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GREEN economy

Driving a Green Economy Through Public Finance and Fiscal Policy Reform

WORKING PAPER v. 1.0

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Executive Summary

A green economy (GE) can be defined as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. A GE is characterized by substantially increased investments in economic sectors that build on and enhance the Earth's natural capital or reduce ecological scarcities and environmental risks. These sectors include renewable energy, low-carbon transport, energy-efficient buildings, clean technologies, improved waste management, improved freshwater provision, sustainable agriculture and forest management, and sustainable fisheries. These investments are driven or supported by national policy reforms and the development of international policy and market infrastructure.

Achieving a transition to a GE has become a priority for many governments. It will require substantial policy reforms at the international, national and local levels in order to help realize the economic opportunities arising from a shift to less polluting or resource efficient patterns of production and consumption, including new sources of employment. It also implies managing related structural changes including, for example, potentially adverse effects on traditional economic sectors underlying the "brown" economy.

A GE sets new priorities for macroeconomic policy, with growth being generated by economic sectors that are critical or highly material for greening the global economy. A portfolio of fiscal, regulatory and information-based policy measures will likely be required to promote an effective and fair transition to a GE. Such a portfolio will need to be carefully coordinated to ensure measures are complementary and neither counteract each other nor generate unintended consequences.

Fiscal policy plays a critical role in a GE. The means by which tax revenues are generated has a fundamental effect on the structure of incentives facing businesses and households, in both consumption and investment decisions. Secondly, how government spends these revenues not only on recurrent costs, but also investments in public infrastructure or supporting technology development, plays a critical role in shaping the path of economic development.

Effective policy implementation requires cooperation across different parts of government, particularly finance and environment departments. Building relevant administrative capacity, for example in environment as well as customs and revenue agencies, is also likely to be an important dimension, particularly in developing countries. A well-designed set of indicators can help assess interactions between the environment and the economy, and evaluate progress towards a GE.

Available evidence suggests past environmental tax reforms have often been successful in improving environmental sustainability in specific sectors. A GE needs to be based on a broader and more robust implementation including, for example, through more systematic taxation of fossil-fuel-based energy and other natural resources.

Environmentally-related charges currently raise only modest amounts of revenue in many countries, but could potentially make a major contribution to restoring fiscal positions in many countries, provided any compensation arrangements are carefully

targeted. Indeed, many developing countries are highly dependent on natural resource tax revenues.

Green subsidies are likely to be less effective than pollution pricing measures, but well-targeted, transitional measures may facilitate the shift towards a GE in cases where market barriers and positive social spillovers clearly exist, or where there are technical or political obstacles to the alternatives.

Reforming environmentally harmful subsidies—which fuel unsustainable economic activity, are fiscally expensive, and often confer limited benefits on poor households—should be a key priority, particularly in the agriculture, energy, fisheries, forest and water sectors. Better information on the magnitude and distributional consequences of such programmes could help with designing and implementing more effective transitional measures.

Finally, direct public expenditure has a key role in promoting more sustainable economic growth, including through cleaner infrastructure provision, support for research and development in environmental technologies. Indirect support, for example through different forms of public guarantees, may also help leverage green investment by households and firms.

In sum, both fiscal policy and public finance can be key drivers of a country's transition to a greener economy—or a brake on green growth and low carbon job creation. This paper explores the linkage and options available to policy-makers considering ways to drive and accelerate the transition to lower-carbon, more resource-efficient and socially-inclusive economic growth.

I. Introduction

Concerns about environmental sustainability are rising… Without rapid transformation in energy and land use sectors, the global economy is at serious risk from climate change. A recent study by the Organisation for Economic Cooperation and Development (OECD) (2010) estimated that current and planned policy measures are likely to reduce emissions by only around 12 per cent against 2005 levels by 2020, which is significantly short of the 25-40 per cent cuts below 1990 levels recommended by the Intergovernmental Panel on Climate Change (IPCC) (2007). Water and air quality is also deteriorating rapidly in some cases, particularly in major cities in the developing world.[1] Significant pressures on land and other natural resources are already being observed, and will likely increase with a population estimated to reach 9 billion by 2050 (United Nations, 2008): more than a quarter of the global marine fish stocks, for example, are already estimated to have collapsed.[2]

…amid a weak economic outlook. The recent crisis has adversely affected human welfare across the global economy, and the outlook remains fragile. Governments have used both monetary and fiscal policies to strengthen the economy in the short term, including through specific measures to encourage environmental protection activities in a number of cases. And as the recovery strengthens, policy-makers are examining potentially new sources of environmentally sustainable growth in the longer term. Severe fiscal pressures being experienced in many countries are adding to the momentum for policy reforms aimed at promoting more efficient use of environmental resources. Such structural adjustments have been observed following previous economic crises, including as conditions of multilateral assistance by the International Monetary Fund (IMF) and World Bank.

A "Green Economy" (GE) is an important concept linking economic growth and environmental sustainability. It implies realizing growth and employment opportunities from less polluting and more resource efficient activities, including in energy, water, waste, buildings, agriculture and forests; and managing related structural changes such as potentially adverse effects on vulnerable households and traditional economic sectors. The concept of a GE, and its policy implications,

[1] World Bank (2008), for example, estimated that air and water pollution in China costs in excess of 4 per cent of GDP annually.

[2] Worm and others (2006). Stocks are here defined as having collapsed where the current catch level is less than 10 per cent of the maximum registered catch.

will apply differently across countries, reflecting national circumstances and priorities. However, for developing countries in particular, widespread opportunities exist to strengthen economic development, including poverty reduction as well as food and water security in developing countries, through improved environmental and natural resource management.

This working paper explores economic policy issues relating to managing the transition to a GE, with a particular focus on fiscal instruments and public finance. Section II discusses the concept of a GE, and outlines some economic issues and principles facing policy-makers. Section III provides an overview of policy reform issues, including issues relating to the coordination of different measures. Section IV discusses the critical role of green taxes in influencing the prices of goods and services affecting environmental conditions and natural resource use, focusing on lessons from previous environmental fiscal reforms, key policy design and implementation issues, and reform priorities. Section V discusses the role of expenditure policies in promoting the transition to a GE, including green subsidies, direct government expenditure (for example on infrastructure) and the reform of environmentally harmful subsidies. Section VI offers concluding remarks.

II. Economic Issues and Principles

Economic opportunities from transition

There are likely to be significant opportunities to enhance human welfare from better management of scarce environmental and natural resources. Human activity is currently causing excessive environmental and natural resource degradation, often because households, firms and even governments[3] do not bear the full societal costs of their actions. Measures to address externality-generating activities, and reverse policy distortions affecting environmental conditions offer real opportunities for increased productivity. For instance, Ragwitz and others (2009) suggest that reforming policies to deliver the European Union's (EU) climate policy objectives could create an additional 410,000 jobs and boost GDP by approximately 0.25 per cent.

The benefits of a transition to a GE could be particularly significant where existing policy distortions are large. In agriculture, removing subsidies and tariffs to cotton alone would increase real incomes in sub-Saharan Africa by US$150 million per year (Roubini Global Economics, 2009). Distortions in fossil fuel markets, arising from annual energy subsidies valued in excess of US$500 billion, are also highly significant (IEA, 2010). An OECD (2010) study, for example, estimated that their removal could boost the global economy by around 0.3 per cent (and by more than 2.5 per cent in the case of India), and reduce global greenhouse gas (GHG) emissions by 10 per cent.

A framework for evaluating progress

However, the case for a GE is often imperfectly understood by economic policy-makers, partly due to technical challenges in its assessment. Benefits, for example from sustained biodiversity, are not valued directly by markets, and require specialized (and highly context specific) assessment techniques.[4] Evaluating policy responses is also challenging, given the typically large number of instruments bearing on environmental markets, the difficulties in assessing direct causation, and the perennial problem of comparing the changes from the policy with an unknowable baseline. The returns to key public investments, for example, in energy and transport infrastructure, are often extremely difficult to assess, given their complex effects on private consumption patterns such as car use. Large projects may also have economy-wide effects, including through lower fuel prices. A sound evaluation framework is therefore needed to guide policy towards transition to a GE.

There may be trade-offs between cyclical (short-term) and structural (long-term) policy objectives. Some traffic control measures, for example, can improve both productivity and environmental conditions relatively swiftly. Strong synergies between cyclical and structural objectives may also exist in the case of some environmental "clean up" (Strand and Toman, 2010). In other instances, there may be trade-offs: some environmental protection measures, such as climate change mitigation, may help sustain longer-term productivity, but reduce incomes and raise production costs in the short term. This renders the choice of discount rate critical for evaluating investment returns and allocating finite project and programme resources most productively.[5] A key challenge for policy makers seeking to ensure high returns to limited public resources is to properly account for potentially important long-term benefits, costs and risks. Even reversing policy distortions such as reforming energy subsidies—clearly desirable from an overall economic and environmental perspective—could raise tensions and cause economic losses in the short term if broader fiscal policies are not adjusted to help sustain incomes, particularly among poor households.

[3] The global nature of environmental challenges such as climate change generates a "free-rider" problem, which encourages globally excessive emissions levels, even when policies are optimal from a national perspective.

[4] See, for example, The Economics of Ecosystems and Biodiversity (TEEB) website http://www.teebweb.org/.

[5] Debate on the appropriate discount rate with which to appraise policies in this context followed the publication of the Stern Review (see, for example, Nordhaus (2007), Dasgupta (2007), Weitzman (2007)).

Understanding the distributional impacts of policy is critical for managing an equitable transition to a GE. The benefits of avoided environmental degradation often fall disproportionately on poor households. Over a billion people of the world's poorest people, for example, are vulnerable to unsustainable deforestation (Peskett and others, 2008). The differing distributional effects potentially warrant the use of "equity" weights in cost benefit evaluation for environmental projects and programmes. In addition, policy responses may also affect the distribution of incomes through higher product prices and shifting patterns of labour productivity,[6] with the precise effects depending on: i) the extent to which producers pass on any additional costs (although full pass through is commonly assumed, at least in the short run); ii) specific consumption and production patterns for target products (kerosene is consumed by wealthy society groups in the case of aviation, but used for lighting and heating by poor households); and, iii) evaluation timeframes (higher prices may have smaller distributional effects if viewed across an entire lifecycle, when there are greater opportunities for shifting consumption and production patterns).

Employing a set of indicators capturing different aspects of the economic transition can help encourage and evaluate progress towards a GE. A well-designed set of indicators can help measure key interactions between the environment and economy at the macro level, and guide policy management. Three principal groups of indicators relevant to the GE concept can be considered:

i) Investment, employment and output in key sectors of the green economy: Key sectors of the green economy include energy, buildings, transport, manufacturing, tourism, waste management, as well as the critical ecosystem and resource-based sectors of agriculture, forests, fisheries and water. Indicators on investments in greening these sectors and the associated share in production and employment, directly reflect policy actions, such as the share of renewables in the energy mix.

ii) Decoupling economic growth from impacts on the environment: This includes measures of the intensity of energy, resource and materials use and waste generation for specific sectors and the economy as a whole, such as with energy use per unit GDP, GHG emissions per unit GDP. These capture the outcomes or impacts of policies and investments to green key sectors.

iii) Aggregate indicators of economic progress and well being, including poverty alleviation and natural capital depreciation. A range of initiatives are investigating alternatives to traditional economic measures such as GDP as the principal compass for economic policy making and assessment. The depreciation of ecosystems and natural capital can be reflected in net savings rates, including for example an accounting of the drawdown of fossil fuel stocks (see Box 1).

UNEP is collaborating with key international partners—including EUROSTAT[7], OECD[8], UN Statistical Division[9], and the World Bank—to develop an agreed set of headline indicators suitable for measuring progress towards a GE.

Box 1: Measuring savings rates

The World Bank (2006) has developed measures of wealth and income that take resource depletion and environmental degradation directly into account. In a forthcoming analysis, the Bank identifies negative savings in excess of one per cent in around 20 developing countries, which include some major oil extractors and often highly impoverished countries with extremely low gross savings rates, highlighting the serious implications of rapid resource depletion for sustainable economic growth.

[6] Fullerton and Monti (2010) suggest that a carbon tax in the U.S. may be relatively more regressive, because low-income groups have a higher propensity to work in polluting sectors in which wages and employment levels may fall. Further empirical analysis of this issue is desirable for different countries.

[7] Among many efforts, EUROSTAT has developed a classification of environmental goods and services (EGS) within the context of the system of national accounts.

[8] See OECD (2010) on indicators for measuring green growth.

[9] The UN Statistical Division is overseeing efforts to revise the System of Integrated Environmental and Economic Accounting (SEEA) to be accepted as an international statistical standard.

III. Policy Reform Issues and Strategies

A central role for fiscal policies

Fiscal policies have an important bearing on economic growth, and their effective use is a prerequisite for transition to a GE. Delivering robust and fair economic growth is essential, particularly given the critical and urgent priority of poverty reduction and economic development in low-income countries. Fiscal stimulus measures have played an important role during the crisis, including in many instances through specific measures to promote environmental protection activities. Although difficult to demonstrate robustly in an empirical way,[10] fiscal frameworks conducive to longer-term growth are likely to feature broad-based taxation systems with few exemptions (which are often costly to administer), relatively low marginal rates (World Bank and PriceWaterhouseCoopers, 2008), and efficient public expenditure regimes. In terms of specific measures, studies generally emphasize the merits of indirect over direct taxes, and the particular risks associated with levies on financial capital.[11] Reversing wasteful and inefficient subsidies, for example to fossil fuels, is likely to be an important expenditure reform priority.

Fiscal policies are critical to fostering an efficient and fair transition to a GE, and likely form part of an efficiency enhancing tax shift that can raise revenue and promote resource efficiency. Environmental taxes and charges aimed at "getting the prices right" are essential to creating incentives for less polluting and more resource-efficient patterns of production and consumption. Expenditure measures can also be harnessed to promote the development of, and catalyze private investment in, environmental technologies, and to protect the incomes of the most vulnerable from higher product prices or shifting employment patterns. Avoiding general subsidies and other mechanisms, which undermine the relative price changes necessary to encourage transition to a GE, is an important guiding principle in this regard (also because political economy factors often make them challenging to remove).

Good fiscal policy design generally favours environmental charges over green subsidies—especially given the intense fiscal challenges in many countries. Measures to raise the cost of pollution are likely to create more effective incentives for curbing inefficient demand than green subsidies,[12] although broader tax reforms, for example to reverse preferential Value Added Tax (VAT) rates on fossil fuels, may be a sensible precursor to implementing pollution charges. Limited and temporary subsidy schemes may be justified where there are clear social spillovers, such as in the case of support to R&D in environmental technologies, or technical barriers to the implementation of alternative measures. They may also be justified to promote political support during the initial stages of reform. However, in addition to the fiscal costs of such policy choices (which fall at a time of significant budget pressures in many countries), subsidies risk encouraging rent-seeking, and the desired behavioural and investment changes are often difficult to target.

Public investment choices significantly affect the transition to a GE, particularly given important infrastructure investment anticipated in the coming years. Significant investment is likely to be required to meet projected energy demand. The vast majority of this investment will take place in developing countries, given remaining deficiencies in the quality and availability of essential economic goods and services including energy, water, sanitation and transport[13] (although capital replacement needs are also growing in many developed countries).[14] These investment choices will have a significant bearing on future patterns of economic development and environmental

[10] Numerous attempts to clarify the impact of taxation and expenditure policies on growth have been made, but the results are broadly inconclusive and not always robust, largely due to the complex relationship between fiscal policy and the macro economy.
[11] OECD (2008a) ranked the effects of different taxes on growth, suggesting that taxes on immovable property are least damaging (if levied at moderate levels), followed by consumption taxes, the personal income tax and, lastly, the corporate income tax.
[12] OECD (2004) found that the cost of displacing GHG emissions by means of subsidies tends to be considerably higher than most estimates of the associated environmental damages.
[13] Around 1.6 billion people (mostly in sub-Saharan Africa and southern Asia) still do not have access to electricity (IEA, 2008).

conditions, especially given the long-term nature of the capital stock (World Bank 2010a, Chapter 4). Over 40 per cent of GHG emissions, for example, are derived from long-lived electricity- and heat-related capital investments (Shalizi and Lecocq, 2009). Poorly designed infrastructure and other public investments can substantially diminish the responsiveness of economic behaviour to future policy reforms. There is also an opportunity to consider investment choices in developing countries that are less capital intensive and less focused on building infrastructure. For instance, the micro-lending programme of Grameen Shakti, a not-for-profit renewable energy company in Bangladesh, has offered financial packages based on installment payments to lower recurrent costs to enable households in rural communities install solar home systems. As of November 2009, more than 300,000 such systems had been installed, with at least 660 women installing, repairing, and maintaining these systems, as well as producing accessories; in addition, more than 600 youth had been trained.[15]

Wider policy strategies and coordination issues

Complementary policy measures are required, particularly where market failures limit the effectiveness of fiscal incentives. Fiscal policy measures, particularly pollution charges, are essential to creating underlying incentives for more sustainable economic activity. However, alone they are generally insufficient for a successful transition to a GE. Wider measures, including information and regulatory policies, will likely be needed. Product labels, for example, can strengthen behavioural responses to fiscal incentives by enabling consumers to distinguish environmentally friendly goods, such as sustainably caught fish or energy-efficient appliances. Direct regulation can help limit inefficiencies arising from poorly coordinated markets. Rules governing land use can be employed to encourage higher density patterns of urban development, likely to be conducive to greater environmental sustainability (World Bank 2010a, Chapter 4). They may also be used to manage secondary effects of fiscal (or other) policies, for example, by preventing illegal dumping (which may be more economically attractive after the introduction of waste charging).

…including legal and institutional reforms, often closely linked with wider priorities of "good governance"… Effective transition to a GE is likely to require a broad range of legal and institutional reforms. Strengthening property rights, for example, has an important role to play, for instance by limiting the scope for illegal logging and other natural resource exploitation activities. Stable, long-term natural resource concessions are likely to help encourage both environmental sustainability and economic development. Concessionaires may have incentives either to under-invest in extraction technologies if they fear that physical capital will subsequently be expropriated; or, alternatively, to undertake excessive resource depletion if they perceive access rights to be uncertain or temporary.[16] Effective implementation of policies affecting remotely located natural resources requires substantial investment and reform of relevant public bodies, including finance ministries, customs and revenue administrators, as well as environment ministries and agencies.

…as well as structural reforms in key markets, including energy, often characterized by imperfectly competitive patterns of supply. Structural changes may be required to promote market access, for example by renewable energy suppliers (such as through competitive power purchasing arrangements), and to enable distributors to pass on higher costs to consumers (for example, by reforming end user price regulations)—in conjunction with more systematic taxation of fossil-fuel-based alternatives. Promoting more flexible labour markets is also likely to help smoothen the

[14] The UK Department for Trade and Industry (2007) for example suggested that around 30 per cent of UK electricity generation capacity would need to be retired by 2020.

[15] See http://www.gshakti.org/.

[16] Bohn and Deacon (2000) discuss the balance of these risks across different natural resource markets.

transition to a GE, including through retraining workers in industries expected to decline in size. In response to the collapse of the North Atlantic cod stocks off the eastern coast of Canada, for example, the government introduced a community-based economic development programme to assist in short-term job creation (Ruseski, 2006).

Transition to a GE is likely to require substantial international cooperation, especially for transboundary pollutants. Climate change, for example, is a "global public bad", making broad based international cooperation fundamental to its effective control. Collective management of shared ocean fish stocks is another example where coordination between countries is essential. However, even in the case of largely national and local level environmental challenges, international cooperation is needed where policy responses induce adverse structural changes in internationally traded markets (thereby creating incentives for countries to protect their domestic industries). There is a range of fora through which international cooperation for environmental protection can be effectively promoted. First and foremost, negotiations surrounding the various multilateral environmental agreements (MEAs) provide such an opportunity. Multilateral bodies such as the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO) are likely to be heavily involved in the challenge of coordinated taxation of pollution from international transportation.

Managing distributional concerns

Fiscal policies are key to managing any adverse distributional consequences of the transition to a GE, particularly on poor households… Taxes on energy, for example, are commonly considered to be regressive, although this depends on the detailed economic circumstances (outlined above).[17] However, such effects can often largely be offset through adjustments in fiscal frameworks. Metcalf (2007), for example, shows how this can be achieved through changes to income tax credit and social security payments in the U.S. Lump sum transfers, such as winter fuel supplements to pensioners in the UK, have also been utilized. However, such adjustments need to be carefully designed to target those most affected.

…reversing environmentally harmful subsidies, and exploiting opportunities for more targeted forms of compensation, will be critical in many developing countries. Although capacity limitations affect the feasibility of some of the more sophisticated compensation mechanisms, general price subsidies to environmentally harmful or natural resource intensive goods and services—widely prevalent in many developing countries—are an expensive and poorly targeted way of supporting the poor. This is because fuel and fuel-intensive goods account for a larger share of the spending of the poor, but richer social groups spend more on them in absolute terms. There may be substantial opportunities for more targeted compensation arrangements even in countries where fiscal systems are not highly sophisticated. Fuel price increases in Indonesia, for example, were introduced in conjunction with conditional cash transfer programmes designed to increase the education and health of poor communities. Under this programme, payments were made to female household heads through local post offices on the condition that they agree to use health and education services.[18] Ghana provides another example where reduced fuel subsidies were accompanied by measures such as the elimination of school fees for primary and secondary education.

Strengthening political consensus on the costs and benefits of a transition to a GE, and a gradual approach to implementation, is likely to help facilitate effective reform. Given the ultimate importance of stakeholder buy-in, strong political consensus on the case for reform, supported by detailed analysis on the likely economic impacts, is desirable. To aid this process, some countries have, for example, established independent "Green Tax Commissions", or large-scale public consultations (OECD, 2001). A strong communication strategy is needed to reassure affected groups that they will be supported, including through the possible maintenance of subsidies that are most important to the budgets of poor households in the short term, and through the progressive redirection of funds into high-priority areas for public spending, such as health care or education. Assurances of fiscal neutrality have previously been an important component of some environmental fiscal reform processes. However, this may be less feasible and credible given the currently weak fiscal

[17] It may also be desirable to consider the distributional consequences of environmental (and other) tax reforms against alternative means of meeting public revenue needs. In this context, removing tariffs may be a more appropriate comparator in many developing countries than, say, a progressive income tax.

[18] This targeting scheme has also been used to design a community-based conditional cash transfer programme called Generasi. Hutagalung, Arif, and Suharyo (2009); Bloom (2009).

circumstances of many countries, making greater emphasis on contributing to fiscal consolidation potentially appropriate.

IV. Environmental and Natural Resource Taxation

Role and experiences of green taxation

"Green" taxes and charges are an essential element of policy frameworks to encourage transition to a GE… By increasing the relative cost of polluting goods and services, environmental taxes are a powerful policy tool for encouraging more sustainable economic behaviour. They can be levied on: natural resources extraction, such as forests, fisheries, or mineral deposits; environmentally damaging products including fossil fuels; or harmful by-products of production or consumption such as industrial pollution or waste.

…and also have sound revenue-raising potential. The OECD (2010) estimates that revenues from environmentally-related taxes amount to about 1.7 per cent of GDP on average across member countries, varying from about 0.7 per cent on average in North America to 2.5 per cent in Europe (over 90 per cent of these revenues come from taxes on fuels and motor vehicles).[19] Moreover, their full revenue-raising potential is currently untapped. The Institute for European Environmental Policy for instance estimates that countries could realistically source 15 per cent of revenues from green taxes in the medium to long term.[20] Such revenue opportunities are likely to be most robust where the tax base is inelastic to price changes, as is the case, for example, with fossil fuels.

A number of developed countries have implemented levies on polluting activities, including road transportation, energy use and waste. Denmark, Norway and Sweden are among the countries to have introduced environmentally-motivated energy tax reforms since the 1990's. However, while motor fuel excises are by far the most prevalent tax bearing on the environment, they are typically designed to meet revenue and other non-environmental objectives. Some national and local governments (for example in London and Singapore) have begun to prefer more time and location specific road access charging to more specifically target growing problems of congestion. Various forms of waste-related charges, including fees for accessing landfills, have also been levied in certain countries, such as the UK, Finland, Sweden and Denmark.

While concrete evaluations are scarce, there is growing evidence of the likely effectiveness of these environmental tax reforms:

- Barker and others (2009) concluded that energy tax reforms in some European countries improved environmental sustainability, lowering current GHG emissions by around six per cent in the case of Sweden and Finland, and by two-to-three per cent in Germany and Denmark.

- The EU implemented an Emissions Trading Scheme (ETS) in 2005. However, experiences with this innovative instrument have so far been mixed. It likely reduced GHG emissions by around 40-50 MtCO2 in 2008 (World Bank, 2009). However, supply probably exceeded demand for permits (the market was "long") in 2009, due to the effects of the economic crisis on energy demand (World Bank, 2010b).

- In road transportation, largely tax-induced increases in fuel prices in Germany were

[19] However, revenues from such taxes have generally declined slightly as a proportion of GDP. This reflects both a fall in the real value of fuel excises in a number of key countries, and the drop in demand for fuel in response to recent high oil prices.

[20] Bassi, ten Brink, Pallemaerts, and Homeyer (2009).

associated with a 13 per cent fall in fuel demand in the period 1997-2006 (Barker and others, 2009).

- Levies on waste-water effluent, and accompanying measures, are thought to have reduced water pollution in the Netherlands by nearly a half during the 1970's (Green Fiscal Commission, 2009). More recently, the Netherlands introduced high taxes on landfills. As a result, less than two per cent of household waste is disposed of in this way (compared to rates as high as 75 per cent in some other EU countries) (Green Fiscal Commission, 2009).

However, many reforms have been weakened by exemptions and rate reductions, often due to political economy concerns over adverse effects on key industries. A major concern is that environmental tax reforms will hamper some industrial producers, particularly energy intensive firms that are exposed to significant levels of international trade in materials such as aluminium, steel, paper, and cement. An OECD (2001) study shows, for example, that taxation of energy products is patchy, particularly for fuels such as coal, and includes a litany of exemptions and rate reductions for special interest groups. Indeed, the study found that tax revenues from coal, coke, heavy fuel oil and electricity production were "close to zero".

The economic impacts of environmental tax reforms are also likely to depend on how the resulting revenues are used, although empirical evidence on this point is scant. In theory, the adverse economic effects of more expensive environmentally harmful goods and services will be offset, at least partially, if revenues are used to reduce other more distortionary forms of taxation, for example on capital or labour (Goulder, 1995). Such theories have been put into practice by some countries, for instance, Finland, Sweden and the Netherlands elected to compensate households through reduced income tax rates. Denmark, Germany, and the UK reduced social security payments for employers and/or employees. In some cases, the extent of these tax swaps was relatively significant. Germany, for example, shifted around three per cent of total tax revenue away from fossil fuels in this way in the period 1996–1999 (IMF, 2008). However, there is currently limited evidence on the macroeconomic benefits of such measures, which depend on the extent to which the burden of a particular environmental charge can be shifted to factors other than labour, but this does not suggest strong employment gains.[21]

Levies on natural resource extraction have become increasingly prevalent and are a major focus for policy reform in many developing countries…

- *Forestry:* Charges on forest resources, including through concession rights, felling ("stumpage") fees, and levies on timber exports, apply in many countries. However, illegal logging and corrupt revenue management remain widespread challenges to effective poverty reduction and sustainable forest management, particularly in developing countries. Some have sought to implement fiscal (alongside regulatory and legal) reforms in response. Cameroon, for example, chose to auction, rather than negotiate privately with logging companies, long-term forest concessions in 1996 in an effort to extract greater rents and limit corruption opportunities, a trend observed in other countries, including Liberia.[22]

- *Fisheries:* Fisheries represents another sector where levies have been used. For instance, Namibia for example instituted a new policy framework during

[21] See, for example, Carraro and others (1996).

[22] In theory, provided that markets for concessions are transparent and liquid, auctioning of rights is likely to maximize revenues (although downward pressures on other taxes, such as "stumpage" fees might be expected). Secure, long-term patterns of tenure are likely necessary (to complement regulatory arrangements) to encourage concessionaries to employ more sustainable logging practices.

the 1990's to effectively manage its fish resources, which included quota- (relating to catch levels for particular species) and license-based fees. Senegal, Mauritania and Guinea Bissau are among the countries that have sought improved terms as part of international fishing agreements. Mauritania increased its financial compensation by around 60 per cent compared with previous agreements with the EU (now amounting to about 30 per cent of total public revenues) (OECD, 2005, Chapter 6).

- *Mineral and Petroleum Resources:* Many developing countries depend crucially on revenues from extractive industries. In Africa, for example, at least 70 per cent of total government revenues come from the petroleum sector in Algeria, Angola, Democratic Republic of Congo, Equatorial Guinea, Libya, and Nigeria (IMF, 2010). A number of countries sought to revise fiscal arrangements in response to the commodity price boom over roughly five years leading up to 2008. Mongolia and Zambia, for example, introduced windfall taxes on certain mineral resources during this period (IMF, 2010).

…others have also sought to implement environmental taxes, including on industrial pollution. As with developed countries, excises on fuels, particularly for road transportation, are the most widespread taxes bearing on the environment in developing countries. Petroleum taxes account for about six per cent of total revenues in Kenya, for example (GtZ, 2008). However, a number of developing countries have implemented broader environmental tax frameworks. China, for example, has developed an extensive system of charges since the late 1970's, which raised over US$ 2 billion in revenues by 1994 (OECD, 2005). Measures to discourage sulphur dioxide (SO2) emissions, including higher charges on electricity produced without desulphurization technologies, have been an important element of this framework, contributing to declining emissions of around 1.8 million tons per year annually (GtZ, 2008). World Bank (2000) identifies pollution charges as having effectively reduced industrial emissions in other developing countries, including the Philippines and Colombia.

Earmarking environmental revenues has featured widely in both developed and developing countries. The underlying objective of environment levies to change economic behaviour, together with pressures to compensate the most affected households and firms, has resulted in widespread earmarking of green tax revenues. In the U.S., for example, fuel tax revenues are principally dedicated to highway funds. In the EU, over 90 per cent of potential revenues from emissions trading have so far been transferred as compensation to firms, and half of future auction revenues are due to be allocated to funding climate change related policy goals (IMF, 2008). A range of earmarks are also observed in developing countries. Revenue from the Fisheries User Levy in Uganda is primarily used to finance sustainable fishing practices, while most environmental tax revenues in Sri Lanka are allocated to various subsidy programmes (GtZ, 2008). While such links may increase the acceptability of environmental policy reform, and help boost available resources for related public spending, their economic foundations are generally weak as tight earmarking can excessively constrain the public finances.[23]

Policy design and administration

Pollution as a tax base

A "green tax" will be more efficient the more closely targeted it is to the underlying source of the environmental damage. Environmental levies should ideally be imposed directly on pollutants, which are often not readily observable. This makes it desirable to levy on goods and services that are closely correlated with environmental damages. Taxing fossil fuels in proportion to their carbon context, for example, is likely to be an efficient base, because emissions are fixed in proportion to the volume of fuel combusted.[24] By contrast, taxing fertilizers is likely to be a relatively less efficient means of controlling water pollution since this depends also on the particular farming methods employed and would therefore require data on the volume of nitrates and other pollutants in the water run-off from individual farm holdings.

However, administrative weaknesses often necessitate the use of less well-targeted bases. Sophisticated systems of environmental taxation are generally beyond the capacity of most developing countries. Administration of certain natural resource taxes often presents significant monitoring and other

[23] Its feasibility would likely diminish if environmental taxes reached their full potential in the coming years since these would exceed a reasonable budgetary share for environmental protection measures.

[24] There might be a strong technical argument for a tax credit where emissions are sequestered, for example, using carbon capture and storage (CCS) technologies. Note, however, that CCS schemes tend to be very energy-intensive.

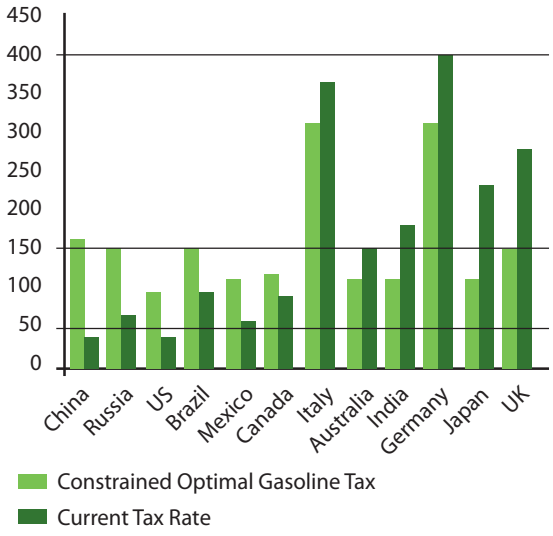
implementation challenges. In forestry, for example, it may be simpler to levy concessionary areas, and/or timber exports, rather than actual extraction through "stumpage" fees, which require close monitoring in often remote forest locations. In road transportation markets it may be more pragmatic to harness motor fuel and vehicle excises than complex road pricing arrangements to control congestion costs.[25] The UK, for example, is reforming its Air Passenger Duty so the levy more closely reflects the distance flown and incentivizes higher load factors. In the EU, governments approved a law in 2008 to include aviation in the EU-ETS starting in 2012, effectively charging airlines with operations in the EU for their GHG emissions.

Reform of administrative capacity is therefore often essential to more effective environmental fiscal reform. Local environmental agencies, as well as revenue and customs administration authorities, are often under-resourced in developing countries, hampering the effectiveness of environmental charging. Recent studies in Tanzania, for example, suggest large revenue shortfalls in both forest and fisheries sectors (Milledge and others, 2007; FAO, 2004). Enhanced revenue and customs administration capacity may also be required, for example, to reduce under-reporting of natural resource exports, and limit tax planning and evasion by firms.[26] Improved monitoring by local environment agencies is also urgently required in many countries to facilitate more effective policy design, enforcement and subsequent evaluation. Monitoring can also enable the implementation of more sophisticated "downstream" pollution charges, such as on industrial wastewater.[27] Incentives for improved enforcement, and reduced risk of corruption, may also be encouraged through the separation of monitoring and collection functions.

Determining a tax rate

Economic theory on the optimal environmental charge is often difficult to put into practice. In theory, a corrective tax should fully internalize relevant environmental costs. However, as outlined previously, these are difficult to assess in practice. A few studies have taken up the challenge: the marginal social cost of carbon, for example, is estimated to be on the order of US$15–US$60 per ton of carbon (/tC), equivalent to around US$2–US$8 per barrel of oil (although estimates by the Stern Review (2007) are much higher, on the order of US$312/tC) (IMF, 2008). For comparison, this is lower than the current EU-ETS forward for delivery in late 2010, which is around €60/tC. Figure 1 below draws on analysis by Ley and Boccardo (2010) of the optimal fuel excise for selected countries, accounting for a range of environmental and social costs (including those associated with accidents and congestion), as well as public revenues needs. They estimate that six countries, accounting for more than 40 per cent of transport oil GHG emissions, have fuel excises, which are below desirable levels.

Figure 1: Comparing current and "optimal" motor fuel taxes in selected countries, US cents/gallon.



Source: Ley and Boccardo (2010).

A potentially more pragmatic approach is to choose a tax rate sufficient to effect real transition to a GE. In the absence of rigorous and widely available assessments of the marginal social costs associated with the consumption or production of particular economic goods and services, an alternative approach is to choose a tax rate which is likely to induce desired changes in investment and behaviour.[28] In the case of climate change mitigation, for example, tax rates on the order of US$150/tC (equivalent to around US$20 per barrel of oil) are widely considered necessary to promote substitution from fossil fuels to renewable energies (Heal, 2009). Even where initial tax rates

[25] Vehicle excises and circulation taxes have no impact on marginal incentives to drive but may affect vehicle numbers.

[26] For example, through the creation of large taxpayer revenue units, with specialist capacity relating to fiscal administration of extractive industries.

[27] This typically requires collecting data on both the concentration and volume of discharges in order to avoid perverse incentives such as diluting effluent.

[28] Baumol and Oates (1989) formally establish a more limited notion of optimality, which determines the overall objective and then sets a tax to realize this at minimum cost.

are lower than the marginal costs of abatement, such levies may establish an important signal to households and firms regarding the responsibilities for, and consequences of, environmentally harmful patterns of consumption and production.

Policy-makers should also focus on strengthening a credible time path for pollution tax rates, particularly where transition to a GE requires long-term investment solutions. Environmentally sustainable forms of energy, water and other physical capital often have long payback periods, making investment choices more sensitive to future rather than present environmental (or other) tax rates. In many cases, it is desirable for pollution charges to rise steadily over time as part of a gradual transition to a GE. However, a fragile economic environment warrants some caution before implementing rapid or unexpected increases in tax rates (Jones and Keen, 2009).[29] Instilling the necessary investor confidence in stricter future fiscal arrangements is inherently challenging. The UK, for example, adopted a fuel price escalator during the 1990s, which committed to increasing the real cost of motoring each year. As a minimum, though, relevant excise rates should be indexed to preserve their real incentive value.

Choosing an instrument

Core instruments for pollution charging include taxes and cap-and-trade schemes. An environmental tax, for example, is simply one levied at a specific rate on some pollutant. Under cap-and-trade, some fixed total of emission rights is issued, and firms trade to obtain the permits they need with the price paid being serving, in effect, as the pollution charge. It is also possible to combine characteristics of the two measures, such as through a cap-and-trade with a maximum price (at which unlimited permits would be issued).

These measures are equivalent if emission rights are auctioned and the structure of abatement costs is known… Under these assumptions, the effect of a tax, on both emissions levels and revenue, can be replicated by setting the total amount of emissions under a cap-and-trade market equal to the resulting emissions under the tax. In this way, each firm will emit the same amount and the government would collect the same revenue. However, in practice, emission permits are often allocated free of charge, which means the government foregoes revenue that it would collect under a pollution tax.

…but real differences emerge when the costs and benefits of policies are uncertain. This makes it likely that policy-makers will set the tax, or the emissions cap, at the wrong level. However, the policy implications depend on the specific nature of the environmental problem, and its technological solutions. Emissions trading may be preferable for chlorofluorocarbons (CFCs), for example, because setting a cap too low would be fairly inexpensive relative to the optimal policy. This is because technical substitutes are readily available, and the scheme would likely still confer sound benefits through additional ozone protection. By contrast, too rapid a reduction in GHG emissions from energy would be expensive given currently immature renewable alternatives, as well as the potential need to scrap existing capital. Also, the environmental benefits of deeper cuts over any short time period would be limited given that the accumulated stock of GHGs contributes to climate change. Given this, economists tend to favour taxes in this latter context.[30]

…or where emissions rights are awarded free of charge, as has so far been observed. Free transfer of emission rights does not in itself diminish the incentive to reduce emissions, since the possibility of selling permits creates an opportunity cost to polluting. But the fiscal costs are significant in some cases. Tens of billions of dollars have so far been lost annually in the EU-ETS (IMF, 2008), and the levels of free transfers envisaged in previous drafts of US climate legislation could result in fiscal losses of around US$670 billion between 2011-19 (Congressional Budget Office, 2009). In addition, abatement incentives could be weakened if investments that do not contribute to reduced emissions are expected to attract larger volumes of free permits in the future.

This policy choice also has important implications for the cross-country distribution of revenues. Revenues from an emissions tax would likely be retained in the country where it is levied, commonly presumed to be the nation in which a pollutant is emitted. However, under international emissions trading, revenues would likely be raised in countries where pollution reduction is relatively cheap, through the sale of emission rights to those where it is more costly. The extent of the resulting transfers

[29] Theoretically the optimal pollution charge should rise over time if marginal damages today are lower than the average (present value) of marginal damages from future emissions. Acegmoglu and others (2009) argue that an emissions charge may only need to be temporary. However, their representation of the economy likely understates the extent of real rigidities in technology markets and the commercial advantage currently enjoyed by many brown technologies, particularly those using fossil fuels.

[30] Weitzman (1974) formalizes the argument surrounding policy efficiency under uncertainty in terms of the relative slopes of the marginal benefit and costs curves.

depends on the nature of the initial endowment of rights. The allocation of rights thus becomes a key design variable, linking both efficiency and equity for international environmental challenges such as climate change. Broad country cooperation lowers the cost of pollution controls, but this depends on individual countries having the necessary incentives (which are affected by expected value of permit sales.)

Taxes may be simpler to administer than permit markets. Pollution taxes can often be implemented using existing systems of indirect tax collection already in place in many countries. By contrast, emissions trading requires a new apparatus to administer a baseline, allocate emissions rights, and verify and enforce compliance. The EU-ETS has experienced a number of administrative challenges. Its first phase was ultimately "long" partly due to insufficient installation level data. Some of these challenges can be addressed by auctioning emission rights (largely obviating the need for detailed firm level data) and, where possible, by imposing obligations on "upstream" producers (such as oil refineries), thereby substantially reducing the number of separately regulated entities.[31]

Key green tax reform priorities

Broader and more robust taxation of major markets affecting environmental sustainability is a key objective. Steps in this direction include removing current preferential rates and exemptions on environmentally harmful goods (for example, lower VAT rates on energy products) and restructuring existing taxes to better reflect social and environmental costs. Exploiting potentially new bases for specific environmental charging is a further priority including, for example, on energy, water, waste, certain chemicals, and exhaustible natural resources.

More rational taxation of fossil fuels is urgently needed, both to limit climate change and control wider social and environmental costs. Fossil fuels are substantially under-taxed in many countries (Ley and Boccardo, 2010). Many tax systems include substantial exemptions for coal, and are unduly favourable to diesel. Raising and systemizing rates across fuel types according to their carbon content, and removing major exemptions, are therefore critical priorities. Fiscal consolidation and heightened concerns regarding climate change have prompted renewed interest in such measures. New carbon taxes have recently been introduced, or are being developed, in countries such as Iceland and Ireland, as well as in provinces such as British Colombia, and are being discussed in France and Japan. The new UK government has also proposed to reform the Climate Change Levy from an energy- to a carbon-related fiscal base.

Full auctioning of emission rights, and efforts to promote price stability, is critical where emissions trading is the preferred fiscal instrument. Realizing the full fiscal benefits of emissions trading schemes requires that rights be sold, not allocated for free. Policy-makers should consider phasing out free permit allocations, for example as part of emerging carbon markets, where these cannot be completely avoided for reasons of political economy. It is also desirable to limit price uncertainty (which causes risk averse households and firms to demand higher rates of return on investments in pollution controls) by ensuring broad sectoral coverage for any scheme.[32]

Congestion charging may be an important element of more comprehensive energy price rationalization in the longer term, particularly in developed countries. Congestion (as well as accident and other social costs) is only weakly correlated with fuel use. As relevant technologies advance, some countries may wish to implement congestion charging. Congestion charging in London is thought to have reduced the vehicle volumes by around 15 per cent in 2003-2004 (Green Fiscal Commission, 2009). The Eddington Review (2006), for example, emphasized the importance of controlling spiralling future congestion costs in the UK. This may facilitate a restructuring—and in some cases perhaps lowering—of fuel excises to focus them on the objectives they are best served to address, such as climate change mitigation.

Robust and stable fiscal frameworks to both capture resource rents, and promote investment in sustainable resource extraction, are critical in resource-rich countries… Although a greater proportion of natural resource rents are sometimes being captured by many developing countries (for example in some international fisheries agreements), in other cases the government "take" remains low. In

[31] In some markets, however, such as agriculture, compliance with GHG emissions trading would likely need to be imposed on the downstream source.

[32] EU-ETS permit prices fell by around 70 per cent between July 2009 and February 2010 (Jones and Keen, 2009).

forestry, for example, Brazil and Indonesia capture less than 15 per cent per cent of potential rents, perhaps rising to around 30 per cent per cent in Gabon and Laos (OECD, 2005). Stable fiscal terms are most likely to encourage often much-needed investment. This would tend to argue for tax frameworks that are both flexible and progressive in response to uncertain and volatile output prices and production costs. Such frameworks are achievable through direct taxation of rents and corporate profitability.

…including extending fiscal arrangements to help reduce deforestation. Deforestation, for example, accounts for around 17 per cent of global emissions and should afford cheap abatement opportunities. However, implementing incentive schemes is hard because baseline rates of emissions from deforestation are difficult to determine, while monitoring and enforcement are also problematic. Sustained efforts will be required to develop the necessary administrative capacity, and mobilize sufficient resources, including through international support. Implementing economic incentives for the Reducing Emissions from Deforestation and Forest Degradation (REDD) regime may be the best current opportunity to facilitate the transition to a GE in forestry. Successful implementation of REDD incentives could open up the prospect of new types of forest-related jobs, livelihoods and revenues, but will require compliance standards that support the co-production of local benefits with global benefits, as well as effective systems for the local control of forests, to ensure these livelihood benefits are realized. The recent pledge of an additional US$1 billion from Norway is a promising start in this regard.[33]

More effective use of environmental and natural resource charging warrants improved administrative capacity. Taxes on natural resources and environmental markets (with the exception, for example, of energy excises) are typically challenging to administer particularly for developing countries, given their remote location and monitoring and compliance requirements. Investing in the capacity of environment agencies and tax administrators is therefore an essential complement to greater and more effective use of environmental charges. Revenue collection departments in resource-rich countries, for example, likely require specialist capacity relating to extractive industries.

International tax coordination is desirable, particularly where the burden of green taxes falls heavily on internationally traded goods. Failure to coordinate environmental charges in response to global challenges such as climate change will increase the overall costs (for example, by missing out on potential gains to trade arising from international differences in the marginal costs of mitigation). Such a failure may also undermine the effectiveness of any measures due to emissions-generating activities shifting to nonparticipant countries, or because downward pressure on world fuel prices stimulates energy demand. However, even for national- and local-level environmental challenges, some degree of international cooperation is needed where the burden falls heavily on internationally traded goods (thereby creating incentives for countries to protect their domestic industries). One response to international tax competition is to seek agreement on minimum tax levels. The EU has sought to manage downward pressures on rates by adopting minimum rates, which is potentially less constraining than "tax harmonization" in that it provides some protection to countries wishing to set relatively high rates while allowing them flexibility to increase their rates. It may also have sound economic logic (differing levels of tax and market distortions may justify some variance in emissions prices across countries).

International reforms are required to promote trade in environmental goods and services, and potentially also to encourage international tax cooperation. The international trading system can have significant influence on green economic activity, enabling or obstructing the flow of green goods, technologies and investments. Renewed efforts to coordinate reduced trade barriers for environmental goods and services through the World Trade Organization (WTO) Doha Round are therefore warranted. Border tax adjustments have been raised as one option to help promote international cooperation by limiting competitiveness risks arising from differential taxation of energy (Stiglitz, 2006). However, such instruments risk being misused to disguise protectionist measures and may or may not be WTO-consistent.[34] Careful consideration of these and other detailed design issues is therefore highly desirable before determining whether to utilize such fiscal policy options.[35]

[33] Letter of Intent between the Government of the Kingdom of Norway and the Government of the Republic of Indonesia on "Cooperation on reducing greenhouse gas emissions from deforestation and forest degradation", May 26 2010. http://www.norway.or.id/PageFiles/404362/Letter_of_Intent_Norway_Indonesia_26_May_2010.pdf

[34] See WTO-UNEP (2009) for a discussion of these issues.

[35] For example, it may be difficult to assess the volume and/or value of carbon levies paid in overseas production processes, which potentially span a number of different countries. Determining the appropriate adjustment may be particularly difficult in the case of permit trading given price volatility.

Coordinated taxation of international «bunker» fuels is also a key objective. International aviation and shipping is largely uncharged for (Keen and Strand, 2007). There is little economic rationale for this anomalous tax treatment either from a fiscal or environmental standpoint. Significant international cooperation would be required to achieve coordinated taxation of aviation or shipping. In the short term, it may be desirable to reform taxes on tickets and cargo to better proxy the environmental damages associated with international transportation.

V. Green Expenditure Policies

Experiences with "green fiscal" stimulus

Environmental measures have been a valuable part of fiscal stimulus packages. Although their effects are uncertain and design-dependent, (ex ante) analysis suggests that environmental support programmes could have strong multiplier effects, and may also appeal to policy-makers to the extent that they foster domestic demand more than would, for example, general consumption or income support. Houser and Heilmayr (2009) estimate that a "green" stimulus package in the United States could produce roughly four times as many jobs as revenue-equivalent temporary tax rebates. A UNEP (2009a) study also emphasized the potential merits of environmental programmes over traditional areas of stimulus support, such as road construction or fossil fuel energy programmes.[36] However, available evidence on the effects of green programmes in developing countries is more limited. Schwartz and others (2009) find increases in direct employment arising from water and sanitation investments in Latin America.

Stimulus funding allocated to environmental goals has been significant, although actual disbursements have been slow. According to UNEP (2010), around US$188 billion in public support to clean energy has been pledged as part of fiscal stimulus plans. The US, China and the Republic of Korea account for around US$67, US$47, and US$25 billion of this total respectively. Resources have also been allocated by a number of countries to other environmental goals, such as forest restoration and improved water and sanitation provision. However, there is some evidence to suggest that actual levels of disbursement may have only been partial. For example, UNEP (2010) estimates that less than ten per cent of the total allocated funds came online during 2009 (although significantly more financing support is expected to flow during 2010 and 2011).

Nevertheless, much stimulus support has gone to brown technologies. Stimulus programmes in many countries, including the extensive package implemented by China have been heavily focused on traditional forms of infrastructure provision, particularly road building projects (for which around US$270 billion has been allocated across the G-20 (Jones and Keen, 2009)). Such expenditures would likely deliver significant structural benefits, provided projects are well-designed. But they may also perpetuate and lock in excessive levels of demand for road transport (especially given often weak fuel pricing policies), thereby constraining the future transition to a GE in the longer term.

There may be large differences in the quantity and quality of jobs created across different "green" stimulus programmes. There is currently no rigorous ex post analysis of the employment effects of specific environmental stimulus programmes. However, basic microeconomic theory might suggest a preference for supporting energy efficiency measures, which reduce energy costs, over renewable energy technologies, which are likely to increase energy prices, to the extent that government support does not fully cover production cost increases. Theory also suggests a preference for supporting certain labour intensive environmental cleanup operations, which are likely to confer some productivity benefits, including through improvements in human health (Strand and Toman, 2010). Analysis by UNEP (2009a) suggests that building insulation and other energy efficiency programmes would likely generate more employment than support to renewables. However, there may also be large differences in the stimulus benefits across particular renewables technologies. Renner, Sweeney and Kubit (2008) show that support to biomass and solar thermal industries, for example, could create more jobs than solar photovoltaics or wind programmes in China. However, it is worth

[36] Suggesting, for example, that photovoltaics create over 50 per cent more jobs than highway construction; biomass generates nearly twice as many jobs as health care; insulation programmes create nearly three times as many jobs as municipal infrastructure; and that mass transit creates more than four times as many jobs as utility programmes.

noting that the quality of the resulting jobs may also differ markedly. Employment in biomass production, for instance, is likely to be in low-skilled agriculture, with limited scope for technological enhancement and learning effects for the individual workers, while employment in solar photovoltaics (which typically requires a higher level of technological know-how) is likely to yield higher wages.[37]

From stimulus to sustainability

In some cases, climate-related stimulus spending could help smooth the longer-term transition to a GE. Energy efficiency programmes, such as measures to support improved building insulation, for example, may not only support the macro economy by lowering household energy costs (and fostering demand for hard hit construction and maintenance services), but also reduce vulnerability to future energy or emissions price increases. Market failures in the building sector, for example—including incomplete capitalization of energy-saving investments in property and rental values, due to their nontransparent nature—may otherwise continue to constrain adjustments by landlords and tenants to more rational pricing of energy.

The extent of these longer-term benefits will likely differ across countries, but are likely to be greatest for those that are more vulnerable to future supply and demand shocks as a result of large accumulated debts, inflexible product or labour markets (and so less able to adjust to price shocks efficiently), or reliance on imported fuels (particularly if sourced from politically or economically unstable markets). However, Strand and Toman (2010) emphasize that trade-offs are also likely to be common. Many investments delivering long-term environmental benefits—such as in public transport infrastructure—could have a limited short-term impact on demand, due, for instance, to long project lead times.

The implementation, and withdrawal, of environmental (as with other) stimulus measures should reflect their likely contribution to sustained growth and employment (Jones and Keen, 2009). But the environmental benefits of many programmes alone are unlikely to warrant their continued support once demand conditions are restored (see, e.g., Box 2 on the cash for clunkers measures). Careful monitoring and ongoing evaluation of these, as with all, spending programmes is therefore needed, including those in the form of tax breaks.

Box 2 : "Cash for Clunkers"

These subsidy programmes for the purchase of new cars were implemented by a number of countries, including the U.S., France, and Germany. They have done much to reinvigorate the automotive sector. However, from a purely environmental perspective, they are not a good way of realizing fuel efficiency savings (Jones and Keen, 2009). Knittel (2009) shows, for instance, that the implicit cost of reducing emissions from such programmes would likely exceed US$450/tC. Higher fuel taxes would be more effective in encouraging fewer vehicle miles, and in fostering advancements in "hybrids" and other fuel-efficient technologies.

Longer-term environmental expenditures

Infrastructure

Consideration of the environmental impacts of important public investments is critical. Significant investment in energy and other infrastructure is anticipated, particularly in developing countries, which is likely to have a powerful impact on future environmental conditions (see, for instance, Box 3 on public investment in green buildings). Energy distribution and transportation networks, for example, are likely to have a significant bearing on future patterns of economic development and environmental conditions (World Bank, 2010a, Chapter 4). Population centres with large road capacity

[37] The nature of labour market distortions differs across countries, affecting the preferences of policy makers for generating demand for particular types of employment.

and limited mass transit facilities for example will almost inevitably lead to greater dependency on private motor vehicles. Once in place, such forms of long-lived capital may not easily (or cost effectively) be adjusted at a later date, raising complex issues regarding the composition and timing of investment in the short and medium terms.

Box 3: Public investment in buildings

Given the high energy demand resulting from buildings, investing in greening the building sector can contribute significantly to energy savings and reducing CO_2 emissions. Greening the building sector can also contribute to job creation. Governments play a lead role either by investing public funds directly in greening public buildings (offices, schools, social housing, etc.), or by providing incentives – such as tax breaks or low-interest loans – to ensure that building green is not more expensive than conventional construction. Publicly-funded buildings can also showcase new technologies and environmental standards, which subsequently could be adopted or made requirements for private investments. In Brazil, where the National Electrical Energy Conservation Programme PROCEL provides funding for retrofitting government buildings, 140 GWh are saved yearly (UNEP, 2007).

Incorporating a shadow price for future environmental impacts could improve resource efficiency. This could be included as part of environmental assessments ideally taking place for both policies and major projects. EU guidance on structural funding recommends this as part of cost-benefit analysis (European Commission, 2008). In the case of climate change mitigation, for example, this implies factoring in plausible assumptions of more efficient carbon pricing in the coming years into long-term spending decisions. Although there remains some uncertainty surrounding the precise definition of "green" and "brown" infrastructure, there may be a sound economic case for adjusting the composition of some existing public expenditure, such as through greater support for mass transit over road building (UNEP, 2009), as an integral part of more environmentally sustainable urban planning.

However, additional public expenditure will also be required to cushion the environmental burden of meeting essential development needs. The World Bank (2010a, Chapter 6) estimates that enhancing the resilience of economic growth in developing countries to future climate change could cost on the order of US$75 billion per year until 2020. Although such estimates are highly uncertain, it is clear that much of this spending—perhaps in excess of one-half—is required for power, transport and water infrastructure as well as coastal protection, which are areas of the economy often heavily dominated by government involvement. The World Bank (2010a, Chapter 6) also estimates that climate change mitigation could raise financing needs of perhaps US$140 to US$175 billion per year until 2030. Even if direct government involvement in affected sectors were low, say just 20 per cent, this would nevertheless still imply additional government expenditure on the order of US$30-35 billion per year. Transfers from advanced economies are likely to be needed to help meet the costs of meeting the environmental challenges faced by developing countries. The US$100 billion per year by 2020, pledged to support climate change responses by developing countries as part of the Copenhagen Accord, could be a significant start in this regard.[38]

Currently available finance is sufficient to meet only a small fraction of these needs. The World Bank (2010a) estimates that only around five per cent of overall long-term climate financing needs are currently being met through a roughly equal mix of international carbon markets and international grants. Tax based incentives—including, for example, incentives implemented through well-functioning and broad based international carbon markets—could, if developed, mobilize private finance to meet the bulk of these costs. However, a larger role for public funding may be warranted, at least initially. Where intervention is preferred, a core policy choice is whether to undertake direct government expenditure, subsidize private investment costs, or share risks (some potential risk sharing instruments are discussed in Box 4).

[38] The "Copenhagen Accord" of 19 December 2010. http://unfccc.int/resource/docs/2009/cop15/eng/l07.pdf

Box 4: Public risk guarantees and environmental policy

Governments may generally be more risk averse than private households and firms. This makes it potentially economically rational to share some environmental and policy risks, such as through public guarantees and forms of sovereign risk transfer (public liabilities relating to environmental loans and investment activities, however, should be transparently recorded).[39] Caribbean countries for example manage hurricane risks through the Caribbean Catastrophe Risk Insurance Facility (IMF, 2008).[40] More general macroeconomic risks are likely to be a significant barrier to investment in many developing countries, for which limited private risk coverage is available. Some country risk insurance is currently publicly provided, for example though the Multilateral Investment Guarantee Agency of the World Bank, and the U.S. Government's Overseas Private Investment Corporation. This coverage could potentially be expanded to climate and other environmental investments, for instance, made under the Global Environment Facility (GEF) and other multilateral financing arrangements. Risk sharing arrangements to specific environmental policy factors could also potentially be considered on a limited and temporary basis in the case of carbon pricing. Such insurance could be restricted to situations where countries renege on legal grandfathering conditions, and support the development and implementation of stronger developing countries' actions (UNEP, 2009b).

The need for more and greener infrastructure presents particular challenges for policy-makers, given the uncertain and inflexible nature of these investments… Without significant investment in cleaner infrastructure, the priorities of both advancing human development and transitioning to a GE may be undermined. There may be strong complementarities between these two objectives, for example in the case of investments to reduce inefficiently high levels of transmission and distribution losses in many developing countries.[41] However, in other instances, tradeoffs may exist. It may be more expensive to develop a power network capable of incorporating intermittent supply sources, such as many renewable technologies. Managing these priorities is highly complex, not least given the fact that such investments are long lived and the returns are often uncertain (Pindyck, 2007). Determining the appropriate degree and timing of coastal defence investment, for example, is challenging, given the uncertainty surrounding future sea level rise due to climate change and the challenge and additional expense of making ex post adjustments to such forms of capital.

… the practical implications of these issues have not yet been properly determined. Nevertheless, it is clear that such considerations create a preference, where feasible, for gradual and flexible investment strategies. However, this is often not possible in the case of infrastructure provision, especially where there are significant pressures to improve deficiencies in the supply of public goods. In such instances, careful consideration of future environmental risks and the uncertainty surrounding these is essential. Some investments may need to be reconsidered, such as construction in low lying areas, and others adjusted, such as more efficient water systems in cases where greater resource scarcity is anticipated.

Governments can help deliver clean infrastructure and other public service needs by incorporating environmental objectives into co-financing arrangements, such as private finance initiatives. Such financing arrangements offer substantial opportunities for improving the efficiency of infrastructure and other public services provision, including the distribution of risk. Relevant assets and liabilities—including future service payments—should nevertheless be properly recorded in the public accounts. However, delivery partners may fail to consider sufficiently environmental and social priorities without explicit contractual obligations in these areas. It may also be desirable to review environmental risk exposure to the efficiency of public investments delivered through existing co-financing arrangements, for example to ensure port facilities are sufficiently equipped in the face of rising sea levels.

Sustainable Public Procurement (SPP)

Governments can help drive demand for, and advancement in, environmental technologies through SPP. The value of government purchases of goods and services is often significant, potentially

[39] For example, as part of a comprehensive statement of fiscal risks. Following Hurricane Katrina the U.S. administration proposed the inclusion of a budget line relating to the costs of future natural disasters.

[40] This risk exposure is then sold on to private capital markets through a Catastrophe Bond, in which the principal is forgiven in the event of a disaster.

[41] World Bank (1995) cited transmissions and distribution losses in China, Indonesia, and India of around 15 to 20 per cent (two-to-three times higher than most developed countries).

on the order of 5–18 per cent per cent of GDP in OECD countries (OECD, 2003). Moreover, although evidence is scant, this value is perhaps even higher in developing countries.[42] Governments can use their purchasing power to encourage innovation and improve the supply and competitiveness of environmentally and socially responsible products.

However such policies need to be carefully and gradually implemented to allow both the public administration and the suppliers to adjust to the new requirements. Most developed countries already have had for a number of years some form of sustainable procurement frameworks in place. Literature reviewing the efficacy of these frameworks indicated some basic, broadly applicable guidelines for success. Support for implementation is required at the highest level of government and may require legislative foundations.[43] Furthermore, a step-by-step approach is essential. This includes starting with a small set of important products and services, and providing specific guidance and training to procurement managers while at the same time informing the market and allowing it to adjust and upgrade the supply of sustainable products. Finally, clear evaluation frameworks are required to ensure that such policies do not lead to the exclusion of small-scale and domestic suppliers.

Subsidy reform and transition to a GE

Subsidies to consumption or production vary widely in their implications for transition to a GE. Khan and others (2006) identify three categories of subsidies: the "good", the "bad", and the "ugly" (or "ambiguous"). While the precise effects of any subsidy scheme are likely to be context- and programme-specific, this framework may nevertheless serve as a basis for considering policy reform issues. Potentially "good" subsidies include well-targeted measures to encourage sustainable activities, for example through support to R&D in environmental technologies; and measures to reduce poverty, such as support for access by low-income households to health and education services. "Bad" subsidies in this context typically lead to excessive resource exploitation and overcapacity in environmentally harmful economic sectors. They include measures to artificially lower the cost of fossil fuels or pesticides, or measures that are so poorly targeted that better value to finite public resources could clearly be achieved in other areas. "Ugly" subsidies could result in either outcome, and warrant closer examination as part of reform efforts. Examples include so-called vessel "buyback" subsidies, which could either promote fish conservation or, if poorly designed, overcapacity; or fertilizer subsidies, which may increase agricultural productivity but could also result in increased water pollution.

Green subsidies

The precise magnitude of green subsidies is unclear, but is likely to be large and rising. No comprehensive estimate on the scale of subsidies across green technologies and markets currently exists, but preliminary studies put the costs at around US$100 billion per year (GSI, 2010). Biofuels subsidies, which have been relatively well studied, are estimated to amount to around US$11 billion in 2006 in the U.S., Canada, and the EU (and are likely to rise rapidly without policy reform).[44] Support to renewable electricity is also likely to be growing rapidly in many countries. Severe fiscal pressures in Spain, for example, recently caused the government to renegotiate the terms of feed-in tariff arrangements, following accrued costs reported to be on the order of US$20 billion since 2000.[45] Increased and more transparent reporting of green (as with many other areas of) subsidies is urgently needed in order facilitate a robust debate regarding the most appropriate use of scarce public resources.

Measures to raise the cost of pollution generally create more effective incentives for curbing inefficient demand than green subsidies. The OECD (2004) found that the cost of displacing GHG emissions by means of subsidy tends to be considerably higher than most estimates of the marginal damage those emissions cause. Subsidy schemes also run the risk of inviting excessive entry by households and firms into beneficent areas of economic activity, and other unwanted strategic behaviour (for instance, by encouraging households and firms to exaggerate any costs they are exposed to). Pfaff and others (2008) found that subsidies to forest protection in Costa Rica had little effect on rates of deforestation, because payments were not targeted at locations most exposed to clearance risks—the majority of lands enrolled in the programme would have remained forested even without such payments.[46]

[42] 8 per cent of GDP in Kenya; 30 per cent in Uganda; 35 per cent in South Africa; 43 per cent in India; and 47 per cent in Brazil. Odhiambo and Kamau, (2003); IISD (2008).
[43] Perera, Chowdhury, and Goswami (2007); Bouwer and others (2005); European Commission (2004).
[44] OECD (2008b). See also Anderson (2006).
[45] GSI available at http://www.globalsubsidies.org/subsidy-watch/analysis/fiscal-deficit-forces-spain-slash-renewable-energy-subsidies
[46] Joskow and Marron (1992) for example stress the difficulty of targeting energy efficiency support to households and firms, which would not have made such investments even in the absence of support.

Furthermore, the fiscal costs of this policy choice are likely to become increasingly important, given current budget pressures in many countries. These costs can be persistent as spending measures, and tax breaks, risk becoming entrenched due to political lobbies forming around them, even though they may often lack a clear rationale as a permanent policy.

Green subsidies are justified where market barriers and positive social spillovers clearly exist… Reducing the costs of environmental protection is a key objective. The existence of barriers to technical progress has been widely used as an argument for subsidy support to early-stage environmental (and other) forms of technology. This reflects, for example, the inability of innovators to reap the full social benefits of innovation.[47] Governments have previously chosen to shape decisively the direction and accelerate the pace of technological progress in strategically important industries. Examples from the second half of the 20th century include the rapid expansion of nuclear power generation in France, the advancement of space technologies in the U.S. and former Soviet Union, and the specialization of Japan in advanced manufacturing industries.

…or where there are clear technical or political obstacles to the alternatives. In some cases, there are limits to the capacity of policy-makers to implement effective systems of pollution charging. In fisheries, for example, it is extremely difficult to monitor and enforce property rights, partly due to the remote and trans-boundary nature of the externality problem.[48] Even where it is feasible to restrict or charge for certain volumes of fish caught, this may not encourage broader sustainable fishing techniques. In such circumstances, limited and well-targeted subsidies may be warranted, in conjunction with regulatory measures, to promote more sustainable resource use, for instance to fund fisheries management (Khan and others, 2006). From a political economy perspective, it may be necessary to accompany tax-based measures with "carrots" to facilitate reform.

Where green subsidies are adopted, these should generally be temporary and their effectiveness closely monitored. Subsidies may be required in some cases because of the lack of feasible, effective alternatives, and some expectation of beneficial spillover effects. Stern (2008) for example advocates US$5 billion per year to help support commercialization of 30 carbon capture and storage (CCS) plants in the coming years.[49] The social benefits of demonstrating the viability of this potentially strategically important technology could be significant, particularly for projects in developing countries. However, the market has no incentives to deliver this technology without effective emissions pricing (since it actually reduces energy productivity) frameworks, which so far have been slow to emerge. As such, there may be a case for targeted government support to realize these benefits, while seeking to foster a more rational pricing framework in the medium and longer term. More generally, governments should limit fiscal risks, and promote value for public money, by ensuring that programmes are regularly reviewed and subject to clear "sunset" clauses which credibly provide for their dissolution. This can be achieved for instance through a cap on total spending which phases out support over time, pre-arranged operational reviews, agreed adjustment conditions, as well as caps on total spending (Victor, 2009).

Direct spending on research and development may be preferable to tax incentives for the development of environmental technologies. Although intensifying international tax competition has fuelled R&D tax incentives in many countries, there is evidence to suggest that these do increase spending on R&D and patenting.[50] However, ensuring that such expenditures promote innovation that generates social rather than private benefits is difficult. Tax reductions may also be ineffective in an environment where corporate profitability is low, and for innovative start-ups more generally. While also subject to risks of rent-seeking behaviour and inefficient divestment choices, it may be somewhat easier to direct public spending support towards areas of private innovation that confer social returns that exceed private benefits (IMF, 2008). Increasing R&D expenditure on improving crop and other agricultural yields, for example, is likely to be an important means of reducing long term pressures on land resources arising from a growing population (OECD, 2009). Reversing the significant declines in public support to basic energy R&D seen since the 1980s, and shifting its composition away from conventional energy technologies, would seem desirable in the context of tackling climate change.[51] There are also important equity considerations to

[47] However, estimates of these spillovers should take account of the likely powerful incentives for private innovation arising from robust and credible taxation of pollution.

[48] FAO (2001), for example, identifies illegal, unreported and unregulated fishing as one of the major factors that drive overexploitation of marine resources worldwide.

[49] Note that this is a controversial and highly contested technology due to safety and efficiency considerations.

[50] See, for example, Jaumotte and Pain (2005).

[51] Determining the proper extent of any R&D support is inherently difficult. However, as an indication of possible orders of magnitudes, Newell (2008) recommends roughly a doubling of U.S. energy R&D to US$8 billion per year by 2016.

R&D expenditure in agriculture: a 10 per cent rise in smallholder productivity can reduce rural poverty levels by 7 per cent in Africa and 5 per cent in Asia (Irz and others, 2001).

Subsidies to environmentally harmful activities

Environmentally harmful subsidies are fuelling unsustainable economic activity and environmental degradation, including through waste and overuse—leading to the premature exhaustion of valuable finite resources or the long-term depletion of renewable resources that support valuable economic activity. Global subsidies to fisheries for example are thought to be one of the key factors driving over-fishing (Sumaila and Pauly, 2006). Many agricultural subsidies are generally believed to intensify production, with adverse effects for water pollution.[52] Support to fossil fuels is estimated to increase global GHG emissions on the order of five-to-ten per cent (OECD, 2010).

"Brown" subsidies are expensive, and can significantly constrain transition towards a GE. When subsidization makes unsustainable activity artificially cheap or low-risk, it biases the market against investment in green alternatives. There is wide consensus that subsidies to fossil fuels, for example, pose a significant barrier to the development of renewable energy technologies.[53] In addition, the fiscal costs, while often poorly reported, are widely acknowledged to be enormous. The net global support to fossil fuels, for example, has been estimated at US$500 billion per year (GSI, 2009). Global fishing subsidies, at least 60 per cent of which have been identified as harmful, have been estimated at US$30-34 billion annually (Sumaila and Pauly, 2006).

Subsidies can be of questionable benefit to the poor… Subsidies are often created in order to transfer welfare to low-income households, but unless the aid is targeted, the majority of spending often leaks to higher-income households. Tariffs on household electricity and water consumption, for example, are set below the cost of supply in many developing countries (OECD, 2005). However, the benefits of these subsidies are often enjoyed by all consumers, and the poorest may either not have access to basic services, or share supplies with other households, so that their consumption levels exceed the "life line" thresholds for subsidized supplies. One recent review estimates that over 80 per cent of the benefits from fuel subsidies commonly go to the top three income quintiles (Arze del Granado and others, forthcoming).

….and may even be actively harmful in some cases. Failure to recoup the full costs of supplying basic services, such as water and electricity, for example, limits the capacity of governments to invest in expanding supplies to those still without access, and to achieving often much-needed improvements in service quality. Internationally, the level of government support provided to agricultural producers in OECD countries, for example, estimated at US$265 billion in 2008, is trade-distorting, causing large welfare losses in developing countries (OECD, n.d.). Similarly, half of global subsidies to fisheries are provided by developed countries, distorting prices and costs in favour of developed country fishing industries (Sumaila and Pauly, 2006).

Reform of environmentally harmful subsidies is therefore a key priority, but is challenging to achieve from both a practical and political standpoint. Subsidy reform focusing on reducing and eliminating harmful subsidies, particularly in agriculture, energy, fisheries, forests and water, is a top priority. However, careful policy implementation is needed to overcome political opposition from vested interests, and to avoid adverse distributional and market outcomes. Three key steps are here advocated:

- First, improve information regarding the magnitude and distributional consequences of major subsidy programmes using a consistent methodical approach to reporting and evaluation. Information on subsidies to both green and brown technologies, as well as access to basic services, is currently limited, particularly in developing countries. This impedes the ability of policy-makers to make effective judgments on reform priorities.

- Second, design a strategy for the implementation of subsidy reform. Designing conditional cash transfer and other income support measures is critical to off-setting the impact of subsidy reform on the real incomes of low-income groups. Reform generally needs to be phased in: for example,

[52] Mayand and others (2003) cite one study which concludes that the complete removal of agricultural domestic support would result in a 35 per cent reduction in total chemical use per hectare, and a 29 per cent reduction in fertilizer use per hectare.

[53] UNEP (2008); El Sobki, Wooders, and Sherif (2009).

expanding access to, and improving the quality of, basic services may require a series of tariff increases, aimed initially at recovering operational and maintenance costs, and subsequently aimed at recouping capital investment needs.

- Third, monitoring and review of the effectiveness and any unintended consequences of subsidy reform, in particular whether compensation policies are reaching their intended beneficiaries. Gradual reform is generally desirable, with careful attention paid to potentially unintended effects of subsidy and other policy reforms. Increasing kerosene prices, for example, may induce substitution towards burning wood, with adverse implications for both health and deforestation (Pitt, 1985). Likewise tighter fishing controls may encourage more destructive techniques, such as bottom trawling, in an effort to sustain profitability.

VI. Concluding Remarks

A Green Economy can be defined as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. Indeed, this paper has attempted to show that improved management of scarce environmental and natural resources offers significant economic opportunities – and that these opportunities are most significant where existing policy distortions are large, for example, due to the widespread subsidization of environmentally harmful activities such as fossil fuel consumption.

Realizing the opportunities from green growth and more environmentally sustainable areas of job creation has thus become an important macroeconomic policy priority for many governments. This implies substantially increased investments across a range of economic sectors that build on and enhance the Earth's natural capital or reduce ecological scarcities and environmental risks.

Encouraging the transition to a GE requires a broad range of regulatory, and information-based measures; legal and institutional developments affecting governance capacity; as well as structural reforms, for example, to key markets such as energy. However, fiscal measures are likely to be of particular importance.

Tax frameworks have a fundamental effect on the structure of incentives facing businesses and households. However, taxation in general still remains too favourable to environmentally harmful consumption or investment decisions. Implementing a broader and more robust environmental taxation scheme is therefore a key objective. A number of countries have already made positive use of environmentally related taxes, particularly for motor fuels, while levies on natural resources are also increasingly being employed especially among resource rich countries.

Public expenditure—current spending as well as capital investments in public infrastructure or R&D—also plays a critical role in shaping economic development. Ensuring an equitable economic transition, including through provision of careful and effective compensation arrangements where warranted, is another imperative of public spending. Avoiding general price subsidies, which are often inequitable, expensive, and undermine the relative price changes necessary to encourage transition to a GE, is likely to be critical in this regard.

Such a diverse range of policies will need to be carefully coordinated to ensure the measures are complementary, and do not counteract each other. Effective implementation is therefore likely to require close cooperation across different parts of government, particularly finance and environment departments, including at an international level. Building the necessary implementation capacity, including in the environment and customs and revenue agencies, is also likely to be an important dimension, particularly in developing countries.

Finally, strengthening political consensus on the costs and benefits of a transition to a GE is likely to be a critical element in effective fiscal policy reform. On the technical side, this could be supported through the development of a robust evaluation framework, including, for example, a sound set of indicators to help assess interactions between the environment and the economy, and evaluate policy progress.

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