

# A Global Green Recovery, the G20 and International STI Cooperation in Clean Energy

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## ABSTRACT

This paper makes the case that a new policy strategy to enhance a global green recovery is needed urgently. The new strategy requires two essential elements. First, G20 economies should follow the lead of South Korea and China and turn their green stimulus investments into a serious long-term commitment, and to support these investments, they should adopt environmental pricing policies and instigate pricing and regulatory reforms to reduce carbon dependency. Second, the G20 also needs to target and coordinate assistance to developing economies in science, technology and innovation (STI) for clean energy. Such assistance is essential to help developing economies to overcome the skills, technological and capital gap that they face in clean energy technologies over the long term. Reform of the Clean Development Mechanism (CDM) is also necessary to establish a long-term global price signal for carbon, and to increase the coverage of developing economies, the sectors and technologies and the overall financing of clean energy projects. Formulating such a policy strategy should appeal to both the Asian-Pacific and Western economies comprising the G20, and by working together to formulate such a strategy, the G20 could lead the way toward a new era of global economic management and STI cooperation in clean energy.

**KEYWORDS:** clean energy, Global Green New Deal, global green recovery, G20, STI

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## 1. INTRODUCTION

With concern about the slow pace of global economic recovery, policymakers should rethink their strategy, emphasizing policies for long-term innovation and sustainable economies rather than short-term measures aimed at stimulus or deficit reduction. This paper argues that the former approach is

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compatible with a complete rethink of the economic recovery – a global "green" recovery.

It has been a little more than a year since the United Nations Environment Programme (UNEP) released its Global Green New Deal – a plan to foster economic recovery and create jobs, while enhancing the livelihoods of the world's poor, and lessening carbon dependency and environmental degradation.<sup>1</sup> Initially, leaders of the Group of 20 (G20), the world's 20 biggest rich and emerging economies, seemed to embrace its ideals.<sup>2</sup> Some devoted large chunks of their financial stimuli to green projects. But most national recovery plans have not, failing to invest in the planet while saving the economy. Without a successor to the Kyoto Protocol having been forged in Copenhagen, the current global carbon treaty – which everyone agrees is insufficient to stop irreversible climate change – will expire in 2012 with no replacement in sight.

This paper makes the case that a new policy strategy to enhance a global green recovery is needed urgently. The new strategy requires two essential elements.

First, there needs to be coordinated global response led by the G20 to support the main objectives of the Global Green New Deal. It recommends an expenditure of 1% global GDP on green initiatives. G20 countries should prioritize energy efficiency and clean energy investments, and developing countries should aim to improve agricultural productivity, freshwater management and sanitation. Such investments should be accompanied by a swath of domestic and international policies – from removing perverse agricultural, fishing and energy subsidies to taxing or trading carbon emissions, instigating tax credits for low-pollution cars and other clean-energy innovations, which would finance the transfer of green technologies to developing countries and create a global carbon market through climate change negotiations.

Second, the G20 also needs to target and coordinate assistance to developing economies in science, technology and innovation (STI) for clean energy.<sup>3</sup> Such assistance is necessary to overcome the technical and market behavior that low and middle income countries face as obstacles to clean energy investment. Most developing economies lack even the minimum research and development (R&D) capacity and skilled workforce capable of attracting the transfer of many energy efficiency and low-carbon innovations. Reform and expansion of the Clean Development Mechanism (CDM) would be one important means of facilitating STI in clean energy for low and middle income countries.

## 2. THE GREEN POLICY RESPONSE

A unique feature of the global policy response to the 2008-9 recession is that, as part of their efforts to boost aggregate demand and growth, some governments adopted expansionary policies that also incorporated a sizable "green fiscal" component. Such measures were wide ranging, including support for renewable energy, carbon capture and sequestration, energy efficiency, public transport and

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<sup>1</sup> In December 2008, I was asked by UNEP to produce its Global Green New Deal strategy, which was first released in February 2009. A revised and expanded version has been published in book form; see Barbier (2010a).

<sup>2</sup> The members of the G20 include 19 countries (Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, the UK and the US) plus the EU.

<sup>3</sup> It is common to refer to the clean energy sector of an economy as comprising low carbon power and energy efficiency (Barbier 2010a,b; Pew Charitable Trusts 2009). Low carbon power includes renewable energy (geothermal, hydro, wind and solar), nuclear power, and carbon capture and sequestration. Energy efficiency includes a much more diverse range of energy-saving activities, such as energy conservation in buildings, fuel efficient vehicles and other products, public transport and rail, and improved electrical grid transmission.

rail, and improving electrical grid transmission, as well as other public investments and incentives aimed at environmental protection.

Of the \$3.3 trillion allocated worldwide to fiscal stimulus over 2008-9, \$522 billion was devoted to such green expenditures or tax breaks (Robins et al. 2009 and 2010). Almost the entire global green stimulus was by the G20, which comprise the world's twenty largest and richest countries.

FIGURE 1 Global Green Stimulus Spending, from September 2008 through December 2009

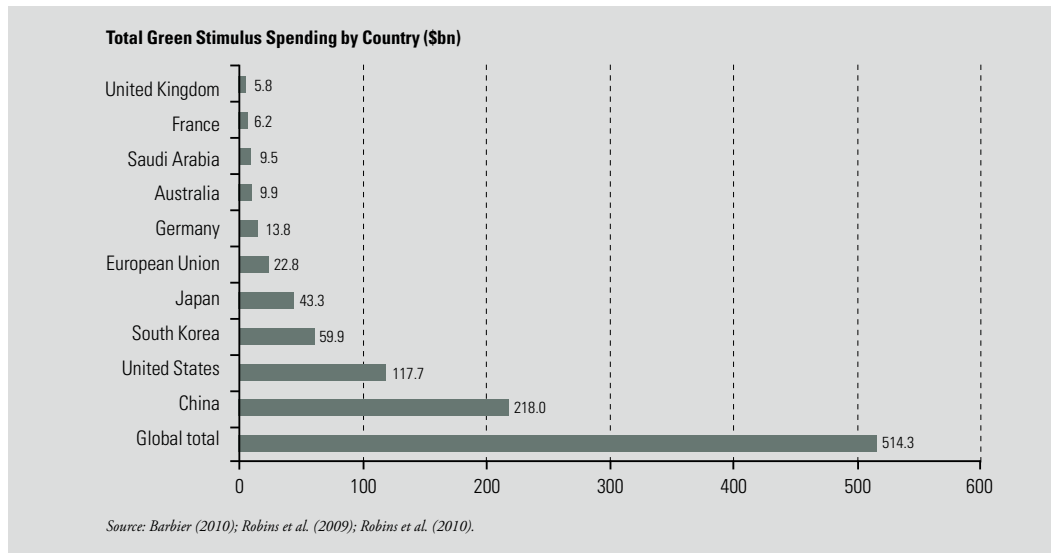
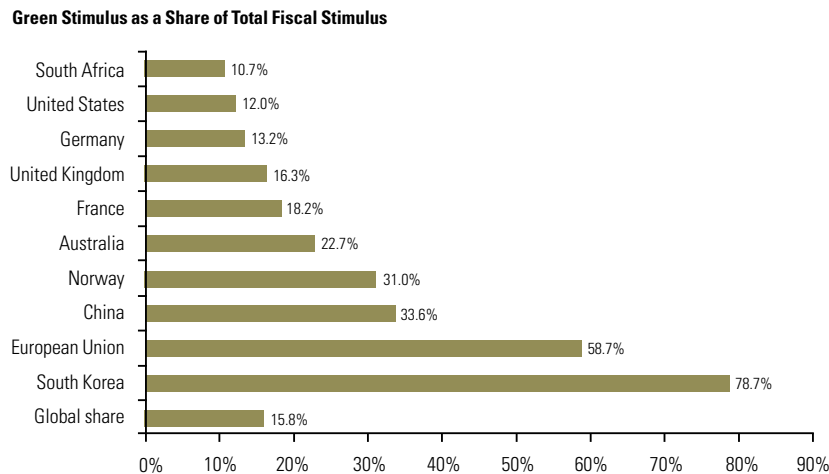


FIGURE 2 Green Stimulus as a Share of Total Fiscal Stimulus, from September 2008 through December 2009



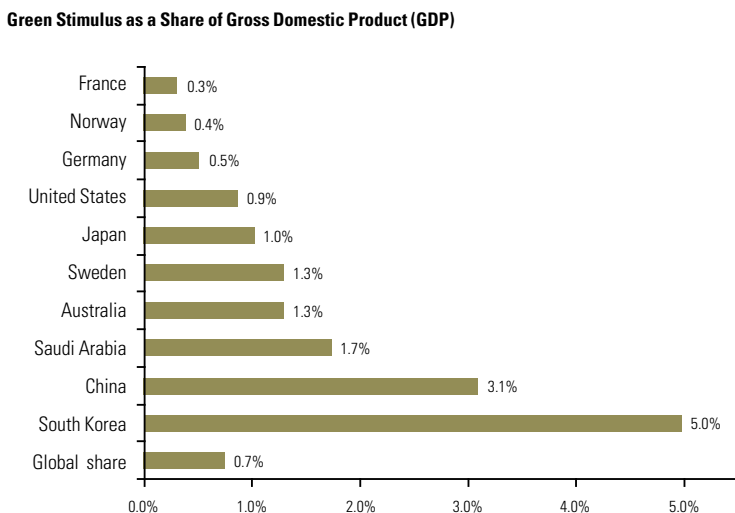
Source: Barbier (2010); Robins et al. (2009); Robins et al. (2010).

As Figure 1 indicates, the United States and China accounted for over two thirds of the global expenditure on green fiscal stimulus during 2008-9. The world's largest economy, the European Union, contributed substantially less to the global total. Total green spending by all of Europe totaled only \$57 billion; in contrast, the Asia Pacific region spent \$342 billion (Robins et al. 2010). The governments of key European economies, such as France, Germany, and the United Kingdom, spent much less on clean energy and other environmental investments than the major Asia-Pacific economies, Japan and South Korea. Several G20 governments did not commit any, or very little, funds to green stimulus, including the large emerging market economies of Brazil, India and Russia.

As shown in Figure 2, green measures and investments amounted globally to around 16% of all fiscal stimulus spending during the recession. However, only a handful of economies devoted a substantial amount of their total fiscal spending to green initiatives. The most notable is South Korea, which allocated nearly 80% of its total expenditure to green investments. China apportioned around a third of its total fiscal spending to green measures. Around 60% of the European Union's fiscal stimulus was for green investments, but as indicated in Figure 1, the overall size of this investment was relatively small. In comparison, whereas the United States total expenditure on green stimulus was large, it comprised only 12% of total fiscal spending. Overall, most G20 governments were cautious as to how much of their stimulus spending was allocated to low-carbon and other environmental investments during the 2008-9 recession.

Perhaps most revealing, however, was the share of green stimulus measures in gross domestic product (GDP), as illustrated in Figure 3. Very few governments spent 1% or more of GDP on green investments during the recession. With the exception of Sweden, all these countries were from the Asia-Pacific region. Large-scale green stimulus programs, such as the 5% of GDP planned by South Korea and the 3% of China, were the exception rather than the norm. The United States spent 0.9% of GDP on green stimulus, more than the global average, but the European Union spent only 0.2% of GDP.

FIGURE 3 Green Stimulus as a Share of GDP, from September 2008 through December 2009



Source: Barbier (2010); Robins et al. (2009); Robins et al. (2010).

### **3. WHY GREEN STIMULUS MEASURES ARE NOT ENOUGH**

However, relying on green stimulus alone is not enough to instigate a global "green" recovery (Barbier 2010a and 2010b). Fossil fuel subsidies and other market distortions, as well as the lack of effective environmental pricing policies and regulations, will diminish the impacts of G20 green stimulus investments on long-term investment and job creation in green sectors. Without correcting existing market and policy distortions that underprice the use of natural resources, contribute to environmental degradation and worsen carbon dependency, public investments to stimulate clean energy and other green sectors in the economy will be short lived. The failure to implement and coordinate green stimulus measures across all G20 economies also limits their effectiveness in "greening" the global economy.

Finally, the G20 has devoted less effort to assisting developing economies that have faced worsening poverty and environmental degradation as a result of the global recession. Nor has the G20 taken a leadership role in facilitating negotiations towards a new global climate change agreement to replace the Kyoto Treaty that will expire in 2012.

In sum, more than ever, the world needs a global green recovery, and it needs the G20 to implement and coordinate this strategy.

### **4. THE NEED FOR A GLOBAL GREEN RECOVERY**

There are several reasons why such a worldwide policy initiative is urgent.

First, the global recession will not diminish the costs of climate change and energy insecurity. The 2008-9 recession was preceded by a surge in global energy prices, with the price of oil reaching \$150 a day in July 2008. Due to rising energy costs, prices for food traded internationally increased almost 60% during the first half of 2008, with basic staples such as grains and oilseeds showing the largest increases.

The International Energy Agency (IEA 2008) estimates that, once growth resumes, fossil fuel demand will rise by 45%, and the oil price could reach \$180 per barrel. The remaining oil reserves will be concentrated in fewer countries, the risk of oil supply disruptions will rise and oil supply capacity will fall short of demand growth. Greenhouse gas (GHG) emissions are likely to increase by 45% to 41 gigatonnes (Gt) in 2030. If atmospheric concentrations of GHG lead to 5-6°C warming, GDP could fall by 5-10% globally, and by more than 10% in developing economies (Stern 2007).

Second, the right mix of investments and policies today could not only reduce carbon dependency and improve the environment, but also create jobs and stimulate innovation and growth in key economic sectors.

But perhaps the most important contribution of a green recovery to the world economy is that it may help alleviate global imbalances (Barbier 2010a and 2010b). A global green recovery strategy of reducing carbon dependency and improving energy security may help to control both the large current account deficits incurred by major oil-importing economies, such as the United States, or even smaller economies that are facing chronic debt crises, such as Greece, Portugal and Spain. Globally, such a strategy would also reduce the trade surpluses of fossil fuel exporting economies.

### **5. IS THE ASIA-PACIFIC REGION TAKING THE LEAD?**

Certainly, the recovery policies adopted by China and South Korea reflect the belief that investments

in clean energy technologies can have a major impact on growth, expanding exports, and creating employment.

For example, one reason that China has adopted green fiscal measures is that its renewable energy sector already has a value of nearly US\$17 billion and employs close to 1 million workers. Other green initiatives included promoting fuel-efficient vehicles, rail transport, electricity grid improvements, and pollution control. China has also raised taxes on gasoline and diesel and reduced the sales tax on more fuel-efficient vehicles. In addition, China is the world's largest recipient of carbon emission reduction credits under the Clean Development Mechanism (CDM), currently earning US\$2 billion from these credits. Overall, China views promotion of green sectors as sound industrial policy; it aims to be the world market leader in solar panels, wind turbines, fuel-efficient cars, and other clean energy industries.

South Korea also sees its industrial strategy tied to green growth. In addition to the Green New Deal, the South Korean government plans to establish a US\$72.2 million renewable energy fund to attract private investment in solar, wind and hydroelectric power projects. In July 2009, South Korea launched a five-year Green Growth Investment Plan, spending an additional US\$60 billion on reducing carbon dependency and environmental improvements, with the aim of creating 1.5-1.8 million jobs and boosting economic growth through 2020.

Although the role of any sustained global green recovery in reducing the chronic trade surpluses in Asian and other emerging market economies is more complex, a necessary step will be to rebalance the pattern of economic growth in these economies to absorb more of their savings domestically. Most policy prescriptions advocate moderating the excessive reliance on exports and export-promoting investments, and instead expand imports of capital goods for key sectors with future growth potential and shifting industrial output structure away from labor-intensive goods to skill, capital and technology-intensive production (Cline 2009; Feldstein 2008; Park and Shin 2009). Such an approach may actually be helped by key elements in a global green recovery strategy (Barbier 2010a and 2010b).

In contrast to the apparent commitments of South Korea, China and the Asia-Pacific region generally, the highly publicized "green" policies of the United States enacted during the 2008-9 recession look less substantial. For example, the February 2009 US\$787 billion American Recovery and Reinvestment Act included around US\$78.5 billion to retrofit buildings, expand mass transit and freight rail, construct a "smart" electrical grid transmission system and expand renewable energy supply. It was suggested that these green stimulus measures could create up to 2 million new jobs over the next few years. However, the original plan called for a comprehensive cap-and-trade system to limit CO<sub>2</sub> emissions and the removal of fossil fuel subsidies to finance and improve the effectiveness of green sector investments (Podesta et al. 2007). So far, these additional policies have failed to materialize, and without them, the current stimulus to private investment and job creation in green sectors may be largely temporary.

Unfortunately, this outcome could be the norm. Without additional policy measures, some of the recent upsurge in global green spending by the G20, including its Asia-Pacific members, will ultimately go to waste: its impact on long-term investment and job creation in green sectors will be restricted by ongoing fossil fuel subsidies and other market distortions, as well as the lack of effective environmental pricing policies and regulations (Barbier 2010a; Strand and Toman 2010). For example, many clean energy investments are still too costly compared to conventional energy sources. Fossil fuel subsidies further distort this cost competitiveness. The lack of policies and regulations to include the costs of carbon emissions and pollution also artificially lowers the market price of using

conventional energy. Evidence from the United States suggests that such "direct emission" policies are critical for spurring private investment and induced technological change in clean energy sectors (Goulder 2004).

Perhaps the biggest failing is that neither the G20 nor its Asia-Pacific members have promoted a green recovery globally. Compared to domestic fiscal spending, the G20 has devoted less effort to reducing the economic and environmental vulnerability of the world's poor. As a result of the food and fuel crises prior to the 2008-9 recession, the annual cost of lifting the incomes of all of the poor to the poverty line rose by \$38 billion or 0.5 percent of developing country GDP (World Bank 2009). Aid flows for improved water and sanitation would need to double, rising by US\$3.6 to US\$4 billion annually, to bring within reach the Millennium Development Goal of halving the proportion of the population without these services by 2015 (UNDP 2006). Nearly \$15 billion in development assistance is required by developing countries if they are to adopt hybrid and alternative fuel vehicles, improve the efficiency of all motorized transport and develop second-generation biofuels (UNFCCC 2007). To adapt to the impacts of climate change, developing countries are estimated to need around \$15 to \$30 billion in additional development assistance from 2010 to 2020 (Project Catalyst 2009).

The continuing stalemate on climate negotiations before and after Copenhagen is also a failure of global governance by the G20. By not taking a leadership role in facilitating international talks to replace the Kyoto Treaty that expires in 2012, the G20 is prolonging the uncertainty over future global climate policy. The delay caused by inaction sharply increases the costs of an agreement to reduce global greenhouse gas emissions and puts at risk the global financing of carbon-reducing projects and clean energy investments in developing economies.

The Toronto G20 summit of 26-27 June 2010 was also notable more for its emphasis on reducing deficits and long-term debt than in promoting a global green strategy. For example, the Summit Declaration stated that "advanced economies have committed to fiscal plans that will at least halve deficits by 2013 and stabilize or reduce government debt-to-GDP ratios by 2016." Moreover, as an example of the new policy commitment the G20 Summit Declaration states: "Recognizing the circumstances of Japan, we welcome the Japanese government's fiscal consolidation plan announced recently with their growth strategy." No mention is made in the Leaders' Declaration of the green stimulus packages and growth strategies adopted by South Korea, China, Japan and other Asia-Pacific members.<sup>4</sup>

## 6. PROMOTING A GLOBAL STRATEGY

However, there are several reasons why the Asia-Pacific members of the G20 should use their considerable influence to urge the entire G20 to promote a global green recovery.

For one, a global green recovery is one area of potential great complementary interests among all G20 economies, which could prove to have additional lasting benefits in terms of promoting global economic cooperation. As pointed out by Gu et al. (2008, p. 288), "it would be important to identify global governance arenas characterized by level playing fields (like the WTO) and converging or at least complementary interests between China and Western countries, to make rapid progress in reducing mistrust and bringing forward cooperative patterns of interaction."

But, equally important are the multiple global economic benefits that arise from concerted action

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<sup>4</sup> From "The G-20 Toronto Summit Declaration June 26-27, 2010". Available at [http://g20.gc.ca/wp-content/uploads/2010/06/g20\\_declaration\\_en.pdf](http://g20.gc.ca/wp-content/uploads/2010/06/g20_declaration_en.pdf).

by the G20, both within their economies and through assistance to developing economies.

With the right policies supporting it, green spending can be effective. It has been estimated that every \$1 billion invested in energy efficiency and clean energy in the US could eventually generate energy savings of \$450 million per year, reduce annual GHG emissions by 592,600 tons by 2020, and lead to approximately 30,000 job-years – a 20% increase in job creation over more traditional fiscal stimulus measures such as income tax cuts or road building (Houser et al. 2009). In China, every \$14 billion of public green investment is expected to increase household consumption by \$8.6 billion and tax revenues by \$143 million, with 600,000 new jobs created (UNEP 2009).

In developing economies, every \$1 invested in improving the energy efficiency of electricity generation saves more than \$3 in operating costs (ESCAP 2008). Small hydropower, biomass and solar photovoltaics (PV) already provide electricity, heat, water pumping and other power for tens of millions of people in many rural areas. Developing economies currently account for 40% of existing global renewable resource capacity, 70% of solar water heating capacity and 45% of biofuels production (REN21 2008). Expansion of these sectors may be critical for increasing the availability of affordable and sustainable energy services for the billions of poor households in these economies currently without access to these services.

G20 economies should therefore follow the lead of South Korea and China and turn their green stimulus investments into a serious long-term commitment. If the G20 economies coordinated the timing and implementation of these investments and policies, the cumulative impact on increasing economic growth and employment, while saving carbon, would have a significant global impact. Together these economies account for almost 80% of the world's population, 90% of global gross domestic product (GDP) and at least three quarters of global greenhouse gas emissions. In addition, with the right policies supporting them, existing green stimulus packages already adopted by G20 governments could increase G20 GDP from 0.7% to 2.2%. But, coordination of these stimulation packages and policies would increase G20 GDP even further, from 1.1% to 3.2% (Barbier 2010a).

To support the public green investments, the G20 should adopt environmental pricing policies, whether through cap and trade or taxes, that would ensure that carbon and other pollutants, as well as water and scarce ecological resources, are no longer 'free' to use by their economies. They should also instigate pricing and regulatory reforms for reducing carbon dependency, including removing perverse subsidies and other distortions in energy, transport and similar markets. Globally, fossil fuel consumption subsidies amounted to \$557 billion in 2008 (IEA/OPEC/OECD/World Bank 2010). Production subsidies accounted for an additional \$100 billion. Together, these subsidies account for roughly 1% of world GDP. Phasing out these subsidies by 2020 could result in a 5.8% reduction in global primary energy demand and a 6.9% fall in greenhouse gas emissions. The financial savings could be redirected to investments in clean and renewable energy R&D and energy conservation, further boosting economies and employment opportunities.

However, the main reason for instigating environmental pricing policies should be the removal of perverse incentives. For example, Table 1 indicates that one of the key barriers to widespread adoption of clean energy measures over the long term is energy-related price distortions, which artificially lowers the cost of inefficient energy use and technologies. Energy efficient measures and clean energy technologies that would otherwise be cost-effective still face a competitive market disadvantage. The perverse incentives arising from such distortions will continue to be an obstacle to any long run strategy for energy efficiency.



TABLE 1 Barriers to Implementing Cost-Effective Clean Energy Policies

Category	Barrier	Key problem associated with barrier	Necessary condition
Information and behavioral barriers	Price distortion	Costs associated with energy and incumbent technologies may not be included in their prices; energy and incumbent technologies may be subsidized	Remove price distortions and subsidies; apply appropriate market-based instruments.
	Information	Information on availability and nature of an energy efficient product is not easily available or accessible at time of investment	Improve accessibility and availability of information on energy efficient products.
	Transaction costs	Perceived costs involved in making a decision to purchase and use equipment outweigh perceived benefits	Reduce transaction costs.
	Bounded rationality	Constraints on time, attention, and the ability to process information lead consumers to make less efficient and sub-optimal decisions	Reduce the constraints on consumers' decisions.
Market organization barriers	Finance	The initial cost of a project may be higher than the finance threshold; poor or constrained access to funds.	Enhanced access to finance.
	Inefficient market organization	Principal agent problems; established companies may have market power to guard their positions.	Enhanced access to finance; better market organization; better designed policies.
	Poor regulation at national or international level	Regulations and codes not keeping pace with development or leading to inefficient outcomes.	Improved regulatory framework, standards and implementation.
Technological barriers	Capital stock turnover rates	Sunk costs; tax rules or regulations that encourage long depreciation; inertia	Improve incentives to invest in energy efficient new capital.
	Uncompetitive market pricing and practices	Failure to benefit from scale economies, learning by doing, technological diffusion	Regulation and reform of uncompetitive pricing practices; improve scale economies, learning by doing and technological diffusion.
	Technology and skill-specific barriers	Lack of familiarity with energy efficient technology or insufficient human skills for that technology	Enhance skills and technical know-how.

Source: Adapted and modified from Jollands et al. (2010).

Economy-wide pricing and regulatory policies have an important role to play in promoting long-run technological innovations that are necessary for low-carbon investments and improved energy efficiency in an economy. Carefully targeted public investment, especially in support of R&D and other complementary infrastructure, not only boost shortfalls in private investment during a credit-constrained recession, but also have the capability of inducing technological innovation necessary for widespread adoption of low-carbon power and energy efficiency in the economy. But, "technology-push policies", such as research and development (R&D) subsidies, public investments and other initiatives, mainly deal with one type of market failure that affects induced innovation in low carbon technologies and energy efficiency. That market failure is the inability of private investors' to appropriate all the knowledge gains generated by R&D. A second market failure stems from the climate change externalities associated with the combustion of fossil fuels and other economic activities that generate greenhouse gas (GHG) emissions. Public investments and expenditures in support of private R&D cannot address this second market failure. Instead, technology-push policies and investments must be supplemented by "direct emissions" policies, such as carbon pricing, to ensure that GHG-generating activities take into account climate change externalities. Both types of policies – direct emissions and technology-push measures – are necessary to promote induced technological change and energy saving by the private sector in the long run.<sup>5</sup>

<sup>5</sup> The terms "technology-push" policies and "direct emissions" policies are from Goulder (2004).

Studies for reducing greenhouse gas emissions in the United States, Europe and other OECD economies show that combining the two policies substantially lower the costs of meeting targets compared to relying just on a technology-push approach, such as a R&D subsidy for low-carbon energy options and energy efficiency (Blesl et al. 2010; Fischer and Newell 2008; Goulder 2004; IEA 2009a and 2009b; Pew Charitable Trusts 2009; Popp 2010). Although the optimal portfolio of policies invariably includes some form of emissions price and subsidies for technology R&D and learning, carbon pricing and direct emissions policies are generally the most efficient policy option if only a single economy-wide policy can be adopted. For example, Fischer and Newell 2008, p. 160) conclude from their analysis of the US electricity sector: “We find that for anything beyond very small emissions reduction targets, the emissions price is the most efficient single policy for reducing emissions, since it simultaneously gives incentives for fossil energy producers to reduce emissions intensity, for consumers to conserve, and for renewable energy producers to expand production and to invest in knowledge to reduce their costs.”

As the dominant sources of international aid, the G20 should also mobilize international policy in support of the Global Green New Deal. For example, collectively the G20 could help secure a post-Kyoto global climate change framework by, first, agreeing the broad outline of such a framework among themselves, including a realistic aid package for adaptation and mitigation funding for developing economies, and second, finalizing the framework through negotiations with the international community. In addition, the G20 should foster a global aid strategy that provides social safety nets, vulnerability funds, sustainable agriculture assistance, improved water and sanitation, and payments for ecosystem services targeted to the poorest of the poor in developing economies.

## **7. STI ASSISTANCE IN CLEAN ENERGY TO DEVELOPING ECONOMIES**

But perhaps the most important source of assistance that could be provided by G20 economies is enhanced science, technology and innovation (STI) aid to developing countries.

In developing economies, many clean energy investment projects with favorable internal rates of return remain unfunded because of the lack of effective financing programs and delivery mechanisms. What is needed is usually a combination of additional technical and financial support for investments that can either realize the potential efficiency gains or achieve operating cost savings. Inadequate financing is a persistent problem not only in low income countries but also emerging market economies in Asia, including China and India (Battacharya and Cropper 2010; Carmody and Ritchie 2007; Chandler and Gwin 2008; Taylor et al. 2008; Zhou et al. 2009). The factors often cited for the lack of financing and delivery mechanisms for energy efficiency in developing economies are the market organization and technological barriers listed in Table 1.

In order to implement widespread and effective energy efficiency interventions, many developing economies will require substantial assistance in overcoming the skills, technological and capital gap that they face. This gap is the principal cause of the market organization and technological barriers (identified in Table 1) that lead to underinvestment in clean energy projects that have favorable rates of return. Targeting and coordinating development assistance in these STI areas should therefore be a priority for the United States, European Union and other major aid donors to improve the adoption of energy efficiency in low income and emerging market economies.

For example, many developing economies face a serious “capital gap” in private and public financial investments that will constrain them from implementing a long-term clean energy strategy. Access to financing is a major constraint if developing economies are expected to invest in such a strat-

egy. Even before the current economic crisis, official development assistance contributed US\$5.4 billion annually to all energy projects worldwide, which is below the estimated US\$8.3 billion in annual low carbon energy investments needed just for the Asia-Pacific region and the \$30 billion required for all developing regions (ESCAP 2008; Wheeler 2008). In some large emerging market economies, notably in Asia, sufficient capital is available from the private sector, both in terms of private investments within developing countries and financing from global and regional capital markets, but only if there is a stable regulatory framework for investment in the developing economy, favorable market conditions and incentives, and reduced uncertainty regarding the long-term price signal for carbon (Carmody and Ritchie 2007; Taylor et al. 2008; ESCAP 2008).

In addition to the “capital gap”, there is also a substantial “skills and technological gap” for low and middle income economies in adopting energy efficiency and low-carbon technologies. Many developing economies spend little on research and development (R&D) on these technologies and have a chronic shortage of workers with the complementary skills necessary to develop and apply low-carbon technologies. Instead, most low and middle income countries, with the possible exception of China, India and perhaps a few other large emerging market economies with some domestic capacity in some clean technologies, are highly dependent on the importation and transfer of technologies and skills developed elsewhere. It is recognized that the transfer of new technologies and skills facilitates the development of an indigenous technological capacity and workforce that enables future innovations and long-term adoption of low-carbon technologies. But, most developing economies lack even the minimum R&D capacity and skilled workforce capable of attracting the transfer of many energy efficiency and low-carbon innovations (Ockwell et al. 2008).

The Clean Development Mechanism (CDM) is increasingly viewed as an important mechanism for solving some of the constraints to reducing the carbon dependency of developing economies (Barbier 2010a). Certainly, the CDM has achieved success in securing the financing and transfer of energy efficiency and other low-carbon technologies in developing countries, and above all, in effectively creating a global trading market. There are concerns, however, about the ability of the current system to establish a long-term global price signal for carbon.

First, its projects tend to be concentrated in a handful of large emerging market economies, such as China, India, Brazil and Mexico. Low-income economies and particularly Sub-Saharan African countries host very few CDM projects.

Second, most of the expected certified emission reduction (CER) credits earned by 2012 are from mainly large-scale projects, such as incineration of greenhouse gases, grid-connected renewable electricity generation, fuel switching, reducing transmission losses, and capturing fugitive methane emissions. Important sectors, such as transportation, building and construction, afforestation and reforestation, small-scale rural energy projects and energy efficiency, are poorly represented in the current CDM project portfolio.

Third, although the pipeline of projects coming through the CDM has increased, the scale of the mechanism needs to be increased, so that it can deliver significantly greater finance and emission reductions globally. In addition, scaling up may require a much simpler and more transparent mechanism, such as sectoral benchmarks that enable entities to receive CER credits for achieving a targeted emissions intensity per unit output or technological benchmarks, which would allow the inclusion of new techniques, such as carbon capture and storage, second-generation biofuels or simple home photovoltaic solar systems.

A variety of proposals have been suggested for scaling up and reforming the CDM, increasing its coverage of countries to more low-income and Sub-Saharan economies and including more sectors

and technologies in the mechanism, including energy efficiency (Collier et al. 2008; Hepburn and Stern 2008; Lloyd and Subbarao 2009; Olsen and Fenhann 2008; Schneider et al. 2008; Wheeler 2008). Such ideas should help the international community agree on the best way to extend the CDM and global carbon market beyond 2012, preferably as part of a global climate change agreement, and to include reforms of the mechanism to increase the coverage of developing economies, the sectors and technologies and the overall financing of clean energy projects.

## **8. FINAL REMARKS**

Global policymakers have two choices they can make in response to the lingering economic effects of the recession. Either they can continue to debate the pros and cons of various short-term measures, such as fiscal stimulus or deficit reductions, or they can embark on a long-term strategy to foster a more sustainable and innovative recovery. A Global Green New Deal falls into the latter category.

As argued in this paper, a global green recovery is more than simply devoting additional stimulus to support clean energy projects and other environmental improvements. It also requires a comprehensive approach to tackling the price and other distortions in the economy that prevent long-term investments in clean energy and other green sectors. As China, South Korea and the Asia-Pacific region in general have shown, investments in clean energy technologies can have a major impact on growth, expanding exports, and creating employment. Green growth also makes for a sensible long-term industrial promotion strategy.

But, Asian economies have failed to translate their domestic economic interest in clean energy and green growth into leadership in the international arena, especially through the G20. Commentators have suggested several reasons for this reticence. For example, China and other Asian-Pacific emerging economies are more likely to pursue national green growth strategies as a way of reassuring the West about its overall development strategy, especially with regard to global energy and resource use, but in turn, Asian countries may still be uncomfortable with the global environmental agenda, which is still seen as Western-led (Gu et al. 2008; Kaplinsky and Messner 2008; Richerzhagen and Scholz 2008). As pointed out by Kaplinsky and Messner (2008, pp. 201-202), "the huge natural resource hunger and energy needs of China and India will in the future serve to place the issue of sustainability squarely back on the agenda of global politics and development policies", and as a result, "the flip side of the discussion on sustainability and global climate change is the renaissance of geo-economics and geo-politics: competition between the 'old' and 'new' global powers for energy and resources in Africa, Latin America, Central Asia and Russia." Pushing for a global green recovery agenda may therefore focus more attention, rather than less, on the growing demand and use of global energy and resources by the Asia-Pacific Region.

But, a global economic crisis requires new thinking in geo-politics as well as geo-politics. As suggested in this paper, a global green recovery is one area of potential great complementary interests among all G20 economies, which could prove to have additional lasting benefits in terms of promoting global economic cooperation. One area of important cooperation is on STI assistance for clean energy. Both low-income and emerging market economies face substantial technical and financial barriers that lead to the underfunding of many energy efficiency investment projects with favorable internal rates of return. There are two ways in which the international community can help alleviate this bottleneck. First, major aid donors should target their assistance to developing economies to overcome the skills, technological and capital gap that they face in implementing clean energy measures over the long term. Second, reform of the CDM is necessary to establish a long-term global

price signal for carbon, and to increase the coverage of developing economies, the sectors and technologies and the overall financing of clean energy projects.

Formulating the global green recovery strategy outlined in this paper should appeal to both the Asian-Pacific and Western economies comprising the G20. By working together to formulate such a strategy, the G20 economies could lead the way toward a new era of global economic management and STI cooperation in clean energy.

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