in total from all other developed countries.[20] If 10 percent of revenues were allocated to climate finance, this would provide $5 billion. The economy-wide emission reductions from the change in fuel consumption would be modest relative to those under the carbon tax. Gasoline accounted for about 15 percent of developed country energy-related CO_2 emissions in 2008 and, as already noted, transportation emissions are less sensitive to pricing than power sector emissions.

31. **However, whether gasoline taxes make sense on economic grounds depends on whether existing taxes under-charge for the adverse side-effects of vehicle use**. Studies suggest that current fuel taxes in the United States are well below levels that would be needed to charge motorists for the broader societal costs of vehicle use, which include added congestion and accident risk for other road users, local pollution, and greenhouse gas emissions (Parry and Small, 2005). Up to a point, this means that higher fuel taxes in the United States would be a more efficient way to raise additional revenue than broader fiscal instruments. However, this does not necessarily apply to other developed countries, especially countries like Germany and the United Kingdom, where gasoline taxes may overcharge motorists for societal costs. Part of the problem is that fuel taxes are poorly suited to addressing major problems like traffic congestion, which instead warrant road-specific per mile tolls that vary across time of day with traffic flows.

---

[19] Combusting a gallon of gasoline produces 0.0088 tons of CO_2 (see http://bioenergy.ornl.gov/papers/misc/energy_conv.html).

[20] This reflects the relatively high vehicle miles of US drivers, the small penetration of diesel vehicles in the US passenger vehicle fleet, and the relatively low fuel economy of US vehicles. Revenue is understated slightly to the extent that some (small) developed countries (included in Table 1) are excluded from these calculations due to data being unavailable. On the other hand, the revenue is overstated somewhat as account is not taken of the (moderate) reduction in gasoline consumption in response to higher fuel prices. The above revenue estimates assume the base of the gasoline tax will be the same in 2020 as in 2008 which seems reasonable given that the dampening effect of higher future oil prices and tighter fuel economy policies may roughly offset higher fuel demand from greater vehicle miles travelled (e.g. Krupnick et al. 2010).

Table 6. Cross Country Incidence of Surcharges on Gasoline and Petroleum Consumption, 2008

Country	Gasoline Consumption	Burden of 6 cents/liter tax		Petroleum Consumption	Burden of 2 cents/liter tax	
	billion liters	$billion	% of GDP	billion liters	$billion	% of GDP
	(1)	(2)	(3)	(4)	(5)	(6)
Australia	19.1	1.1	0.17	56.3	1.1	0.17
Austria	2.4	0.1	0.05	16.7	0.3	0.12
Belgium	2.0	0.1	0.04	42.3	0.8	0.26
Canada	42.2	2.5	0.24	132.2	2.6	0.25
Czech Republic	2.7	0.2	0.08	12.5	0.2	0.12
Denmark	2.4	0.1	0.08	10.7	0.2	0.12
Finland	2.3	0.1	0.08	12.6	0.3	0.15
France	12.2	0.7	0.04	114.7	2.3	0.13
Germany	28.3	1.7	0.07	150.4	3.0	0.13
Greece	5.5	0.3	0.12	25.3	0.5	0.18
Hungary	2.1	0.1	0.08	9.4	0.2	0.12
Iceland	0.2	0.0	0.11	1.2	0.0	0.23
Ireland	2.4	0.1	0.09	11.3	0.2	0.15
Italy	15.5	0.9	0.06	96.3	1.9	0.12
Japan	57.9	3.5	0.10	282.3	5.6	0.16
Luxembourg	0.6	0.0	0.11	3.6	0.1	0.23
Netherlands	5.9	0.4	0.06	61.1	1.2	0.22
New Zealand	3.2	0.2	0.19	9.2	0.2	0.18
Norway	1.8	0.1	0.06	13.5	0.3	0.14
Poland	5.7	0.3	0.06	31.5	0.6	0.11
Portugal	2.0	0.1	0.06	17.0	0.3	0.18
Slovak Republic	0.9	0.1	0.06	5.1	0.1	0.11
Spain	8.6	0.5	0.05	91.2	1.8	0.17
Sweden	5.0	0.3	0.10	20.4	0.4	0.14
Switzerland	4.6	0.3	0.10	15.8	0.3	0.12
United Kingdom	22.9	1.4	0.07	102.0	2.0	0.11
United States	530.0	31.8	0.27	1,149.6	23.0	0.20
Total/average	788.4	47.3	0.16	2,493.9	49.9	0.17

Source: EIA (2011).

32. **A modest levy on all petroleum consumption would raise significant revenues and help (albeit very modestly) to reduce macroeconomic vulnerability to oil price volatility**. Gasoline consumption represents only about one-third of petroleum consumption for the average developed country. A levy equivalent to 2 cents per liter on all petroleum products in developed countries (about $3 per barrel of oil or $9 per ton of CO_2), would raise revenues of around $50 billion (Table 6), again providing about $5 billion for climate finance if 10 percent of receipts are allocated to climate finance. Such a levy would also (albeit very slightly) address concerns about macroeconomic risks from oil price volatility. Nonetheless petroleum levies still miss out on the majority of emissions reduction opportunities—for example, they do not raise the price of coal, the most carbon intensive fuel.

Overcoming resistance to carbon pricing

33. **Given the pivotal importance of carbon pricing in mitigating global climate change, novel strategies need to be developed to improve its feasibility**. Appropriate strategies may differ across countries depending on the nature of political obstacles.

34. **One way to increase the feasibility of carbon pricing might be to use some of the revenues for compensating target groups**. Domestically-retained revenues from carbon pricing could be used to adjust the broader tax/benefit system to offset the regressive effects of higher energy prices on households. For example, revenues might fund both a general reduction in personal income taxes rates and an earned income tax credit. However, tax reliefs (e.g., in the form of lower corporate income tax rates) for energy-intensive firms in trade sensitive sectors may be problematic as they complicate policy design, may compromise cost effectiveness, and there is a risk that reliefs will become permanent.[21] Alternatively, the competitiveness of trade vulnerable industries might be preserved through border tax adjustments, but these are contentious (Box 2).

35. **An alternative approach is to scale back pre-existing, environmentally ineffective energy taxes**. In many countries, reducing pre-existing taxes on electricity and vehicle ownership can go a long way in neutralizing the burden of carbon pricing on households and firms (see below). Moreover, with appropriate carbon pricing in place, pre-existing excise taxes on electricity and vehicles (though not value added or general sales taxes) are redundant as they imply higher economic costs for a given carbon reduction.[22] Furthermore, replacing environmentally ineffective policies with policies targeted more directly at dirty fuels—especially coal—may significantly alleviate local environmental problems.[23] The drawback is that net revenues raised from carbon pricing are lower as a result of these tax shifts.

36. **In many OECD countries, the impacts of carbon taxes on electricity prices could be offset by lowering pre-existing taxes on electricity use**.[24] As indicated in Table 3, 12 out of the

[21] The last federal cap-and-trade proposal in the United States (the Waxman-Markey bill) contained a complex allocation of emissions allowances designed to compensate a range of different industries and prevent a large increase in residential electricity prices—less than 10 percent of allowances were to be auctioned initially (see www.govtrack.us/congress/bill.xpd?bill=h111-2454).

[22] A carbon tax and an excise tax on electricity together will place too much of the burden of a given emissions reduction on electricity conservation and too little on other abatement opportunities. Similarly, a carbon tax and excise tax on vehicle ownership will place too much of the burden of emissions reductions on reduced vehicle demand and too little on other opportunities.

[23] For example, coal combustion is a major cause of local air pollution, which poses mortality risks for vulnerable populations (NRC, 2009).

[24] Under Energy Directive 2003/96/EC, minimum excise taxes on electricity are imposed in EU countries, though there are current discussions to revise this Directive to target carbon emissions more directly.

Box 2. Carbon Pricing and Border Tax Adjustments

In principle, imposing taxes on carbon "embodied" in imports can be an efficient way to address concerns about emissions leakage. This will ensure that foreign-produced output is treated, in climate terms, the same as domestic production. Such border tax adjustments (BTAs) can therefore help mitigation efforts without impacting the international competitiveness of domestic industry, while potentially also encouraging participation by other countries, as this will obviate the need for BTAs. And from a wider perspective of global efficiency too, such adjustments can in principle have a role to play (Keen and Kotsogiannis, 2011).

Because of the product or sector-specificity required, BTAs could be administratively complex. Determining the appropriate (equivalent) carbon tax for any given product is not straightforward. BTAs should accurately reflect the production process used by the exporting firm, including the use of inputs and their carbon content. Information on this will often not be available and generating it can be costly and easily give rise to arbitrary decisions and inappropriate outcomes. One major operational challenge is that climate change-related policies often will target plants or enterprises in certain industries, whereas the application of BTAs will (must) center on the products that are cleared through Customs at the border. As argued by Moore (2010) the precedents in those areas of trade policy where detailed information is needed to determine whether and how much to tax imports – most notably antidumping and countervailing duty mechanisms – are not encouraging. Aside from the formidable technical challenges of accurately assessing the carbon footprints-cum-GHG emissions that have been generated by in producing imported products, the history of the use of contingent trade policies suggests that there is a high probability that domestic import-competing industries will lobby and capture the process to their advantage.

Important legal and equity issues also need to be considered. There has been much discussion and argument regarding the WTO compatibility of trade measures that are related to domestic measures to reduce GHG emissions. In the absence of concrete disputes there is significant uncertainty whether BTAs would be deemed to be consistent with WTO obligations and much will depend on the specifics of any BTA regime.[1]

Many developing countries oppose a globally uniform carbon tax on the grounds that that it is appropriate for those countries that are primarily responsible for global warming to take most action to reduce GHG emissions. The unilateral application of BTAs as part of the implementation of carbon tax regimes could give rise to retaliation. Indeed, some major developing countries have indicated that they will consider such a response.

Moreover, studies suggest that using trade policy to take action against countries that have decided not to apply a carbon tax may do little to further the goal of reducing global GHG emissions (e.g., McKibben and Wilcoxen, 2009; Dong and Whalley, 2009; Rutherford, 2010). These suggest that BTAs could have adverse consequences on developing countries' output and trade. The magnitude of the effects will depend on how the BTAs are applied. Mattoo et al. (2009), for example, note that BTAs imposed by OECD nations will impact developing country manufacturers much more detrimentally if tariffs are based on the carbon content embodied in imports than if they were to be based on the carbon content of competing domestic production in the jurisdiction imposing a carbon tax.

[1] Many analysts have concluded that BTAs motivated on the basis of a national carbon tax are likely to violate the WTO's national treatment requirement. However, in practice a government has significant scope to justify the use of BTAs under "general exceptions" provision that permits countries to use trade policy measures to protect the environment, so long as they apply to all trading partners equally and are least trade-restrictive (see Low et al., 2011).

24 countries could completely neutralize the impacts of carbon pricing on residential electricity prices by scaling back excise taxes on electricity use (i.e., these taxes exceed, often by a large amount, the potential pass through of carbon pricing in residential prices). Similarly, 10 countries

(mostly the same ones) could fully offset the effect of carbon pricing on industrial electricity prices by cutting excise taxes.[25]

37. **Similarly in many developed countries, the burden on motorists can be approximately offset by lowering vehicle ownership taxes as carbon pricing is introduced (though again this reduces net revenue impacts)**. Annual revenues from vehicle ownership taxes (primarily sales taxes, registration fees, and road taxes) are equivalent to more than 5 percent of annual expenditures on motor fuels in 21 out of 26 developed countries and exceed 10 percent of fuel expenditures in 14 countries (Table 4, column 3). In fact, in 22 out of 26 developed countries ownership taxes could be scaled back prevent an increase in the total tax burden (fuel plus vehicle ownership) on the average motorist (compare columns 2 and 3 in Table 4).

Feebates: An alternative to carbon taxes

38. **If broad carbon pricing is infeasible, feebates are a possible alternative**. Feebates are tax/subsidy combinations that can be used to lower the emissions intensity of power generation and improve the energy efficiency of vehicles, household appliances, etc. A feebate for the power generation sector, for example, would impose a tax (or fee) per kWh on relatively dirty generators, equal to an emissions price times the difference between their CO_2 per kWh (averaged across their portfolio of plants) and a "pivot point" CO_2 per kWh. And relatively clean generators would receive a subsidy (rebate) per kWh equal to the same emissions price times the difference between the pivot point and their average CO_2 per kWh. The policy is cost effective because all generators receive the same reward (lowering their tax rate or raising their subsidy) for reducing CO_2 intensity through switching to lower or zero carbon fuels and/or improving plant efficiency. A combination of feebates across different sectors can exploit many (though not all) of the economy-wide CO_2 reduction opportunities. Feebates can be designed to raise revenue—the more revenue they raise the greater their impact on the price of energy and energy-using products.[26]

39. **Power sector feebates can raise a significant amount of revenue**. For example, a feebate price of $25 per ton of CO_2 per kWh, and a pivot point set at 90 percent of the projected

---

[25] At the household level, 22 out of 26 countries could fully neutralize the effects of carbon pricing by reducing some combination of excise and general value added (or sales) taxes. However, from an economic perspective it is generally not desirable to cut value added taxes as this effectively subsidizes electricity relative to other goods (rather than reducing excessive taxation of electricity). In this latter case, too little of the burden of emissions abatement will come from reduced electricity demand from a cost-effectiveness perspective.

[26] The feebate for power generation is equivalent to a tax on generators' CO_2 emissions, with a portion of the revenues used to finance a subsidy per kWh of generation. The lower the pivot point, the greater the amount of revenue raised, the greater the impact on electricity prices, and the more the feebate resembles a simple tax on power sector CO_2 emissions.

industry-average CO_2 per kWh, would yield revenues of approximately $6 billion in 2020 for the United States.[27] Given that the United States accounts for about 60 percent of power sector CO_2 emissions in developed countries, this suggests total revenues from similar feebate policies applied more broadly could be around $10 billion. To maintain revenues over time the pivot point would need to be reduced, perhaps annually, as the emissions intensity of power generation falls progressively (though presumably this revenue loss would be partially offset by a rising emissions price).

40. **Feebates can also cost-effectively increase energy efficiency and raise further revenues**. Most obviously, feebates can be applied to new passenger vehicles, with a tax on relatively fuel inefficient vehicles—equal to an emissions price times the difference between their CO_2 per mile and a pivot point CO_2 per mile—and a subsidy for relatively fuel efficient vehicles—equal to the emissions price times the difference between the pivot point and their CO_2 per mile (e.g., Small, 2010). Again, the policy is cost effective as it provides the same reward across all vehicle classes and across all possibilities for reducing CO_2 per mile (e.g., improvements in engine efficiency, reductions in vehicle size, use of lighter materials). Feebates could also be used to promote increased efficiency of electricity-using durables (e.g., refrigerators, air conditioners). Across sectors, a set of feebates is cost effective if a uniform price is imposed on emissions from different sectors.

41. **Feebates may be more acceptable than carbon taxes, because they avoid a large increase in energy prices**. For example, under the feebate discussed above for the power sector, the increase in residential and industrial electricity prices is only about one-tenth as large as under the carbon tax.[28] However, feebates raise much less revenue—and the more they are designed to raise revenue, the greater their impact on energy prices (as net tax payments are passed forward into prices).

42. **Neither feebates nor the other schemes for preventing large energy price increases alleviate the burden on upstream (domestic) coal suppliers**. This is because all the carbon pricing schemes discussed above are designed to promote a substantial shift away from carbon-intensive fuels—unless there is widespread development and deployment of carbon capture and storage technologies, which face many technical and legal obstacles (e.g., Jepma and Hauck, 2010).

---

[27] In (spreadsheets underlying) Krupnick et al. (2010), projected power generation for the United States in 2020 is 4,125 billion kWh and the projected emissions intensity is 0.000597 tons per kWh. Therefore on average (after the 90 percent rebate), there will be a net tax payment of 0.15 cents per kWh. This assumes the feebate covers all (new and existing) generation sources, rather than just new sources.

[28] Loosely speaking, the price increase is proportional to the amount of revenues that are raised, to the extent that revenues are eventually passed forward into higher prices for end users.

IV. Broader (Non-Carbon-Related) Fiscal Instruments

43. **Traditional tax instruments and new taxes on financial institutions could be important revenue sources for climate finance**. Although carbon pricing is critical in efficiently curbing CO_2 emissions, there is no need to earmark funds from carbon pricing for climate finance. Indeed, the revenue from carbon pricing could flow into national budgets instead, and climate finance can be based on other criteria than carbon emissions. This raises the question as to what other, domestic revenue sources would be appropriate in developed countries to generate additional contributions for climate finance. In principle, countries could reshuffle expenditures in order to free up funds for climate finance, without raising extra revenue. However, they could also increase revenue from traditional domestic taxes. In the latter case, the question is what tax would be most desirable. The discussion below builds on the detailed analyses of revenue-raising possibilities in advanced and emerging economies in IMF (2010b) and of options for new taxes on the financial sector in IMF (2010a).

44. **The *value-added tax (VAT)* has proved to be a relatively efficient source of revenue, generating fewer distortions than many other taxes**.[29] Almost all developed countries—with the exception of Saudi Arabia and the United States—have a VAT. On average, the VAT raises over 5 percent of GDP in revenue in these countries. However, in many countries exemptions and excessive rate differentiation reduce the effectiveness of the VA—achieving little equity gain that could not be better achieved by more directly—targeted instruments, and creating further distortions—as well as increasing costs of administration and compliance. Hence, there is generally substantial scope for further improving the revenue performance of the VAT by reducing exemptions and eliminating reduced rates, combined if needed by measures to address any adverse distributional impact. In a number of emerging economies with a VAT, there is often a compliance gap, that is, a loss of revenue due to poor tax compliance, suggesting that improved enforcement would allow for substantial revenue gains. In countries with very low rates, such as Japan, a higher VAT rate could add to revenue. In countries without a VAT, its introduction is a leading option for substantially enhancing revenues.

45. **Many countries have scope to increase revenues from *excises* on tobacco and alcohol**. Their yield has been declining over the last decades, partly reflecting falling real tax rates. Policymakers might have moderated rate increases to avoid cross-border shopping and smuggling. International cooperation can help avoid such threats and allow countries to increase their revenue yield. Scope for new types of excises on specific products, however, seems fairly limited. Taxing telecom services is sometimes suggested, partly to tax rents (where these have not been collected by auction). Caution is needed, however, as this can undermine valuable network externalities and distinguishing, as would be appropriate, between personal and business use is typically hard.

---

[29] See e.g., Norregaard and Kahn (2007) for a general assessment and Arnold (2008) for empirical evidence.

46. **The *corporate income tax (CIT)* seems an unlikely candidate as a source of additional revenue**. International tax competition over the past decades has intensified, and led to significant reductions in statutory CIT rates. Many countries have, at the same time, broadened their tax bases by adjusting tax depreciation rules and restricting deductions (e.g., for interest). There remains some scope for base broadening in some countries, but the potential revenue gains are fairly modest. International coordination could perhaps strengthen the revenue potential of the CIT, but this remains contentious in principle and quite remote in practice.

47. **The *personal income tax (PIT)* is generally considered key to achieving equity objectives and might have some potential for higher revenue, although not likely through rate increases**. High effective marginal rates of PIT can have damaging incentive effects on both real activity and compliance. For instance, while incentive effects on labor supply of primary workers are generally found to be modest, tax effects on the participation decisions of secondary workers (mainly married females) can be substantial. Moreover, high marginal tax rates for low-wage earners tend to create large labor-market distortions by driving unskilled workers out of the formal labor market. There is also significant evidence that higher rates of PIT encourage tax avoidance and evasion, particularly for high income individuals. These considerations do not necessarily point to applying low PIT rates across the board, such as envisioned under flat tax regimes. Rather, a case can be made for a progressive system, combining rates that rise with income and with targeted tax credits where distortions are largest. Some countries may still have scope for base-broadening and simplification within—and higher revenue from—the PIT by reducing allowances and exemptions. Personal income taxes on capital income are generally non-neutral—taxing some but exempting other forms of capital income or applying different rates to different sources of income—leaving some scope for higher revenue from PIT. Yet, the opportunities for rate increases are limited in light of the disincentive and avoidance effects it will cause.

48. **Recurrent *property taxes* are a promising source of increased revenue for a number of countries**. Efficiency and fairness arguments strongly favor the use of property taxes: they appear to have only limited effects on growth, and to be borne mainly by the well-off. At present, they yield approximately 3 percent of GDP in Canada, the United Kingdom, and the United States, but well below 1 percent in other developed countries. This suggests significant untapped potential, but realizing this requires overcoming practical obstacles such as administrative complexities and unpopularity in light of their transparency. Nonetheless, property taxation has clear potential for significant and relatively efficient revenue enhancement in several countries.

49. **Taxes on the financial sector have received increased attention during recent years**. There are several forms, as described and discussed in IMF (2010b) and (European Commission, 2010). "Bank taxes" have been introduced by several countries over the last two years or so, in some cases contributing to general revenue in others feeding a resolution fund. Their revenue yield, however, is relatively low, and seems unlikely to increase substantially. Broad-based financial transactions taxes have attracted considerable popular support, and their

adoption has recently been proposed by the European Commission.[30] Advocates argue that an FTT can raise substantial revenue at a low rate and may improve financial market performance by discouraging high-frequency trading. Others see drawbacks and risks. For instance, an FTT would increase the cost of capital and so could have a significant adverse impact on long-term economic growth; their real burden will likely fall on final consumers rather than on actors in the financial sector; and these taxes are particularly vulnerable to avoidance and evasion. IMF (2001b)[31] stresses the feasibility of taxing a wide range of financial transactions, and the revenue this might yield, but concludes that a Financial Activities Tax (FAT) is more attractive. This is a tax that would be levied on the sum of profits and remuneration of financial institutions (variously defined). In one form, the FAT would effectively be a tax on value added in the financial sector and so and serve as an (imperfect) offset to any tendency of the financial sector becoming too large because of the commonplace exemption of financial services under the VAT.

[30] See http://ec.europa.eu/taxation_customs/taxation/other_taxes/financial_sector/index_en.htm

[31] See also Brondolo (2011) and Matheson (2011).

V. Conclusion

50. **Broad-based, revenue-raising, carbon pricing policies (i.e., carbon taxes and cap-and-trade systems with allowance auctions) are a particularly promising source of climate finance**. If scaled appropriately, these policies can raise substantial revenues—about $25 billion if 10 percent of revenues are earmarked. These policies automatically exploit all possible opportunities for reducing carbon emissions across all sectors of the economy—other carbon-related instruments (whether fiscal or not) are less effective in exploiting these reduction opportunities. Carbon pricing instruments also provide across-the-board incentives for clean technology development and (with appropriate crediting provisions) maximize the breadth of international carbon markets for promoting clean development in low-income countries. And, because of all these benefits, carbon-pricing policies of the scale considered here are a more attractive source of climate finance than broader (non-carbon-related) fiscal instruments.

51. **There are many options for improving the acceptability of carbon pricing**. These range from scaling back other (environmentally weaker) taxes in the power and transport sectors to help neutralize the overall burden on households and firms, to broader adjustments to the fiscal system targeted, for example, at low-income households. Another promising option is feebates to promote energy efficiency and de-carbonization of the power sector—under this approach, policymakers can choose the point at which firms pay taxes or receive rebates to trade off raising net revenue against impacts on energy prices. The drawback of these schemes is that they result in lower overall revenues for climate finance, fiscal consolidation, or other purposes.

References

Atkinson, Anthony B., ed., 2004, *New Sources of Development Finance* (Oxford: Oxford University Press).

Bovenberg, A. Lans, and Lawrence H. Goulder, 2001, "Neutralizing the Adverse Industry Impacts of CO_2 Abatement Policies: What Does It Cost?" In *Behavioral and Distributional Effects of Environmental Policy*, C. Carraro and G. Metcalf ed., pp. 45–85 (Chicago: University of Chicago Press).

Brondolo, J., 2011, Taxing *Financial Transactions: An Assessment of Administrative Feasibility*, IMF Working Paper 11/185 (Washington: International Monetary Fund).

Clarke and others, 2009, "International Climate Policy Architectures: Overview of the EMF 22 International Scenarios," *Energy Economics* Vol. 31, pp. S64–S81.

Dong, Y. and J. Whalley, 2009, "How Large are the Impacts of Carbon Motivated Border Tax Adjustments?" *EPRI Working Paper* (http://economics.uwo.ca/centres/epri/).

Energy Information Administration, 2011, *International Energy Statistics* (Washington: U.S. Department of Energy). Available at: www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm.

European Commission, 2010, *Financial Sector Taxation, Taxation Paper No. 25, DG Taxation and Customs Union.* (Brussels).

Eyraud and others, 2011, *Who's Going Green and Why? Trends and Determinants of Green Investment,* IMF Working Paper (Washington: International Monetary Fund).

Harberger, Arnold, C., 1964, "The Measurement of Waste," *American Economic Review* Vol. 54, pp. 58–76.

International Energy Agency, 2010a, *World Energy Outlook 2010* (Paris: OECD, IEA).

International Energy Agency, 2010b, *Energy Prices and Taxes, Fourth Quarter* (Paris: OECD, IEA).

International Monetary Fund, 2010a, *A Fair and Substantial Contribution by the Financial Sector*, Final Report for the G-20. Available via the Internet: www.imf.org/external/np/g20/pdf/062710b.pdf .

______, 2010b, *From Stimulus to Consolidation: Revenue and Expenditure Policies in Advanced and Emerging Economies* (Washington).

______, 2011, *Market-Based Instruments for International Aviation and Shipping as a Source of Climate Finance* (Washington).

Jepma, Catrinus, and D. Hauck, 2010, "The Economics of Carbon Capture and Storage: An Update," *International Review of Environmental and Resource Economics*, Vol. 4, pp. 221–60.

Keen, Michael, and C. Kotsogiannis, 2011, *Coordinating Climate and Trade Policies: Pareto Efficiency and the Role of Border Tax Adjustments* (Washington: International Monetary Fund).

Krupnick and others, 2010, *Toward a New National Energy Policy: Assessing the Options*, (Washington: Resources for the Future and National Energy Policy Institute).

Matheson, Thornton, 2011, "Taxing Financial Transactions: Issues and Evidence," IMF Working Paper 11/54 (Washington: International Monetary Fund).

Mattoo and others, 2009, "Reconciling Climate Change and Trade Policy," World Bank Policy Research Working Paper 5123 (Washington).

McKibbin, Warwick, and P. Wilcoxen, 2009, "The Economic and Environmental Effects of Border Tax Adjustments for Climate Change Policy," Lowy Institute Working Paper (Sydney).

Metcalf, Gilbert, 2007, "A Proposal for a U.S. Carbon Tax Swap: An Equitable Tax Reform to Address Global Climate Change," The Hamilton Project (Washington: Brookings Institution).

Moore, Michael, 2010, "Implementing Carbon Tariffs: A Fool's Errand," World Bank Policy Research Paper (Washington: The World Bank Group).

Organization for Economic Cooperation and Development, 2012, *OECD Environmental Outlook to 2050*, (Paris: OECD, forthcoming).

______, 2011a, *Development Perspectives for a Post-Copenhagen Climate Financing Architecture*, (Paris: OECD).

______, 2011b, OECD Library. Database available via the Internet: www.oecd-ilibrary.org .

Parry, Ian W.H., and K. A. Small, 2005, "Does Britain or The United States Have the Right Gasoline Tax?" *American Economic Review* Vol. 95, pp. 1276–89.

______, and R. C. Williams, 2011, "Moving U.S. Climate Policy Forward: Are Carbon Tax Shifts the Only Good Alternative?" In Robert Hahn and Alistair Ulph (eds.), *Climate Change and Common Sense: Essays in Honor of Tom Schelling* (Oxford University Press, forthcoming).

Rutherford, Thomas, 2010, "Climate-Linked Tariffs: Practical Issues," *ETH Zurich Working Paper* (Switzerland).

Sijm, Jos, K. Neuhoff and Y. Chen, 2006, "CO_2 Cost Pass-Through and Windfall Profits in the Power Sector," *Climate Policy,* Vol.6, No.1, pp. 49–72.

Smith, Anne E., M. E. Ross, and W. D. Montgomery, 2002, "Implications of Trading Implementation Design for Equity-Efficiency Tradeoffs in Carbon Permit Allocations," Working Paper (Washington: Charles River Associates).

Stern, Nicholas, 2007, *The Economics of Climate Change: The Stern Review* (Cambridge, U.K.: Cambridge University Press).

United Nations, 2010, *Report of the Secretary-General's High-Level Advisory Group on Climate Change Financing* (New York).

U.S. Interagency Working Group on Social Cost of Carbon, 2010, *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866* (Washington: United States Government).

World Bank and International Monetary Fund, 2005, *Moving Forward: Financing Modalities Toward the MDGs*, Paper for the Development Committee, 2005-8 (Washington).

______, 2011, *Mobilizing Climate Finance*, Paper for the G20 Finance Ministers (Washington).