Rethinking the Economic Recovery:

A Global Green New Deal

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Executive Summary

Global Crises

In 2008, the world was confronted with multiple crises – fuel, food and financial. The result of these crises has been the worst global economic recession since the Great Depression of the 1930s. In 2009, for the first time in decades, the volume of world trade is projected to decline as global per capita income contracts.[1] The number of unemployed globally could rise this year by between 18 million and 51 million over 2007 levels.[2] Every 1 per cent fall in growth in developing economies will translate into an additional 20 million people consigned to poverty.[3]

Faced with the social and economic consequences of a deepening world recession, it may seem a luxury to consider policies that aim to reduce carbon dependency and environmental degradation. Such a conclusion is both false and misleading.

Opportunity from Crisis

The multiple crises threatening the world economy today demand the same kind of initiative as shown by Roosevelt's New Deal in the 1930s, but at the global scale and embracing a wider vision. The right mix of policy actions can stimulate recovery and at the same time improve the sustainability of the world economy. If these actions are adopted, over the next few years they will create millions of jobs, improve the livelihoods of the world's poor and channel investments into dynamic economic sectors. A "Global Green New Deal" (GGND) refers to such a timely mix of polices.

An expanded vision is critical to the lasting success of a world economic recovery. Reviving growth, ensuring financial stability and creating jobs should be essential objectives. But unless new policy initiatives also address other global challenges, such as reducing carbon dependency, protecting ecosystems and water resources and alleviating poverty, their impact on averting future crises will be short-lived. Without this expanded vision, restarting the world economy today will do little to address the imminent threats posed by climate change, energy insecurity, growing freshwater scarcity, deteriorating ecosystems, and above all, worsening global poverty. To the contrary, it is necessary to reduce carbon dependency and ecological scarcity not just because of environmental concerns but because this is the correct and only way to revitalize the economy on a more sustained basis.

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[1] World Bank. 2009. *Global Economic Prospects 2009.Commodities at the Crossroads.* The World Bank, Washington DC. United Nations. *World Economic Situation and Prospects 2009.* United Nations, New York.

[2] International Labor Organization (ILO). 2009. *Global Employment Trends January 2009.* ILO, Geneva. International Institute of Labour Studies, ILO. 2009.

[3] World Bank. "Global Financial Crisis and Implications for Developing Countries." Paper for G-20 Finance Ministers' Meeting. São Paulo, Brazil. November 8, 2008.

Business As Usual Growth

Once a business-as-usual growth path resumes:

- Global energy demand will rise by 45 per cent by 2030, and the price of oil is expected to rise to US$180 per barrel.
- Greenhouse gas (GHG) emissions will increase by 45 per cent by 2030, leading to an increase in the global average temperature up to 6^{o}C.
- The world economy will sustain losses equivalent to 5-10 per cent of global gross domestic product (GDP) and poor countries suffer costs in excess of 10 per cent of GDP.
- Ecological degradation and water scarcity will increase.
- There will be over 1 billion people living on less than US$1 a day and 3 billion living on less than US$2 a day by 2015.

Given the current fossil fuel dependency of the world economy, once growth resumes, the oil price is expected to rise to US$180 per barrel.[4] The impact will be felt throughout the global economy, but especially by the poor. In 2008, rising fuel prices cost consumers in developing economies US$400 billion in higher energy expenditures and US$240 billion in dearer food. The rise in food prices in 2007 is estimated to have already increased global poverty by between 130 million and 155 million people.[5] Increasing energy prices will do little to alleviate the widespread problem of global energy poverty. Billions of people in developing countries have no access to modern energy services, and those consumers who do have access often pay high prices for erratic and unreliable services. Among the energy poor are 2.4 billion people, who rely on traditional biomass fuels for cooking and heating, including 89 per cent of the population of sub-Saharan Africa, and another 1.6 billion people who do not have access to electricity.[6]

Even if demand for energy remains flat until 2030, just to offset the effect of oilfield decline the global economy will still need 45 million barrels per day of additional gross production capacity – an amount approximately equal to four times the current capacity of Saudi Arabia.[7] But with the resumption of world economic growth on a business-as-usual path, fossil fuel demand is unlikely to stay constant, despite the rise in energy prices. The International Energy Agency

[4] International Energy Agency. 2008. *World Energy Outlook 2008.* Organization for Economic Co-operation and Development and the International Energy Agency, Paris.
[5] World Bank. 2009. *Global Economic Prospects, op cit.*
[6] Modi, Vijay, Susan McDade, Dominique Lallement and Jamal Saghir. 2005. *Energy Services for the Millennium Development Goals.* The International Bank for Reconstruction and Development/The World Bank and the United Nations Development Programme, Washington DC and New York, NY.
[7] International Energy Agency. 2008, *op cit.*

(IEA) expects that, by 2030, global energy demand will rise by 45 per cent.[8] Increasing consumption of fossil fuels will worsen energy security concerns for carbon-dependent economies, such as increased concentration of the remaining oil reserves in a fewer number of countries, the risk of oil supply disruptions, rising energy use in the transport sector, and insufficient additions of oil supply capacity to keep pace with demand growth.[9]

A world economic recovery that revives fossil fuel consumption will accelerate global climate change. With the resumption of energy demand growth, greenhouse gas (GHG) emissions will also increase by 45 per cent to 41 gigatonnes (Gt) in 2030, with three-quarters of the rise generated by China, India and the Middle East.[10] Without a change in the carbon dependency of the global economy, the IEA warns that the atmospheric concentration of GHG could double by the end of this century, and lead to an eventual global average temperature increase of up to 6ºC.[11] Such a scenario is likely to cause a sea level rise between 0.26 and 0.59 meters, and severely disrupt freshwater availability, ecosystems, food production, coastal populations and human health.[12] According to the Stern Review, with 5-6°C warming, the world economy could sustain losses equivalent to 5-10 per cent of global gross domestic product (GDP), with poor countries suffering costs in excess of 10 per cent of GDP.[13] Across all cities worldwide, about 40 million people are exposed to a 1 in 100 year extreme coastal flooding event, and by the 2070s the population exposed could rise to 150 million.[14]

The world's poor are especially vulnerable to the climate-driven risks posed by rising sea level, coastal erosion and more frequent storms. Around 14 per cent of the population and 21 per cent of urban dwellers in developing countries live in low elevation coastal zones that are exposed to these risks.[15] The livelihoods of billions – from poor farmers to urban slum dwellers – are threatened by a wide range of climate-induced risks that affect food security, water availability, natural disasters, ecosystem stability and human health.[16]

Global ecosystems and freshwater sources are also endangered by an economic recovery that ignores environmental degradation. Over the past 50 years, ecosystems have been modified more rapidly and extensively than in any comparable period in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber and fuel. The result has been a substantial and largely irreversible loss in biological diversity. Approximately 15 out of 24

[8] International Energy Agency. 2008, *op cit*.
[9] International Energy Agency. 2007. *Oil Supply Security 2007: Emergency Response of IEA Countries.* Organization for Economic Cooperation and Development and the International Energy Agency, Paris.
[10] International Energy Agency. 2008, *op cit.*
[11] International Energy Agency. 2008, *op cit*.
[12] IPCC. 2007. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment*. Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva.
[13] Stern, Nicholas. 2007. *The Economics of Climate Change: The Stern Review.* Cambridge University Press, Cambridge, UK.
[14] Nicholls, R.J., S. Hanson, C. Herweijer, N. Patmore, S. Hallegatte, Jan Corfee-Morlot, Jean Chateua and R. Muir-Wood. 2007. *Ranking of the World's Cities Most Exposed to Coastal Flooding Today and in the Future: Executive Summary.* OECD Environment Working Paper No. 1. OECD, Paris. The top ten cities in terms of exposed population are Mumbai, Guangzhou, Shanghai, Miami, Ho Chi Minh City, Kolkata, Greater New York, Osaka-Kobe, Alexandria and New Orleans.
[15] McGranahan, G., D. Balk, D. and B. Anderson. 2007. "The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones." *Environment and Urbanization* 19(1): 17-37.
[16]Organization for Economic Cooperation and Development (OECD). 2008. *Costs of Inaction on Key Environmental Challenges.* OECD, Paris.United Nations Development Programme (UNDP). 2008. *Human Development Report 2007/2008. Fighting Climate Change: Human Solidarity in a Divided World.* UNDP, New York. Sukhdev, Pavan. 2008. *The Economics of Ecosystems & Biodiversity: An Interim Report.* European Communities, Brussels.

major global ecosystem services have been degraded or used unsustainably, including freshwater, capture fisheries, air and water purification, and the regulation of regional and local climate, natural hazards, and pests.[17]

Poor people in developing countries are most affected by the continuing loss of critical ecological services. Nearly 1.3 billion people in developing economies – over a fifth of the world's population – live on lands prone to degradation and water stress or in upland areas, forest systems, drylands and similar fragile environments. Almost half of this population (613 million) consists of the rural poor.[18] For the world's poor, global water scarcity manifests itself as a water poverty problem. One in five people in the developing world lacks access to sufficient clean water, and about half the developing world's population, 2.6 billion people, do not have access to basic sanitation. More than 660 million of the people without sanitation live on less than US$2 a day, and more than 385 million on less than US$1 a day.[19]

Even before the current global economic crisis, it was estimated that, by 2015, there will be nearly 1 billion people living on less than US$1 a day and almost 3 billion living on less than US$2 a day.[20] As noted above, the current recession is likely to increase these numbers significantly. But a world economic recovery programme that does not also address directly the problems of energy and water poverty, climate change and ecological risks will have little impact on improving the livelihoods of the poor.

A Global Green New Deal

The three objectives of a Global Green New Deal (GGND) are:

- Revive the world economy, create employment opportunities and protect vulnerable groups.
- Reduce carbon dependency, ecosystem degradation and water scarcity.
- Further the Millennium Development Goal of ending extreme world poverty by 2015.

The urgency of an international debate over the need for a Global Green New Deal (GGND) is of paramount importance. Currently, governments worldwide are proposing and implementing US$2 to 3 trillion in additional spending over the next one to two years to revive the world economy. However, very few of these proposals contain all three of the above elements that are essential to a comprehensive GGND.

[17] Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being: Current State and Trends.* Island Press, Washington, DC.
[18] World Bank. 2003. *World Development Report 2003*. World Bank, Washington DC, p. 59. See also Comprehensive Assessment of Water Management in Agriculture. 2007. *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture.* Earthscan, London and International Water Management Institute, Colombo, Sri Lanka.
[19] United Nations Development Programme. 2006. *Human Development Report 2006. Beyond Scarcity: Power, Poverty and the Global Water Crisis.*
[20] Based on projections to 2015 of the share of world population living on US$1 a day and US$2 a day in International Labor Organization (ILO). 2004. *World Employment Report 2004-05*. ILO, Geneva and 2015 mid-level projections of world population from Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2006. *World Population Prospects: The 2006 Revision and World Urbanization Prospects: The 2005 Revision*. United Nations, New York.

While the focus of a Global Green New Deal is on policies aimed at reducing carbon dependency and improving the management of ecosystems and freshwater resources, such a strategy is not just about creating a greener world economy. Ensuring the correct mix of global economic policies, investments and incentives can achieve the more immediate goals of stimulating economic growth, creating jobs and reducing the vulnerability of the poor and the long-term aim of sustaining that recovery.

Reducing Carbon Dependency

In high income and large emerging market economies, policies to improve energy efficiency and conservation, expand clean energy supply options and improve the sustainability of transport can create a substantial number of jobs and boost important economic sectors in the short term. Comprehensive proposals for China, the United States, the European Union and South Korea indicate that an ideal opportunity exists to enhance economic recovery through such a low-carbon strategy. The proposed initiatives also illustrate the importance of adopting complementary carbon pricing policies, which should include removing perverse subsidies and other distortions in energy markets.

For example, elements of a "green economic recovery" programme proposed for the United States are incorporated into the $827 billion fiscal stimulus plan of the Obama Administration.[21] The full US green economic recovery programme calls for a $100 billion initiative over the next two years, equivalent to just over 0.7 per cent of US GDP, which could be paid with proceeds from auctions under a greenhouse gas cap-and-trade programme and the elimination of fossil fuel subsidies and tax breaks. The programme would create 2 million jobs by investing in four energy efficiency and renewable energy strategies:

- Retrofitting buildings to improve energy efficiency
- Expanding mass transit and freight rail
- Constructing a "smart" electrical grid transmission system
- Developing renewable energy, i.e. wind power, solar power, next-generation biofuels and other bio-based energy.

Targeting investments to the above sectors and providing complementary carbon pricing incentives can also generate economic recovery and employment gains in other high income and large emerging market economies.[22]

[21]Pollin, Robert, Heidi Garrett-Peltier, James Heintz, and Helen Scharber. 2008. *Green Recovery: A Programme to Create Good Jobs and Start Building a Low-Carbon Economy.* Center for American Progress, Washington DC.

[22] The sources for the following box are: Houser, Trevor, Shashank Mohan and Robert Heilmayr. 2009. *A Green Global Recovery? Assessing US Economic Stimulus and the Prospects for International Coordination.* Policy Brief Number PB09-3. Peterson Institute for International Economics and World Resources Institute, Washington, DC, February. Renner, Michael, Sean Sweeney and Jill Kubit.2008. *Green Jobs: Towards a Decent Work in a Sustainable, Low-Carbon World.* UNEP/ILO/IOE?ITUC, Geneva.

Economic and employment implications of greening the energy sector:

- Green energy initiatives have the potential to save the US economy an average of US$450 million per year for every US$1 billion invested. In addition, every $1 billion in government spending would lead to approximately 30,000 job-years and reduce annual US greenhouse gas (GHG) emissions by 592,600 tons between 2012 and 2020 – a 20 per cent increase in job creation over more traditional fiscal stimulus measures.
- The renewable energy sector of China has a value of nearly U$17 billion and already employs close to 1 million workers. Further investments the renewable energy sector and other "clean technologies" could have a major impact on developing new economic growth, expanding exports, and creating employment.
- An immediate and large-scale programme to expand energy conservation and renewable energy supply in the European Union (EU) could create 1 to 2 million new, full-time jobs.
- The energy conservation and green building investments that form part of South Korea's Green New Deal amount to 0.5 per cent of GDP, and the full low carbon strategy accounts for 1.2 per cent of GDP. These strategies are expected to create 181,000 and 334,000 jobs, respectively.

Removal of fossil fuel subsidies eliminates perverse incentives in energy markets and provides an immediate source of financing for low-carbon strategies. Globally around US$300 billion annually, or 0.7 per cent of world GDP, is spent on such subsidies, which are employed mainly to lower the prices of coal, electricity, natural gas and oil products.[23] Most of these subsidies do not benefit the poor but the wealthy, nor do they yield widespread economic benefits. Energy subsidies in the high income economies of the Organization for Economic Cooperation and Development (OECD) amount to about US$80 billion annually, and subsidies in 20 non-OECD countries total US$220 billion. Cancelling these subsidies would on their own reduce greenhouse gas emissions globally by as much as 6 per cent and add 0.1 per cent to world GDP. The financial savings could also be redirected to investments in clean energy R&D, renewable energy development and energy conservation, which would further boost economies and employment opportunities.

Eliminating fossil fuel subsidies can also benefit low-income economies. For example, energy sector reforms in Botswana, Ghana, Honduras, India, Indonesia, Nepal and Senegal have proven to be effective in leading a transition to more efficient and cleaner fuels that particularly benefit poor households. The economic and employment gains for developing economies of a wide range of low-carbon policies could be significant. Every US$1 invested in improving the energy efficiency of electricity generation can save more than US$3 in investment costs in low and middle income countries, because current efficiency levels are currently much lower in these economies.[24] Small hydropower, biomass and solar photovoltaics (PV) already provide electricity, heat, water pumping and other power for tens of millions of people in rural areas of developing countries. 25 million households depend on biogas for cooking and lighting, and 2.5 million household use solar lighting systems. Developing economies currently account for 40 per cent of existing global renewable resource capacity, 70 per cent of solar water heating capacity and 45 per cent of biofuels

[23] United Nations Environment Programme. 2008. *Reforming Energy Subsidies: Opportunities to Contribute to the Climate Change Agenda.* UNEP, Geneva.
[24] As quoted in UN ESCAP 2008, *op cit*.

production.[25] Expansion of these sectors will not only increase the availability of affordable and sustainable energy services for the world's poor but also provide much needed employment opportunities in developing economies. As Grameen Shakti in Bangladesh has demonstrated, it is possible to disseminate PV solar home systems, biogas facilities and improved cooking stoves to over 200,000 poor households and generate thousands of jobs.

Low-carbon strategies in the transport sector that target the next generation of biofuels, develop fuel-efficient motor vehicles and expand urban public transit and rail networks also have the potential to stimulate growth and create jobs.[26]

Low-carbon transport strategies can stimulate growth and create jobs:

- More than 3.8 million jobs could be created globally through the production of vehicles with high fuel efficiency, hybrid and alternative fuel use and low emission technologies, and up to 19 million additional ancillary jobs worldwide in fuel refining and distribution, sales, repairs and services.
- At least 1.2 million jobs are involved worldwide in biofuel production, but global expansion of next generation feedstocks could easily yield 10 million jobs or more.
- Mass transit systems have significant direct employment impacts globally, accounting for 367,000 workers in the United States and 900,000 in the European Union alone. Investment in public urban transit has also has major secondary employment effects, with a multiplier of 2.5 to 4.1 per direct job created.
- In the United Sates, a 10-year federal investment programme in new high-speed rail systems has the employment potential of 250,000 new jobs.
- In South Korea, US$7 billion invested in mass transit and railways over the next three years is expected to create 138,000 jobs.

However, enhancing the economic, environmental and employment gains from a sustainable transportation strategy will require the removal of perverse incentives and the implementation of market-based instruments and regulations. Removal of transport market and planning distortions would contribute to less economic waste, reduce pollution and congestion, foster greater transport choice and facilitate sustainable transport strategies that would boost economic recovery and employment. Fiscal policies, such as fuel and vehicle taxes, new vehicle incentives, road fees, user fees, vehicle insurance and fleet vehicle incentives, can have powerful impacts on encouraging the introduction of cleaner, fuel-efficient vehicles. Combining these policies with regulatory measures, such as more stringent greenhouse gas and fuel economy standards, may produce the most important shifts in vehicle demand and use. Such policies are proving increasingly attractive not only to high-income OECD economies but also to large emerging market economies, such as China and India.

Reducing Ecological Scarcity and Poverty

There is a link between reducing ecological scarcity and improving the livelihoods of the poor. Ecological scarcity is the loss of myriad ecosystem benefits, or "services", as these

[25] REN21. 2008. "Renewables 2007 Global Status Report". REN21 Secretariat, Paris and Worldwatch Institute, Washington DC.

[26] The sources for the following box are the various references cited in Barbier 2009, *op cit.*, Boxes 10-12.

systems are exploited for human use and economic activity.[27] As noted previously, this scarcity problem is

accelerating on a global scale, and is manifesting itself in the loss of many ecosystem services that are vital to the poor. As the world economic crisis deepens and expands, it is the poor who are most vulnerable to the consequences, and increasing ecological scarcity adds further to this burden. Thus, a GGND must also tackle urgently the problem of extreme world poverty caused by rising ecological scarcity, as well as implement measures that more directly reduce the vulnerability of the world's poor.

This objective can be accomplished through several pathways.

Most developing economies and the majority of their populations depend directly on exploiting natural resources.[28] For the foreseeable future, primary product exports will remain the main source of export earnings and savings that will facilitate the foreign direct investment, domestic private and public investment and international borrowing necessary for financing economic development. Ensuring sustainable income from primary production is not only essential for generating the necessary savings and revenues in the long run but also important to guarantee that sufficient financial flows are available for investment in the physical capital, infrastructure, skills, health services and educational opportunities necessary for long-term development. Encouraging more primary production from a country's natural resource endowment is not truly sustainable, however, unless it also alleviates the persistence of widespread poverty, especially rural poverty, and improves the economic livelihoods of the large numbers of people concentrated in fragile, resource-poor environments.

Reducing poverty in developing economies requires:

- Policies, investments and reforms to enhance the sustainable and efficient use of natural resources and production processes dependent on them.
- Ensuring that the financial returns from more sustainable activities are re-invested in the industrial activities, infrastructure, health services, and the education and skills necessary for long-term economic development.
- Targeting investments and other policy measures to improving the livelihoods of the rural poor, especially those living in fragile environments.
- Protecting and improving the provision of ecosystem services on which the extreme poor depend.

Three resource-dependent developing economies have shown progress with the first two objectives: Malaysia, Thailand and Botswana.[29] All three countries managed to achieve a long-term investment rate exceeding 25 per cent of GDP and long-run average annual growth rates exceeding 4 per cent, which are investment and growth rates comparable to that of high income economies. Malaysia and Thailand have successfully diversified their economies

[27] Barbier, Edward B. 1989. *Economics, Natural Resource Scarcity and Development: Conventional and Alternative Views.* Earthscan Publications, London, pp. 96-7.
[28] Barbier, Edward B. 2005. *The Role of Natural Resources and Economic Development*. Cambridge University Press, Cambridge, UK. Barbier, Edward B. 2008. "Poverty, Development, and Ecological Services." *International Review of Environmental and Resource Economics* 2(1):1-27.
[29] See Barbier 2005, *op cit.*

through re-investing the financial gains from primary production for export. Botswana is a mineral-rich economy that developed favorable institutions and policies for managing its natural wealth and primary production for extensive economy-wide benefits.

Asking national governments of developing economies to implement policies, reforms and investments to improve the sustainability of primary production seems a tall order during a deepening global economic crisis. However, as argued by the World Bank, such a strategy is even more vital for resource-dependent developing economies during a worldwide recession in which private investment flows and trade has declined.[30] The main policy priorities should be improving the sustainability of primary production activities, with the aim of ensuring that they generate sufficient investible funds for diversifying the economy, building up human capital, and investing in social safety nets and other investments targeted at the poor. In addition, the failure to implement such policies worsens extreme poverty in developing economies and raises the costs of implementing these measures.

There are two ways in which a GGND can improve the livelihoods of the poor.

The first is to provide financing directly, through involving the poor in payment for ecosystem services schemes and other measures that enhance the environments on which the poor depend. Wherever possible, the payment schemes should be designed to increase the participation of the poor, to reduce any negative impacts on nonparticipants while creating additional job opportunities for rural workers, and to provide technical assistance, access to inputs, credit and other support to encourage poor smallholders to adopt the desired land use practices. More effort must be devoted to designing projects and programmes that include the direct participation of the landless and near landless.

The second is to target investments directly to improving the livelihoods of the rural poor, thus reducing their dependence on exploiting environmental resources. For example, in Ecuador, Madagascar and Cambodia poverty maps have been developed to target public investments to geographically defined sub-groups of the population according to their relative poverty status, which could substantially improve the performance of the programmes in term of poverty alleviation.[31] A World Bank study that examined 122 targeted programmes in 48 developing countries confirms their effectiveness in reducing poverty, if they are designed properly.[32]

Targeting the poor is even more urgent during major economic crises. Under-investment in human capital and lack of access to financial credit are persistent problems for the extreme poor, especially in fragile environments. Low income households generate insufficient savings, suffer chronic indebtedness and rely on informal credit markets with high short-term interest rates. Two types of policies and investment programmes targeted to the poor are essential in these circumstances. The first is a comprehensive and targeted safety net that adequately insures the poor in time of crisis. The second is the maintenance, and if possible expansion, of long-term educational and health services targeted at the poor. Unfortunately, during financial and economic crises, publicly funded health and education services are often the first expenditures reduced by developing country governments.

[30] World Bank. "Global Financial Crisis and Implications for Developing Countries." Paper for G-20 Finance Ministers' Meeting. São Paulo, Brazil. November 8, 2008.
[31] Elbers, Chris, Tomoki Fujii, Peter Lanjouw,Berk Özler and Wesley Yin. 2007. "Poverty alleviation through geographic targeting: How much does disaggregation help?" *Journal of Development Economics* 83:198-213.
[32]Coady, David, Margaret Grosh and John Hoddinott. 2004. "Targeting outcomes redux." *World Bank Research Observer* 19(1):61–85.

Reducing Water Scarcity

If a Global Green New Deal is to have a lasting impact on reducing worldwide poverty and at the same time ensure that the ensuing global economic recovery is sustainable, then the GGND must also include policy measures to address another looming global ecological scarcity problem – the emerging water crisis. There are two aspects of this emerging water crisis: the worldwide scarcity of freshwater supplies relative to increasing demand, and the lack of clean water and sanitation available for millions of the poor in developing regions.

There is a consensus that growing scarcity and competition for water are major threats to poverty alleviation, especially in the rural areas of developing economies, or as UN-Water states, "first and foremost, water scarcity is an issue of poverty."[33] In many economies, including high-income countries, freshwater is routinely wasted and inefficiently used because of considerable distortions and disincentives in the way in which water is allocated. The problem is particularly serious in irrigated agriculture, which uses about 70 to 90 per cent of the world's freshwater supplies. A further complication in water management is that many of the world's important river basins and other major sources of freshwater cross international boundaries.

A Global Green New Deal implemented over the next couple of years should aim to improve water management worldwide, and at the same time contribute to the goal of providing water services to the poor.

Reducing global water scarcity requires:

- Targeting investments and other policy measures to improve the supply of clean water and sanitation services to the poor.
- Removing subsidies and other incentive distortions and implementing, where appropriate, market-based instruments and other measures to improve the efficiency of water delivery and utilization and to manage water demand.
- Facilitate transboundary water governance and cooperation over shared management and use.

A top priority of the GGND must be to revive the necessary investments to attain the Millennium Development Goal of halving, by 2015, the proportion of people in the world without sustainable access to safe drinking water and basic sanitation. The total economic benefits of the global investment in achieving the MDG would amount to about $38 billion annually.[34] The benefits for Sub-Saharan Africa alone would amount to $15 billion annually, which equals approximately 60 per cent of the continent's current aid flows. Other benefits include around 1 million children's lives saved over the next decade as the investments are made, averaging 203,000 fewer child deaths per year by 2015. In addition, there would be 272 million days gained in school attendance as a result of reduced illness from diarrhea alone. Poor households would also benefit from the income gains from the reduced number of days spent ill, the money savings from less health service use and expenditures on medicines, and the increase time spent on income and productive activities of the household.

[33] UN-Water. 2007. *Coping with Water Scarcity: Challenge of the Twenty-First Century.* United Nations, New York, UN Water Day, March 22, 2007.
[34] UNDP 2006, *op cit.*

Across all developing countries, when such wider benefits are included, the return on US$1 invested in clean water and sanitation interventions ranged from US$5 to US$11, and from US$5 to US$28 for some low-cost interventions.

In addition, removing water subsidies and other incentive distortions, adopting market-based instruments and implementing other measure to increase the efficiency of water allocation should be seriously considered by all economies, rich and poor. Improving transboundary water governance and cooperation over shared management and use must also be an important objective of the GGND.

Challenges Facing Developing Economies

Reducing carbon dependency and ecological scarcity through a GGND poses a number of challenges for low and middle income economies, however.

For example, many developing economies face a serious "capital gap" in private and public financial investments that will constrain them from implementing the proposed GGND. Equally limiting is the "skills and technological gap". Most developing economies, with the possible exception of Brazil, China, India, Russia and other large emerging market economies, do not have the research and development (R&D) capacity or the skilled workforce to import and adapt the new skills and technology for many of the proposed investments. Both of these gaps can be overcome by increased financing, but during the current global economic crisis, new financial flows are in short supply. Potential aid flows from donors are likely to be reduced and not increased. The crisis has already curtailed private investment flows, especially to more risky investments with longer term returns. The political will to develop new and innovative financial mechanisms to spur global investments may also weaken.

Trade is an important incentive for some actions proposed under the GGND, but as discussed previously, global trade is projected to decline for the foreseeable future. International commodity prices have also been highly volatile, especially for energy and food, with prices first rising and then falling sharply as the global recession has deepened. Developing economies, particularly those who are highly resource dependent, face balance of payment problems and uncertainty over export and government revenues. Under such conditions it is difficult to implement investments and reforms, such as those required to improve the sustainability of primary production activities, increase health and educational expenditures, develop comprehensive safety net programmes targeted at the poor and finance clean energy and transport technologies. The current economic climate also deters the progress needed in the Doha Round of world trade negotiations to support the GGND.

There are also a number of failures in current global governance that may inhibit a GGND. In the absence of a post-Kyoto climate change agreement, there is growing investment uncertainty over the future of the global carbon market and the Clean Development Mechanism (CDM) after 2012. Future Joint Implementation (JI) projects may also be affected. Both uncertainty over future global climate policy and the delay caused by inaction increase sharply the costs of an agreement.[35] Delay in adopting effective climate policies will affect the cost of future agreements that will be required to abate an even larger amount of emissions. Such inaction in the short term increases significantly the costs of compliance in the long term, which is compounded by the effects of uncertainty on investment and policy decisions. Scaling up and reforming the CDM, increasing its coverage of countries to more

[35] Bosetti, Valentina, Carlo Carraro, Alessandra Sgobbi and Massimo Tavoni. 2008. "Delayed Action and Uncertain Targets: How Much Will Climate Policy Cost?" Nota di Lavora 69.200. Fondazione Eni Enrico Mattei, Milan.

low-income and Sub-Saharan economies and including more sectors and technologies in the mechanism should also be priorities.

New trade and financial mechanisms are required, and international agreements on transboundary pollution and water management need to be negotiated, as important complements to a GGND. In addition, aid shortfalls seriously limit some of the key GGND measures proposed for developing economies.

Even before the current economic crisis, not only has overall development assistance to poor countries fallen in real terms over the previous decade, but the share of assistance to the water and sanitation sector of developing economies has declined even more. For example, in its 2006 report on water, the UNDP estimated that the sector accounted for less than 5 per cent of development assistance, and aid flows would need to double to bring the MDG within reach, rising by US$3.6 to US$4 billion annually.[36] With the advent of the current economic crisis and the fall in revenues of national governments, addressing the gap in overseas aid for clean water and sanitation in developing economies needs to be a priority of the international community under a GGND.

As a result of the food and fuel crises in recent years, the number of extremely poor was estimated to have increased by at least 100 million. Many of those already poor are slipping even more deeply into poverty; for instance, 88 per cent of the recent increase in extreme urban poverty arose from poor households becoming poorer and only 12 per cent from households falling into poverty. Because of these impacts, 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.[37] Because the current economic crisis is expected to exacerbate this worldwide problem of poverty, the President of the World Bank, Robert Zoellick, has called for every high-income economy to pledge 0.7 per cent of its stimulus package to a global "vulnerability fund" that would be used to finance in developing economies a comprehensive and targeted safety net for the poor, investments in infrastructure including low-carbon technology projects and support for small and medium-sized enterprises and micro-finance institutions.[38] Similarly, the UN High Level Task Force on the Global Food Crisis has called on donor countries to double financing for food assistance, other types of nutritional support and safety net programmes, and for an increase in the percentage of aid to be invested in food and agricultural development from the current 3 per cent to 10 per cent within five years.[39]

The South Korean Green New Deal

South Korea has announced a Green New Deal plan that contains many of the national actions of the proposed GGND. At a cost of around U$36 billion over 2009 to 2012, the initiative aims to create 960,000 jobs. It is expected that 149,000 jobs will be created in 2009, mainly in construction. The low-carbon projects include developing railroads and mass transit, fuel efficient vehicles and clean fuels, energy conservation and environmentally friendly buildings. These measures alone will account for over 1.2 per cent of GDP, whereas the full GND plan involves investments of around 3 per cent of GDP.[40]

[36] UNDP 2006, *op cit.*
[37] World Bank 2009, *Global Economic Prospects*, *op cit.* World Bank 2008 "Global Financial Crisis and Implications for Developing Countries.", *op cit.*
[38] Zoellick, Robert B. "A Stimulus Package for the World." *The New York Times*. January 22, 2009.
[39] High-Level Task Force (HLTF) on the Global Food Crisis. 2008. *Comprehensive Framework for Action.* July 2008. United Nations, New York.
[40]The source of this information and table is from a "Briefing Note for Foreign Correspondents", Ministry of Strategy and Finance, Government of South Korea. January 19, 2009.

South Korea's Green New Deal		
Project	**Employment**	**US$ million**
Expanding mass transit and railroads	138,067	7,005
Energy conservation (villages and schools)	170,702	5,841
Fuel efficient vehicles and clean energy	14,348	1,489
Environmentally friendly living space	10,789	351
River restoration	199,960	10,505
Forest restoration	133,630	1,754
Water resource management (small and midsize dams)	16,132	684
Resource recycling (including fuel from waste)	16,196	675
National green information (GIS) infrastructure	3,120	270
Total for the nine major projects	**702,944**	**28,573**
Total for the Green New Deal	**960,000**	**36,280**

The Role of the International Community

Several actions are needed at the global level to facilitate national governments to overcome the challenges they face in implementing the GGND strategy and to enhance the sustained economic benefits gained from such policies.

There are three areas in which international actions are needed:

- Promoting global governance.
- Facilitating access to finance.
- Enhancing trade incentives.

Improving global governance is crucial to meeting the financial, trade and policy coordination challenges to implementing the Global Green New Deal. All international fora, and especially the UN system, have a role to play in promoting, developing and enhancing a GGND. The most likely global policy forum for fostering urgent action on the GGND is the G20 group of the world's 20 largest rich and emerging economies. Concerted action by the G20 nations could facilitate key areas of the GGND, such as the proposed actions for reducing carbon dependency, removing subsidies and other perverse incentives, coordinating adoption of market-based instruments, and facilitating transboundary governance of water and other shared resources. In addition, the G20 has emerged as the global forum for coordinating policy action during the immediate economic crisis, and is therefore well placed to consider the proposed GGND as part of its response to the crisis. The G20 could also foster progress in improving aid flows and in facilitating a post-2012 climate change and global carbon market architecture.

A healthy financial system is necessary for the success and effectiveness of the GGND. The international community should therefore adopt as soon as possible reforms to the governance of the financial system that increase transparency and simplicity, and improve the alignment of incentive structures. In addition, bilateral and multilateral aid donors should increase their development assistance over the next few years, and target it to the sectors and actions that comprise the key components of the GGND. Of urgent need is guaranteed financing for the type of vulnerability fund proposed by Robert Zoellick and overcoming shortfalls in the aid necessary to promote clean water and sanitation in developing economies.

In addition, the international community should consider developing and expanding innovative financing mechanisms, such as the International Finance Facility, Climate Investment Funds and Global Clean Energy Cooperation, as possible means to fund key components of the GGND.

As more than 90 per cent of trade is financed with some form of short-term credit, insurance or guarantee, maintaining adequate trade flows and their financing is critical to the GGND. New financing facilities also provide a unique opportunity to promote the expansion of trade finance focused specifically on activities advocated for the GGND. There is also an opportunity to mobilize committed trade facilitation financing to enhance the GGND. Support for a GGND requires that trade protectionism be avoided, and that trade liberalization provides opportunities for promoting key sectors, such as limiting fisheries subsidies, reducing tariff and non-tariff barriers on clean technology and services, and reducing agricultural protectionism.

To summarize, the following are the key national and international actions that are required for the proposed GGND.

National Actions Proposed for the Global Green New Deal

1. The United States, the European Union and other high income OECD economies should spend over the next two years at least 1 per cent of their GDP on the national actions proposed for reducing carbon dependency, including removing subsidies and other perverse incentives and adopting complementary carbon pricing policies.
2. The remaining middle and high income economies of the Group of 20 (G20) should aim, as far as possible, also to spend over the next two years at least 1 per cent of their GDP on the national actions proposed for reducing carbon dependency.
3. Developing economies should also implement over the next two years the national actions proposed for reducing carbon dependency. Under the current economic conditions it is difficult to determine how much each economy should spend on these activities.
4. Developing economies should spend at least 1 per cent of their GDP on national actions proposed for improving clean water and sanitation for the poor. They should also develop urgently comprehensive, well-targeted safety net programmes and maintain, if not expand, educational and health services for the poor.
5. Developing economies should adopt actions for improving the sustainability of their primary production activities, although under the current economic conditions it is difficult to determine how much each economy should spend on these activities.
6. All economies should consider removing water subsidies and other distortions, adopting market-based instruments or similar measures to increase water efficiency, and facilitating transboundary water governance.

International Actions Proposed for the Global Green New Deal

1. The most likely global policy forum for promoting urgent international action on the GGND is the G20 forum of the world's 20 largest rich and emerging economies, although all international fora, and the UN system especially, have a role to play in promoting, developing and enhancing the GGND.

2. At its April 2009 London meeting, the G20 should consider proposals for a GGND, such as the actions recommended by this report, and help develop framework ideas towards securing a global climate change agreement at Copenhagen in December 2009.
3. The international community should reach agreement on extending the CDM beyond 2012, preferably as part of a global climate change agreement, and reforming the mechanism to increase the coverage of developing economies, the sectors and technologies and the overall financing of global GHG emission reductions.
4. The international community should support efforts to improve payment for ecosystem services targeted to the poor and to include more ecosystems, and efforts to improve governance and shared use of transboundary water resources.
5. The international community should adopt as soon as possible reforms to the governance of the financial system that increase transparency and simplicity, and improve the alignment of incentive structures.
6. Bilateral and multilateral aid donors should increase their development assistance over the next few years, and target it to the sectors and actions that comprise the key components of the GGND.
7. The international community should develop and expand innovative financing mechanisms, such as the International Finance Facility, Climate Investment Funds and Global Clean Energy Cooperation, as possible means to fund key components of the GGND.
8. The international community should develop and expand new trade financing and trade facilitation financing packages, and use them to target support to the GGND.
9. The international community should review existing trade agreements and shape future agreements to identify and minimize barriers to enhance effective support of the proposed GGND actions.
10. The international community needs to reach successful conclusion of the Doha Round trade negotiations, especially on fishery subsidies, clean technology and services and reducing agricultural protectionism.

Conclusion

In 2008, the world was confronted with multiple crises – fuel, food and financial. The resulting worldwide recession requires a bold initiative and vision on a global scale. A Global Green New Deal is the necessary response to these challenges.

A GGND is not just about creating a greener world economy. It is about ensuring that the correct mix of economic policies, investments and incentives reduce carbon dependency, protect ecosystems and alleviate poverty while fostering economic recovery and creating jobs. Reviving the world economy is essential, but measures that focus solely on this objective will not achieve lasting success. Only through the national actions and global cooperation envisioned in a GGND will the world sustain its economic recovery by addressing the imminent challenges posed by climate change, energy insecurity, growing freshwater scarcity, deteriorating ecosystems, and above all, worsening global poverty.

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PART ONE: Why a Global Green New Deal?

Introduction: Crisis and Opportunity

2008 will be remembered as the year of multiple global crises. The year began with a looming fuel crisis, as well as continued rising food prices. Towards the end of the year, the world was faced with a major financial crisis, which quickly turned into the worst international economic recession since the Great Depression.

These crises pose serious implications for human welfare and well-being world wide, especially in terms of unemployment, poverty, and environmental impacts. But they may also provide a unique opportunity for governments to come together to promote sustainable economic development at the global level.

In January 2009, the United States lost nearly 600,000 jobs, the highest monthly unemployment rate since 1974. About 3.6 million jobs have disappeared since December 2007, when the current economic downturn began. In China, redundancies in the state sector this year are likely to add about 3.5 million to the country's jobless total, and reports from China's leading export province of Guangdong indicate that migrant workers have started returning to rural areas. Each week major multinational corporations, such as 3M, Bank of America, Credit Suisse, Motorola, Nokia, Siemans, Sony and Tata, announce sizable cutbacks in their worldwide workforce. According to the International Labor Organization (ILO), the number of unemployed globally could rise in 2009 by between 18 million and 51 million over 2007 levels.[1]

Although before the crisis the proportion of the world's population in extreme poverty was purported to be declining, projections suggested that by 2015 there would still be nearly 1 billion people living on less than US$1 a day and almost 3 billion living on less than US$2 a day.[2] As the international recession spreads and deepens, global poverty trends are expected to worsen. Every 1 per cent fall in growth in developing economies is estimated to consign another 20 million people to poverty.[3]

Alarmed by the state of the world economy, the leaders of the world's 20 biggest rich and emerging economies, which together account for almost 80 per cent of the world's population and 90 per cent of global gross domestic product (GDP), met on 15 November 2008 in Washington DC.[4] A key conclusion of this first-ever G20 summit was the need for all national governments to boost economic growth through fiscal stimulus measures, including increases in public spending and investments. Already the G20 have proposed or are considering increased public spending or lowering taxes to quicken economic recovery and create job opportunities

[1] International Labor Organization (ILO). 2009. *Global Employment Trends January 2009.* ILO, Geneva. International Institute of Labour Studies, ILO. 2009.

[2] Based on projections to 2015 of the share of world population living on US$1 a day and US$2 a day in International Labor Organization (ILO). 2004. *World Employment Report 2004-05*. ILO, Geneva and 2015 mid-level projections of world population from Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2006. *World Population Prospects: The 2006 Revision and World Urbanization Prospects: The 2005 Revision*. United Nations, New York.

[3] World Bank. "Global Financial Crisis and Implications for Developing Countries." Paper for G-20 Finance Ministers' Meeting. São Paulo, Brazil. November 8, 2008.

[4] 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 United Kingdom and the United States) plus the European Union.

(see Box 1). If fully enacted, the total amount of these fiscal stimulus packages could amount to over US$2 trillion, or at least 3 per cent of current world GDP. The largest amounts are likely to be spent by China (US$586 billion, or 8.3 per cent of its GDP), the United States (US$827 billion, 6 per cent of GDP) and the European Union ($259 billion, 1.8 per cent of GDP).[5]

The year 2008 was not only memorable for the global financial upheaval; it was also the year of a world fuel and food crisis.

In July 2008, the price of oil peaked at US$150 per barrel. Although the price of oil has fallen rapidly since then, most forecasts predict that the era of "cheap" fossil fuel energy and secure world supplies is over. For example, the International Energy Agency (IEA) suggests that by 2030 global energy demand will rise by 45 per cent causing a significant increase in real fossil fuel prices. The IEA trend projection expects the oil price to rise to US$180 per barrel once growth resumes. Based on current trends, greenhouse gas emissions will also increase by 45 per cent to 41 gigatonnes (Gt) in 2030, with three-quarters of the rise generated by China, India and the Middle East.[6]

Prices for food traded internationally increased almost 60 per cent during the first half of 2008, with basic staples such as grains and oilseeds showing the largest increases. The recent fall in energy and fertilizer prices has reversed this trend somewhat, but food prices in the near term are expected to remain much higher than during the 1990s and more than 60 percent higher than their levels in 2003. The impact of higher food prices on the world's poor and developing economies is particularly significant. For example, the increase in food prices over 2007 is likely to have increased global poverty by between 130 million and 155 million people, or by around 1.3 to 1.5 percent. The cost of higher food and fuel to consumers in developing countries amounted to around $680 billion in 2008 ($400 billion for energy, $240 billion for food).[7] Food and energy account for disproportionately high shares of expenditure in poor households.

There is also growing evidence that the global financial, fuel and food crisis has led to significant long term environmental impacts, which in turn are detrimental to human welfare.

The fourth assessment of the Intergovernmental Panel on Climate Change (IPCC) confirms that the carbon dependency of the world economy is contributing to global warming.[8] Global greenhouse emissions from human activities have grown since pre-industrial times, growing 70 per cent between 1970 and 2004. Increased atmospheric concentrations of greenhouse gases are due primarily to fossil fuel use, with land-use change and agriculture providing significant but smaller contributions. The result has been increasing global surface temperatures, rising sea levels at an average rate of 1.8 mm/year since 1961, and disruptions to ecosystems. Greenhouse gas emissions are expected to continue at or above current rates, causing further global warming, sea level rise and ecological damage. Already, climate change is linked to an increase in extreme

[5] Based on 2007 estimated Gross Domestic Product (GDP) in terms of purchasing power parity from the US Central Intelligence Agency *The World Factbook*, available at https://www.cia.gov/library/publications/the-world-factbook/rankorder/2001rank.html. In 2007, World GDP was estimated at $65,610 billion, European Union GDP at $14,430 billion, US GDP at $13,780 billion and China at $7,099 billion.

[6] International Energy Agency. 2008. *World Energy Outlook 2008.* Organization for Economic Cooperation and Development and the International Energy Agency, Paris.

[7] World Bank. 2009. *Global Economic Prospects 2009.Commodities at the Crossroads.* The World Bank, Washington DC.

[8] IPCC. 2007. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment*. Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva.

weather events, such as storms, floods and drought. These events destroy lives, force population migration and contribute to food shortages. Across all cities worldwide, about 40 million people are exposed to a 1 in 100 year extreme coastal flooding event, and by the 2070s the population exposed could rise to 150 million.[9]

The Millennium Ecosystem Assessment (MA) has documented how global economic activity and population growth have affected the world's ecosystems and the various services, or benefits, which they produce.[10] Over the past 50 years, ecosystems have been modified more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber and fuel. The result has been a substantial and largely irreversible loss in biological diversity. The MA also found that approximately 15 out of 24 of the major ecosystem services it examined are being degraded or used unsustainably, including freshwater, capture fisheries, air and water purification, and the regulation of regional and local climate, natural hazards, and pests.

Poor people in developing countries are particularly vulnerable to the resulting loss in critical ecological services. [11] Nearly 1.3 billion people – over a fifth of the world's population – live in fragile environments found in developing economies (see Box 2). Almost half of them (613 million) consist of the rural poor. They live on lands prone to degradation and water stress, and in upland areas, forest systems and drylands. These marginal environments are areas "where the people's links to the land are critical for the sustainability of communities, pastures, forests, and other natural resources" (see Box 2).[12]

The rapid growth of rural populations in the developing world is being outpaced by the even faster growth of urban populations. In 2007, 2.38 billion people, approximately 44 per cent of the population, lived in the urban areas of developing countries.[13] By 2019, half of the developing world will live in cities, and by 2050 5.33 billion people, or 67 per cent of the population in developed countries, will inhabit urban areas. This brisk pace of urbanization means that the growing populations in the cities will be confronted with increased congestion and pollution and rising energy, water and raw material demands. Although such environmental problems are similar to those faced by industrialized countries, the pace and scale of urban population growth in developing countries are likely to lead to more severe and acute health and welfare impacts.

The rural and urban poor especially face severe water problems. One in five people in the developing world lacks access to sufficient clean water, and about half the developing world's population, 2.6 billion people, do not have access to basic sanitation. More than 660 million of

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[9] Nicholls, R.J., S. Hanson, C. Herweijer, N. Patmore, S. Hallegatte, Jan Corfee-Morlot, Jean Chateua and R. Muir-Wood. 2007. *Ranking of the World's Cities Most Exposed to Coastal Flooding Today and in the Future: Executive Summary.* OECD Environment Working Paper No. 1. OECD, Paris. The top ten cities in terms of exposed population are Mumbai, Guangzhou, Shanghai, Miami, Ho Chi Minh City, Kolkata, Greater New York, Osaka-Kobe, Alexandria and New Orleans.

[10] Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being: Current State and Trends.* Island Press, Washington, DC.

[11] Organization for Economic Cooperation and Development (OECD). 2008. *Costs of Inaction on Key Environmental Challenges.* OECD, Paris.United Nations Development Programme (UNDP). 2008. *Human Development Report 2007/2008. Fighting Climate Change: Human Solidarity in a Divided World.* UNDP, New York. Sukhdev, Pavan. 2008. *The Economics of Ecosystems & Biodiversity: An Interim Report.* European Communities, Brussels.

[12] World Bank. 2003. *World Development Report 2003.* World Bank, Washington DC, p. 59. See also Comprehensive Assessment of Water Management in Agriculture. 2007. *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture.* Earthscan, London and International Water Management Institute, Colombo, Sri Lanka.

[13] Population Division of the United Nations Secretariat. 2008.*World Urbanization Prospects: The 2007 Revision Executive Summary*. United Nations, New York.

the people without sanitation live on less than US$2 a day, and more than 385 million on less than US$1 a day.[14] The scarcity of freshwater supplies relative to increasing demand, and the lack of clean water and sanitation available for million of the poor in developing regions, points to another looming global problem – an emerging water crisis.

Collectively, these global financial, economic, and environmental challenges are severely constraining the ability to sustain prosperity in developed economies and to achieve the Millennium Development Goals in the developing world.

A Global Green New Deal

Meeting the short run challenges of reviving the worldwide economy and creating jobs must not mean sacrificing long run economic and environmental sustainability. Carefully designed economic policies, investments, and incentives aimed at immediate global economic recovery and job creation should be made compatible with reducing the carbon dependency of the world economy, protecting vulnerable ecosystems and alleviating poverty. Ignoring the latter objectives would instead provide just a "temporary fix" to the world economy, perpetuating long run economic instability and continuing environmental deterioration.

The premise of this report is that the current economic crisis has brought governments together to instigate a worldwide recovery. Such an opportunity should also be used to address other important global economic, social and environmental challenges.

Addressing both short-run economic recovery and other global challenges will require bold measures by world leaders. Seventy-five years ago, during the depths of the Great Depression, President Franklin D. Roosevelt of the United States launched a series of wide-ranging programmes to provide employment and social security, reform tax policies and business practices, and stimulate the economy. The programmes instigated under Roosevelt's New Deal were implemented over a short period, and the scale of investments and expenditures were sufficiently large – approximately 3 to 4 per cent of total GDP during this period - to affect the structure of the US and even world economy.

The multiple crises facing the world today demand the same kind of government leadership as shown by Roosevelt's New Deal in the 1930s, but at the global scale and embracing a wider vision.

Efforts to revive the world economy should not stop at simply recreating the same pattern of global economic development of the past. Instead, serious consideration must be given to new and bold measures that not only stimulate economic growth and job opportunities but also move the world economy further down the path of more environmentally sustainable development. There is a need to "green" the world economy as we revive it, not recreate the old "brown" one. For developed countries, the objective should be to revive economic prosperity while demonstrating that restructuring the economy towards reducing carbon-dependency and environmental impacts is feasible. For developing countries, the objective should be to ensure that moving to a more sustainable economy will at the same time help achieve the Millennium

[14] United Nations Development Programme. 2006. *Human Development Report 2006. Beyond Scarcity: Power, Poverty and the Global Water Crisis.*

Development Goals. Or, as the economist Jeffrey Sachs has argued, we must not lose sight of the global objective of ending extreme poverty by 2015.[15]

In sum, what the world needs urgently today is not just increased public spending to quicken economic recovery and create job opportunities. Such an injection of spending, whether it is the planned US$2 trillion or more proposed by the G20, is necessary but not sufficient. Instead, what is called for is a new global "Green New Deal" to meet multiple global challenges.

The package of policy, investment and incentive measures must have three fundamental objectives:

- **Any Global Green New Deal (GGND) must contribute significantly to the short run objective of helping revive the world economy, create employment opportunities and protect vulnerable groups.**
- **A GGND must reduce carbon dependency, ecosystem degradation and water scarcity, so that by 2025 substantial progress is made in limiting global warming and the damages to major ecosystems and their services.**
- **A GGND must also further the Millennium Development Goal of ending extreme global poverty by 2015.**

Achieving these three objectives is ambitious but essential to enhancing global economic welfare. Such a Global Green New Deal will require a commitment by governments to adopt and coordinate a mix of national and global policy actions. The aim of this strategy is to revive the international economy and to forge a new global economic development model based on reducing environmental harm and scarcities, training workers for 21st century skills, creating new employment opportunities and reducing the carbon dependency of all economies.

The scale of investments and spending required will be large and the timeframe for implementing such measures is short. Yet, the opportunity for instigating the Global Green New Deal is now.

At no other time in recent world history has it been possible to achieve a worldwide consensus over a package of policies that can converge on attaining all three fundamental objectives. The purpose of the following report is to provide a framework, or "blueprint", for policy discussion on what a GGND might look like. The report addresses three critical policy questions:

- How is it possible to complement and coordinate current proposals for an estimated US$2 trillion or more of additional fiscal spending by national governments over the next two years to enhance global economic recovery and create new jobs with a range of policies, investments and incentives that will not only achieve these goals but also improve the environmental, social and economic sustainability of the world economy?
- What are the key components of such a Global Green New Deal that are necessary for all national governments to adopt to achieve the objectives of a sustained and "greener" economic recovery?

[15] Sachs, Jeffrey D. 2005. *The End of Poverty: Economic Possibilities for Our Time.* Penguin Books, New York.

- What are the various constraints faced by national governments, especially in developing economies, in implementing such a GGND, and how can the international community help facilitate governments in overcoming these constraints?

The urgency of a global debate over the need for such a strategy is of paramount importance. Although the current proposals by G20 governments for US$2 trillion or more in additional spending over the next one to two years to revive the world economy are laudable, very few of these proposals adopt specific "green" measures (see Box 1).

Yet it is possible that world leaders can introduce fiscal measures and other policies over the short term that will expedite economic recovery and create jobs while being consistent with the medium term objectives of reducing carbon dependency, environmental deterioration and extreme world poverty. Achieving these objectives simultaneously through a coordinated effort by the world community over the next few years is the essence of the Global Green New Deal.

Purpose and Organization of the Report

The purpose of this report is to stimulate a worldwide policy debate on the urgent need for a Global Green New Deal. The main aim is to outline the basic "framework" or "blueprint" of such a strategy. Thus, this report should be seen as the first step in the process of developing a GGND. The focus is mainly on framing the broad dimensions of this strategy, adding important examples and explanations wherever possible, but is necessarily limited in the details, development, and discussion of specific policy recommendations.

The report is organized around the three critical policy questions stated above, these are:

- How is it possible to complement and coordinate current proposals to enhance global economic recovery and create new jobs *and* improve the environmental and economic sustainability of the world economy?
- What are the key components of such a Global Green New Deal that are necessary for all national governments to adopt to achieve the objectives of a sustained and "greener" economic recovery?
- What are the various constraints faced by different national governments in implementing such a GGND, and how can the international community help facilitate governments in overcoming these constraints?

Part One has argued that it is possible to design a GGND strategy to complement current plans to revive the world economy and create new jobs and that such a strategy is also essential to the economic and environmental sustainability of the global economy.

Part Two provides an overview of the key components of the GGND that are necessary for all national governments to adopt to achieve the objectives of a sustained and "greener" economic recovery.

Although the specific priorities, policies, investments and incentive mechanisms adopted by each national government will differ with the economic, environmental and social conditions of the economy, there are two broad areas of a GGND that should be targeted by all economies. These areas are:

- Reducing carbon dependency.
- Reducing ecological scarcity.

The strategies for achieving each of these objectives are outlined separately, and specific measures for each strategy are assessed for their impact on not just environmental objectives but also the economic goals of instigating a speedy economic recovery, creating jobs, sustaining growth and reducing poverty. Both the different national level actions and challenges faced by governments in high income (mainly OECD) economies, large emerging market economies (e.g. transition and middle income economies, including Brazil, China, India and Russia) and low income economies are identified and discussed.[16]

Despite these challenges, some national governments have adopted some national actions of the proposed GGND as part of their economic recovery strategies. For example, the Obama Administration has included elements of a US$100 billion low carbon strategy advocated for the United States in its major fiscal stimulus package (see Chapter 2.1). South Korea has launched its own US$36 billion Green New Deal, which include several low carbon, ecological restoration and water management recommendations of this report (see Chapter 2.4).

Part Three focuses on the actions necessary at the global level to facilitate national governments to overcome the challenges they face in implementing the GGND strategy and to enhance the sustained economic benefits gained from such policies.

Of particular concern are the constraints faced by the emerging market and low income economies as they strive to accelerate economic development, expand trade opportunities and alleviate widespread poverty.

Part Four concludes the report by summarizing the main findings and the recommendations for national and international action under the proposed GGND.

[16]According to World Bank. 2008. *Word Development Indicators 2008.* The World Bank, Washington DC., high income economies are those in which 2006 Gross National Income (GNI) per capita was $11,116 or more. In contrast, low and middle income economies are those in which 2006 GNI per capita was $11,115 or less. Most high income economies consist of those countries that comprise the Organization of Economic Cooperation and Development (OECD). The countries currently in the OECD include, from Europe, Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Republic of Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom, and members from other regions, Australia, Canada, Japan, Mexico, New Zealand, South Korea, and the United States. However, a few of these OECD countries do not meet the World Bank's definition of "high income" economies, such as Hungary, Mexico, Poland, Slovakia and Turkey.

PART TWO: The Key Components of a Global Green New Deal

The policy debate over developing a "blueprint" for greening modern economies has been with us for some time.[17] The multiple global crises of the past couple of years have brought renewed attention on the possible convergence between green economy initiatives and short-term solutions to resolving these crises.

The food crisis of the past several years spurred the United Nations in 2008 to assemble a High Level Task Force (HLTF) to recommend international policies to ameliorate the crisis. The HLTF formulated a comprehensive plan of coordinated actions at the national and global level, with short, medium and long term objectives to boost agricultural production, trade and sustainability. The HLTF plan also called on donor countries to double financing for food assistance, other types of nutritional support and safety net programmes, and for an increase in the percentage of aid to be invested in food and agricultural development from the current 3 per cent to 10 per cent within five years.[18]

In response to the growing concerns over climate change and fossil fuel dependency, policy think tanks in the United States have been urging the new US administration to consider specific measures to ensure the development of a "low carbon" economy.[19] In its 2008 Yearbook, the United Nations Environment Programme documented the growing numbers of companies worldwide instigating environmental policies and investors pumping billions of dollars into cleaner and renewable energies.[20] A "Green New Deal" was proposed for the United Kingdom as early as July 2008.[21] A similar focus on building a "green recovery" in the United States was launched soon after.[22]

These initiatives are an encouraging sign that there is an emerging consensus in the international community for a global Green New Deal (GGND). As emphasized in the introduction, to be truly global, such a strategy must encompass widespread adoption by national governments of fiscal measures and other policies over the short term that will expedite economic recovery and create jobs while being consistent with the medium term objectives of reducing carbon dependence, environmental deterioration and extreme world poverty. To achieve these aims, adoption of such a package of initiatives must be implemented quickly, in the next year or two. To be effective, the scale of additional investments and programmes must be large, much more than the "green measures" in current proposals by G20 governments for additional spending over the next one to two years to revive the world economy (see Box 1).

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[17] An early influential contribution to this debate was Pearce, David W., Anil Markandya and Edward B. Barbier. 1989. *Blueprint for a Green Economy*. Earthscan, London. A ten-year retrospective and update appeared as Pearce, David W. and Edward B. Barbier. 2000. *Blueprint for a Sustainable Economy*. Earthscan, London.

[18] High-Level Task Force (HLTF) on the Global Food Crisis. 2008. *Comprehensive Framework for Action.* July 2008. United Nations, New York.

[19] See, for example, Podesta, John, Todd Stern, and Kit Batten. 2007. *Capturing the Energy Opportunity: Creating a Low-Carbon Economy*. Center for American Progress, Washington, D.C., Becker, William S. 2008. *The 100 Day Action Plan to Save the Planet: A Climate Crisis Solution for the 44th President.* St Martin's Press, New York and McKibbin, Warwick and Peter Wilcoxen. 2007. "1. Energy and Environmental Security." Presented by Brookings Global Economy and Development, *Top 10 Global Economic Challenges: An Assessment of Global Risks and Priorities.* Brookings Institution, Washington DC, February 2007.

[20] United Nations Environment Programme. 2008. *UNEP Yearbook 2008: An Overview of Our Changing Environment.* UNEP, Geneva.

[21] Green New Deal Group. 2008. *A Green New Deal: Joined-up policies to solve the triple crunch of the credit crisis, climate change and high oil prices.* New Economics Foundation, London.

[22] Pollin, Robert, Heidi Garrett-Peltier, James Heintz, and Helen Scharber. 2008. *Green Recovery: A Programme to Create Good Jobs and Start Building a Low-Carbon Economy.* Center for American Progress, Washington DC.

Part Two elaborates on the key components that could comprise a timely and effective GGND. These components are based on a strategy aimed at two broad objectives:

- Reducing carbon dependency.
- Reducing ecological scarcity.

Chapters 2.1 and 2.2 highlight how national actions to achieve each of these goals can also achieve the more immediate aims of stimulating economic growth, creating jobs and reducing the vulnerability of the poor. Although the specific priorities, policies, investments and incentive mechanisms adopted by each national government will differ with the economic, environmental and social conditions of the economy, examples are provided of the type of successful initiatives that have been adopted or could be implemented.

As far as possible, each measure discussed is assessed for its impact on not just environmental objectives but also the economic goals of instigating a speedy economic recovery, creating jobs, sustaining growth and reducing poverty.

Because the economic, environmental and social conditions across economies vary considerably, governments will face markedly different challenges in implementing national level actions to achieve these goals. The various challenges faced by governments and the actions required for them are likely, in particular, to differ for three distinct groups of economies: the high-income economies that comprise the Organization for Economic Cooperation and Development (OECD); large emerging market economies, e.g. transition and middle-income economies, including Brazil, China, India and Russia; and low-income economies, which face the most severe constraints in implementing any global GND strategy.

Chapter 2.3 outlines the challenges that especially confront developing economies. Chapter 2.4 concludes Part Two by summarizing the main national actions that are essential for success of the proposed GGND and outlining the US$36 billion Green New Deal of South Korea, which contains many of the national actions advocated in this report.

2.1 Reducing Carbon Dependency

A critical component of the GGND is the necessity to reduce the carbon dependence of the world economy.

As indicated in Box 3, although from 1990 to 2005 the greenhouse gas (GHG) intensity of the world economy may have declined, overall global emissions have risen. They are projected to rise even further over the next twenty-five years, as fossil fuel energy use continues as global populations increase, the world economy grows and poorer economies develop. Thus, reviving economic growth in today's carbon-dependent world economy will simply contribute to both the rising demand for and combustion of fossil fuels and increased GHG emissions.

In 2005, the top ten emitters of greenhouse gases (GHG) were either rich economies (e.g. the United States, European Union, Japan and Canada) or large emerging market economies (e.g. China, Russia, India, Brazil, Mexico and Indonesia). Together, the top emitters accounted for over 70 per cent of the world's total GHG (see Box 3). By 2030, however, this situation is likely to change. Emissions from energy sources alone will more than double for developing economies, increase by nearly 30 per cent in transition economies, and rise by 17 per cent in OECD economies. By 2030, developing economies would account for more than half of world

GHG emissions from energy use, and China's share could be close to one third. Other large emerging market economies, such as India and Russia, will also continue to contribute significantly to global emissions.

Without a change in the carbon dependency of the global economy, the International Energy Agency (IEA) warns that the world is on a path for a doubling of the atmospheric concentration of GHG by the end of this century, and an eventual global average temperature increase of up to 6°C.[23]

Such a scenario is likely to cause a global sea level rise between 0.26 and 0.59 meters, and severe disruption to freshwater availability, ecosystems, food production, coastal populations and human health around the world.[24] According to the Stern Review, with 5-6°C warming, existing estimates of the overall costs suggest an average 5-10 per cent loss in global GDP, with poor countries suffering costs in excess of 10 per cent of GDP.[25]

However, reducing carbon dependency in the world economy is not just about averting global warming. An increasing number of studies have emphasized the importance of reducing fossil fuel use to enhance national and global energy security. The vulnerability of today's economies to oil shocks is now well established.[26] The IEA predicts that the risk of oil supply disruptions has grown in recent years and will continue to grow in the near future, given the continued demand growth for fossil fuels by carbon-dependent economies, increased concentration of the remaining oil reserves in a fewer number of countries, the concentration of oil use in the transport sector, and insufficient additions of oil supply capacity to keep pace with demand growth.[27] The problem is exacerbated by the decline in production from major oilfields. Although the world's oil reserves are sufficiently large to meet future demand for oil, even if this demand were to remain flat until 2030, 45 million barrels per day of additional gross production capacity, approximately four times the current capacity of Saudi Arabia, needs to be found worldwide just to offset the effect of oilfield decline.[28]

Increasingly, reducing the carbon dependency of the world economy is seen as a means to addressing both the twin global objectives of energy security and climate change mitigation.[29]

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[23] International Energy Agency. 2008, *op cit*.
[24] IPCC. 2007. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment*. Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva.
[25] Stern, Nicholas. 2007. *The Economics of Climate Change: The Stern Review.* Cambridge University Press, Cambridge, UK.
[26] Hamilton, James D. 2008. "Oil and the macroeconomy", In Steven N. Durlauf and Lawrence E. Blume, eds. *The New Palgrave Dictionary of Economics* Palgrave Macmillan, London. Available online at http://www.dictionaryofeconomics.com/dictionary. Jiménez-Rodríguez, Rebeca and Marcelo Sánchez. 2005. "Oil price shocks and real GDP growth: empirical evidence for some OECD countries." *Applied Economics* 37(2):201-228. World Bank. 2009. *Global Economic Prospects 2009.Commodities at the Crossroads.* The World Bank, Washington DC.
[27] International Energy Agency. 2007. *Oil Supply Security 2007: Emergency Response of IEA Countries.* Organization for Economic Co-operation and Development and the International Energy Agency, Paris.
[28] International Energy Agency. 2008, *op cit*.
[29]Becker 2008, *op cit*. McKibbin and Wilcoxen. 2007, *op. cit*. "1. Pascual, Carlos and Elkind, Jonathon, eds. *Energy Security: Economics, Politics, Strategies, and Implications.* Brookings Institution Press, Washington, DC. International Energy Agency. 2007. *Energy Security and Climate Policy: Assessing Interactions.* Organization for Economic Co-operation and Development and the International Energy Agency, Paris. United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). 2008. *Energy Security and Sustainable Development in Asia and the Pacific.* ESCAP, Bangkok, Thailand.

Results from country case studies of the Czech Republic, France, Italy, the Netherlands and the United Kingdom reflect a generally worsening trend to 2030 in terms of CO2 emissions and energy security, if these economies do not reduce significantly their carbon dependency.[30] Import dependency on fossil fuels is reaching 100 per cent for the small island developing economies in the Asia-Pacific region, and fossil fuels in China, India, Indonesia, the Philippines, Thailand and Vietnam provide more than three quarters of final energy consumption.[31] It is the increasing carbon dependency of these Asian and other developing economies that not only place them at great risk from future disruptions to global fossil fuel supply but also will ensure that they become the main source of global greenhouse gas emissions by 2030 (see Box 3).

Energy security and vulnerability to climate change take on a completely different dimension for the world's extreme poor. A large fraction of the population in developing countries has no access to modern energy services, and those consumers who do have access often pay high prices for erratic and unreliable services. Approximately 2.4 billion people in developing countries, including 89 per cent of the population of sub-Saharan Africa, rely on traditional biomass fuels for cooking and heating, and another 1.6 billion people do not have access to electricity.[32] The combination of extreme poverty and low human development limits the capacity of the global poor to manage and adapt to rising energy costs and increasing climate risks.

The World Bank has found that the sharp rise in oil prices over the past five years has had a direct impact on global food prices, with a disproportionate impact on the world's poor. For example, the resulting higher food prices over 2005 to 2007 increased the poverty headcount among urban populations of developing countries by 2.9 per cent and among rural populations by 2.1 per cent.[33] The urban poor in developing countries are particularly at risk from the climate-driven impacts of rising sea level, coastal erosion and more frequent storms. Around 14 per cent of all developing country populations, and 21 per cent of their urban dwellers, live in low elevation coastal zones that are particularly vulnerable to these risks.[34] Box 4 summarizes the vulnerability of billions of poor people in developing regions to a wide range of similar climate-induced risks.

Moving to a low-carbon world economy is not only necessary to address mounting concerns over global energy security and climate change but also imperative for improving the human development prospects of the world's poor.

A GGND implemented over the next couple of years can put the world economy on a development path to achieve these objectives, and at the same time boost short-run economic recovery and create millions of jobs worldwide. Achieving these multiple goals will in turn require progress simultaneously in four main areas:

- improving energy efficiency and conservation;

[30] International Energy Agency. 2007. *Energy Security and Climate Policy, op. cit.*.
[31] United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). 2008, *op cit.*
[32] Modi, Vijay, Susan McDade, Dominique Lallement and Jamal Saghir. 2005. *Energy Services for the Millennium Development Goals.* The International Bank for Reconstruction and Development/The World Bank and the United Nations Development Programme, Washington DC and New York, NY.
[33] World Bank. 2009, *op cit.*.
[34] McGranahan, G., D. Balk, D. and B. Anderson. 2007. "The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones." *Environment and Urbanization* 19(1): 17-37. The authors estimate that, in comparison, 10 per cent of the global population lives in the high-risk low elevation coastal zones.

- expanding "clean energy" supply options;
- improving the sustainability of transport;
- adopting economy-wide policy measures to discourage carbon use (such as cap-and-trade, carbon taxes, etc.); and
- at the same time, increasing the availability of affordable and sustainable energy services (e.g., lighting, heating for cooking and space, etc.) for the world's poor.

The remainder of this chapter provides examples of the type of national actions that can be adapted by various national governments in these areas. The next section reviews comprehensive proposals that would alter drastically the carbon dependency of three major world economies, China, the European Union and the United States. The evidence from these three economies, which together account for more than half of World GDP, suggests that implementing these plans would also stimulate new economic sectors, increase the demand for skilled work, create jobs, and thus boost overall economic recovery and sustain growth. The potential for implementing similar proposals in other countries is also discussed. A separate section also looks at policies and actions for improving the sustainability of transport, which is an essential component of a low carbon national strategy.

Creating Low-Carbon Economies

Together, China, the United States and the European Union account for half the world's emissions of greenhouse gases, and under existing policies, these three economies will still be the largest source of these emissions in 2030 (see Box 3). Although this report's advocacy of a global Green New Deal does not rest solely on reducing carbon dependency in these three economies alone, achieving this aim for China, the European Union and the United States would clearly have a major impact on moving the global economy to a more low carbon development path. Moreover, a number of proposals and studies have shown that it is possible to reduce significantly fossil fuel energy use and greenhouse gas emissions in the three economies while at the same time encouraging new economic sectors and employment opportunities. Other OECD and large market economies, especially the major contributors to global GHG emissions, might find it useful to adopt similar strategies as these proposals for China, the European Union and the United States. Governments in low income economies might also consider adopting some elements of the various strategies for creating low-carbon economies whilst promoting a "green" economic recovery.

As indicated in Box 5, China is already committed to policies that will introduce more energy saving and green energy supply options to achieve the twin objectives of improved energy security and reduced carbon intensity of economic production. In addition, China is the world's largest recipient of carbon emission reduction credits under the Clean Development Mechanism (CDM), currently collecting around US$2 billion in tax revenues from these CDM credits. Box 5 describes a number of studies showing that China could accelerate its transition to a low carbon economy by adopting innovative economic policies and instruments, including carbon taxes, other emission taxes and careful targeting of subsidies. The costs of such policies are often more than offset by ancillary benefits, such as improved air quality, increased agricultural productivity, development of new economic sectors and technologies, improved employment and reduced poverty. The Chinese economy would also gain from an increase in employment and

sectoral growth opportunities. Currently, China's renewable energy sector is an important source of exports, has a value of nearly U$17 billion and employs close to a million workers. Expansion of this sector as part of a low carbon strategy would provide a needed boost to employment and growth prospects in China.

The example of China from Box 5 illustrates how the effective implementation of polices for energy efficiency and conservation, increasing clean energy supply options and carbon pricing policies and other economic instruments can be used in a large emerging market economy to foster a transition to a low carbon economy. Several studies have shown that a similar set of policies can induce such a transition across all Asian economies, including low income nations.[35] For example, in 2006, India already accumulated US$2.6 billion in investments in sustainable energy supply, second only to China (US$4.0 billion) among developing economies. If India invested substantially in end-use energy efficient management, it would reduce energy consumption by about 45 per cent by 2030. Similar savings could be achieved by the entire Asia-Pacific region (including the Russian Federation).[36]

Thus, the adoption of a low carbon development strategy for China and the rest of Asia could provide important global leadership to other large market, transition and developing economies of the possibilities of a new development model while stimulating a much needed short-term economic boost and job opportunities. One Asian country that is well on to adopting such a strategy is South Korea. As part of its Green New Deal launched in January 2009, South Korea is investing in energy conservation and environmentally friendly buildings (see Chapter 2.4 for further details). These measures alone will amount to nearly US$6.2 billion in new investments, or over 0.5 per cent of GDP, and will create around 181,000 new jobs.

As illustrated in Box 6, an ideal opportunity exists in the United States to merge short-term interests in creating job opportunities and stimulating economic recovery while transitioning in the medium term to a more low-carbon economy. Such a policy would involve two major components, an immediate "green" fiscal stimulus and the introduction of a carbon pricing policy. The first component involves implementing over the next two years a US$100 billion "green recovery programme" that could create an estimated 2 million jobs through investments in energy efficiency and clean energy strategies. Accompanying this investment programme is the development of a comprehensive cap-and-trade system for greenhouse gas emissions, which could eventually pay for the recovery programme by generating US$75 billion a year in revenues from permit sales. An additional element of the carbon pricing policy would be the immediate elimination of all federal tax breaks and subsidies for the US oil and gas industry, which currently amount to at least US$6 billion annually. In essence, this two-part strategy represents an important component of a national Green New Deal for the United States. The initial cost of the $100 billion green recovery programme is equivalent to just over 0.7 per cent of US GDP. Elements of this programme have already been incorporated into the $827 billion conventional

[35] See, for example, Carmody, Josh and Duncan Ritchie. 2007. *Investing in Clean Energy and Low Carbon Alternatives in Asia.* Asian Development Bank, The Philippines. Renner, Michael, Sean Sweeney and Jill Kubit.2008.*Green Jobs: Towards a Decent Work in a Sustainable, Low-Carbon World.* UNEP/ILO/IOE/ITUC, September 2008.UN ESCAP. 2008, *op cit.* Zhang, ZhongXiang. 2008. "Asian energy and environmental policy: Promoting growth while preserving the environment." *Energy Policy* 36:3905-3924.

[36] UN ESCAP. 2008, *op cit.* See also Shukla, P.R. 2006 "India's GHG emission scenarios: Aligning development and stabilization paths." *Current Science* 90(3):384-395.

fiscal stimulus package proposed by the Obama Administration for implementation over the next two years (see Box 1).[37]

Box 7 indicates that, with its "Triple Twenty" policy, the European Union (EU) is making its own tentative steps towards implementing a Green New Deal. But, as in the United States, more could be done to combine stimulus policies aimed at immediate economic recovery and job creation with a medium-term strategy for a transition to a low-carbon economy. A critical step in this transition is for Europe to expand and improve its cap-and-trade Emission Trading System (ETS) to reduce greenhouse gas emissions while implementing over the next year or two substantial investments in energy efficiency, renewable energy supplies and clean use of fossil fuels. Over the next decade, there are likely to be important synergies in emission reductions and economic gains across all EU member state if these measures are pursued. An immediate and large-scale investment programme to expand energy conservation and renewable energy supply is likely to create at least 1 to 2 million new, full-time jobs. Similar to the United States, the European Union could implement a US$100 billion green recovery programme, which would be equivalent to around 0.7 per cent of EU GDP.[38] Such investments would add significantly to current EU proposals to spend US$259 billion in a conventional fiscal stimulus (see Box 1). However, a large part of the financing of any European green recovery programme could be met through the revenues generated through an expanded ETS. In the next implementation phase, for instance, the ETS is anticipated to earn over US$68 billion in annual revenues for the EU.

The examples of China, the United States, the European Union and South Korea indicate that a large-scale investment in an immediate green recovery programme would not only be an important step in the transition to a low-carbon economy but also stimulate new economic sectors, increase the demand for skilled work, create jobs, and thus boost overall economic recovery and sustain growth. A US$100 billion programme implemented over the next two years in both the United States and the European Union – about 0.7 per cent of GDP in both economies - would be an essential part of such a global Green New Deal. The energy conservation and green building investments that form part of South Korea's Green New Deal amount to 0.5 per cent of GDP, and the full low carbon strategy accounts for 1.2 per cent of GDP (see Chapter 2.4). A similar green recovery stimulus, of approximately the same proportionate magnitude, should be adopted by other high-income OECD economies, such as Australia, Canada, Japan and New Zealand.[39] In China, as well as other large emerging market economies, it is difficult to estimate how much should be invested in an immediate green recovery programme, but it is clear from the example of China in Box 5 that a substantial economy-wide investment in energy efficiency and increasing clean energy supply options would yield substantial benefits in terms of sectoral growth, economic stimulus and employment creation.

Instigating a sizable green fiscal stimulus in energy conservation and clean energy supply options over the next two years is critical for a GGND and to jump start the transition to a low-carbon economy.

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[37] Based on 2007 estimated US GDP in terms of purchasing power parity of $13,780 billion, from the US Central Intelligence Agency *The World Factbook*, available at https://www.cia.gov/library/publications/the-world-factbook/rankorder/2001rank.html.

[38] Based on 2007 estimated European Union GDP in terms of purchasing power parity of $14,430 billion, from the US Central Intelligence Agency *The World Factbook*, available at https://www.cia.gov/library/publications/the-world-factbook/rankorder/2001rank.html.

[39] For example, 0.7 per cent of GDP spent on a green recovery programme over the next two years would mean an expenditure of around US$30 billion in Japan, US$9 billion in Canada, US$5 billion in Australia and US$800 million in New Zealand. Based on 2007 estimated Gross Domestic Product (GDP) in terms of purchasing power parity from the US Central Intelligence Agency *The World Factbook*, available at https://www.cia.gov/library/publications/the-world-factbook/rankorder/2001rank.html.

The examples of China, the United States and the European Union also illustrate the importance of adopting a complementary carbon pricing policy.

Europe is already looking beyond the current ETS to implementation of the next phase; in the United States, a comprehensive cap-and-trade system for greenhouse gas emissions is also the expected outcome. In China, a carbon tax is the more likely and feasible option. These various examples suggest that there are a wide range of possible models for a carbon pricing policy for other high income OECD and emerging market economies to choose from. Both cap-and-trade and carbon tax policies will generate sizable revenues, which could be used for financing a number of investments, including increasing energy conservation and renewable energy supply, reducing poverty and inequality, mitigating distributional impacts and the development of clean energy technologies. Additional revenues could be recycled from the use of other economic instruments, emission taxes and the removal of distortional fossil fuel subsidies. The potential in these economies of ending or reducing fossil fuel subsidies and investing the savings in large-scale investments in clean energy and energy conservation as part of a longer term transition to a low-carbon development path is significant.

Removal of fossil fuel subsidies may be a particularly important component of any carbon pricing policy for some economies. Globally around US$300 billion annually or 0.7 per cent of world GDP is spent annually on such subsidies.[40] The vast majority of fossil fuel subsidies are used to lower artificially the prices of coal, electricity, natural gas and oil products. Contrary to widely held views, most of these subsidies do not benefit the poor but the wealthy; nor do they offer widespread economic benefits. Cancelling these global subsidies would on their own reduce greenhouse gas emissions globally by as much as 6 per cent and add 0.1 per cent to global GDP. The financial savings on these subsidies could be redirected towards investments in clean energy R&D, renewable energy development and energy conservation, which would further boost economies and employment opportunities.

As indicated in Box 6, removal of the US$6 billion fossil fuel subsidies in the United States would provide additional source of funding for a green recovery programme to be implemented over the next two years. Generally, however, the scope for removing fossil fuel and similar energy subsidies is greater in non-OECD rather than OECD economies. Energy subsidies in high income OECD economies amount to about US$80 billion annually, but 20 non-OECD countries account for US$220 billion in such subsidies. Russia has US$40 billion in energy subsidies annually, mostly for lowering natural gas prices, whereas Iran's energy subsidies are around US$37 billion. China, Saudi Arabia, India, Indonesia, Ukraine and Egypt have subsidies in excess of US$10 billion per year. Venezuela, Kazakhstan, Argentina and Pakistan have subsidies between US$5 to 10 billion annually, and South Africa, Malaysia, Thailand, Nigeria and Vietnam have subsidies between US$1 and 5 billion per year.

Initiating the reduction in the carbon dependency of all middle and low income economies must be an important objective of any global Green New Deal. As indicated in Box 3, by 2030 developing economies are expected under current trends to produce over half of global greenhouse gas emissions. China alone will account for half of the emissions of all developing economies, and other large emerging and transition economies will account for much of the rest. But the need to provide low-carbon economic development opportunities for low income economies in the near future is still of paramount importance.

[40] United Nations Environment Programme. 2008. *Reforming Energy Subsidies: Opportunities to Contribute to the Climate Change Agenda.* UNEP, Geneva.

As discussed earlier, similar polices advocated in Box 5 for China to promote energy efficiency and conservation, increase clean energy supply options and implement carbon pricing policies and other economic instruments could be applied in many low income economies. There is, for example, widespread scope for such policies to be implemented across Asia, including its low income economies.[41] Eliminating fossil fuel subsidies to finance such investments is also a potentially important source of financing of renewable energy and energy saving investments in not only large emerging market economies but also in low-income economies where such subsidies are prevalent. In addition, as outlined in Box 8, energy sector reforms in developing countries, such as Botswana, Ghana, Honduras, India, Indonesia, Nepal and Senegal, have proven to be effective in leading a transition to more efficient and cleaner fuels that particularly benefit poor households.

The economic and employment gains for developing economies of such policies could be significant. For example, the IEA estimates that for US$1 invested in improving the energy efficiency of electricity generation can save more than US$3 in investment costs in low and middle income countries, because current efficiency levels are currently much lower in these economies.[42] Small hydropower, biomass and solar photovoltaics (PV) already provides electricity, heat, water pumping and other power for tens of millions of people in rural areas of developing countries. 25 million households depend on biogas for cooking and lighting, and 2.5 million household use solar lighting systems. Developing economies currently account for 40 per cent of existing global renewable resource capacity, 70 per cent of solar water heating capacity and 45 per cent of biofuels production.[43] Expansion of these sectors will therefore be important not only increase the availability of affordable and sustainable energy services for the world's poor but also provide much needed employment opportunities in developing economies.[44]

Reducing Energy Poverty

Such provision of affordable and sustainable energy services is an essential component of the GGND for reducing energy poverty worldwide.

Billions of people in developing economies either have no access to modern energy services or pay high prices for erratic and unreliable services.

As illustrated in Box 9, Grameen Shakti of Bangladesh is leading the way with the dissemination of three renewable energy technologies, PV solar home systems, biogas facilities and improved cooking stoves, in rural areas. Already, over 205,000 homes have been installed with PV solar systems, 6,000 biogas plants have been set up and over 20,000 improved stoves have been disseminated. This has led to the creations of 20,000 jobs, over 1000 renewable energy

[41] See, for example, Carmody and Ritchie. 2007, *op cit*. Renner, Sweeney and Kubit 2008, *op cit*. UN ESCAP 2008, *op cit.* Zhang 2008, *op cit*.
[42] As quoted in UN ESCAP 2008, *op cit*.
[43] REN21. 2008. "Renewables 2007 Global Status Report". REN21 Secretariat, Paris and Worldwatch Institute, Washington DC.
[44] The lack of data makes it very difficult to estimate the employment potential of increasing renewable energy supply options in the developing world. For example, as reported by Renner, Sweeney and Kubit 2008, *op cit.* the renewable energy sector accounts currently for more than 2.3 million jobs worldwide. But these figures include employment for only a handful of developing economies, such as China (943,200 workers in all renewable energy sectors), India (10,000 workers in wind power) and Brazil (500,000 workers in biofuels energy). Nevertheless, the employment potential across the developing world is significant, since these statistics suggest that the three developing economies account already for over 65 per cent of renewable energy employment worldwide.

technicians trained, and numerous other employment opportunities through small-scale training. By 2015, the goal is to reach 7.5 million households with PV solar systems, establish 500,000 biogas units and provide two million stoves, with a direct employment potential of at least 100,000 direct jobs and 10,000 technicians trained.

Access to modern energy services not only reduces poverty but also contribute to economic growth by improving productivity, enabling local income generation and reducing unit energy costs. The use of more efficient fuels can reduce the large share of household income spent on cooking, lighting and heating, thus leading to greater expenditures on food, education, health services and other basic needs Low modern energy service use is also correlated with high infant mortality, illiteracy and fertility, and with low life expectancy.

To achieve the objective of improving the access of the world's poor to modern energy services and thus promoting growth and development in the poorest economies, a report for the UNDP and World Bank advocates three key goals: increasing access to modern fuels and cleaner biomass systems for cooking and heating; ensuring access to electricity in all urban and peri-urban areas; and providing access to mechanical power and electricity at centralized points in rural areas.[45] But the report also suggests that such efforts in developing economies will need institutional support and capacity building from the international community to ensure that these economies have the skills and technology needed to support the development and expansion of modern energy services. As discussed in Chapter 2.4, such skills, technology and finance shortfalls are some of the major challenges facing developing economies in implementing a low carbon strategy for reducing energy poverty.

Improving the Sustainability of Transportation

Globally, the transportation sector accounts for over a quarter of total world energy use and 14 per cent of total greenhouse gas (GHG) emissions.[46] In high-income economies, transportation's share of GHG emissions is even higher, e.g. 26 per cent in the United States and nearly 19 per cent in the European Union. But the largest rates of growth in emissions from transportation are occurring in the Middle East and North Africa (4.0 per cent annual average growth over 1990-2005), Asia (3.9 per cent), Sub-Saharan Africa (3.5 per cent) and Latin America and the Caribbean (3 per cent). [47] Worldwide, GHG emissions from the transport sector are growing the fastest among all economic sectors, and road transport currently accounts for 74 per cent of all emissions from transport.

Unless there is a major shift away from current patterns of energy use, world transportation energy use is expected to grow at 2 per cent per year, with energy use and GHG emissions about 80 per cent above 2002 levels by 2030.[48]

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[45] Modi et al. 2005, *op cit*.

[46] Barker T., I. Bashmakov, L. Bernstein, J. E. Bogner, P. R. Bosch, R. Dave, O. R. Davidson, B. S. Fisher, S. Gupta, K. Halsnæs, G.J. Heij, S. Kahn Ribeiro, S. Kobayashi, M. D. Levine, D. L. Martino, O. Masera, B. Metz, L. A. Meyer, G.-J. Nabuurs, A. Najam, N. Nakicenovic, H. -H. Rogner, J. Roy, J. Sathaye, R. Schock, P. Shukla, R. E. H. Sims, P. Smith, D. A. Tirpak, D. Urge-Vorsatz, D. Zhou, 2007: Technical Summary. In: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O. R. Davidson, P. R. Bosch, R. Dave, L. A. Meyer (eds)],Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[47] These data on greenhouse gas emissions from transportation are from Climate Analysis Indicators Tool (CAIT) Version 6.0. 2008. World Resources Institute, Washington, DC.

[48] Barker et al. 2007, *op cit.*

Improving the sustainability of transportation is also essential for other environmental and economic reasons. Transport is an important infrastructure sector in modern economies and can act as an important stimulus to growth. Transportation networks are essential to the daily functioning of cities, and at the same time, population growth, urbanization and industrial activity are the main drivers for the growth of the transport sector, its increased energy use and its growing share of global GHG emissions, especially in rapidly developing economies. It is estimated that the transport sector in urban metropolitan areas accounts for a third or more of total GHG emissions by cities.[49] In addition, air pollution from transport has become one of the worst environmental and health hazards in urban areas of developing countries, particularly due to the high concentrations of urban populations, rapid rates of urbanization and inefficient transport systems. Finally, the poor in urban areas are adversely affected by lack of access to public transportation, the high cost of motorized transport and high accident rates from unreliable road transport.

Creating a more sustainable global transport system is also about enhancing the efficiency, economic growth and job potential of transport networks. There are several reasons why the current global transport system, with its increasing over-reliance on motorized and privately owned road transport, is failing on all three counts.

First, such a system has stressed the benefits of mobility over accessibility. This has resulted in unexpected consequences for urban development, land use planning and employment opportunities. For example, in the United States, the rapid expansion of the highway system between 1950 and 1990 contributed significantly to the population decline of major cities.[50] Unfortunately, the US model has become the model for global transport systems, especially as per capita income rises and automobile use increases. This auto-oriented urban structure, rather than improving the accessibility of jobs, may have worsened it. For example, a study comparing Boston, Los Angeles and Tokyo shows that job accessibility is significantly lower in all three cities for public transit users than for automobile users, but accessibility for public transit users in the US cities is much lower than in Tokyo. In other words, in modern metropolitan areas, lack of access to a private vehicle reduces employment opportunities, but this is particularly true as countries follow the US transportation example and become more auto-oriented.[51]

Second, the bias in the current global transport system towards greater motorized vehicle use, road transport and increased energy use is further exacerbated by sizable transportation market distortions, including the "underpricing" of motorized travel, current urban and land use planning practices that encourage automobile use, and distortions in public investment in favor of road transport over other modes of travel. These distortions lead to additional economic and social costs, including traffic congestion, higher transportation costs, inefficient energy consumption and increased accidents. Most of these latter costs are "external", in that they are imposed on others by vehicle users, and typically comprise about a third of the total costs of automobile use.[52] In the United States, such costs are approaching US$50 billion a year.[53] The economic consequences are often cumulative and far-reaching. In the case of congestion, for example,

[49] World Bank. 2006. *Promoting Global Environmental Priorities in the Urban Transport Sector: Experience from World Bank Group-Global Environmental Facility Projects.* World Bank, Washington DC.
[50] Baum-Snow, Nathaniel. 2007. "Did Highways Cause Suburbanization?" *Quarterly Journal of Economics* 122(2):775-805.
[51] Kawabata Mizuki and Qing Shen. 2006. "Job accessibility as an indicator of auto-oriented urban structure: a comparison of Boston and Los Angeles with Tokyo" *Environment and Planning B: Planning and Design* **33**(1) 115 – 130.
[52] Litman, Todd. 2006. "Transportation Market Distortions." *Berkeley Planning Journal* 19:19-36.
[53] Winston, Clifford and Ashley Langer. 2006. "The effect of government highway spending on road users' congestion costs." *Journal of Urban Economics* 60:463-483.

there are multiple economic effects. A World Bank report finds that the trend towards increased per capita vehicle use in developing economies is leading rapidly to more road congestion, which in turn increases travel time for surface public transport such as buses. But the result is more auto and taxi use, adding to the congestion problem.[54] In large US metropolitan areas, vehicle congestion has reached such significant proportions that it is impacting employment growth. Estimates suggest that a 10 per cent increase in congestion, for a city with travel delays comparable to that of Los Angeles, reduces long-run employment growth by 4 per cent.[55] As current trends in global urbanization and traffic congestion continue, the reductions in employment growth in major cities could be substantial. The billions of dollars that policymakers spend annually on expanding the road network are becoming less effective in decreasing congestion. For example, in the US, every dollar spent on highways reduces the congestion costs to motorists, trucking operations and shipping firms by only eleven cents.[56]

Third, the current global transport system, which encourages more private motorized vehicle use, also disadvantages the poor. In Mumbai, India, over 44 per cent of all commuters walk to work, and 63 per cent of the poor walk to work. The poor who rely on transport generally use public transit; 21 per cent of the poor in the urban center take the bus to work and 25 per cent of the poor in the suburbs take rail to work.[57] Throughout the developing world, at low levels of income people generally take public transit or use some form of non-motorized transport or simply walk. At a middle-income level, there is increased reliance on small motorized transport, such as jitneys, scooters or motorcycles. It is only at high-income levels that private car vehicle use emerges. But it is the low and middle income households that spend the most on transportation, up to 30 per cent of their income in urban areas.[58] Similarly, in Africa, the poorest urban households pay as much as a quarter of their income for transport.[59] As a result, it is the poor who suffer disproportionately from higher transportation costs. For example, in four Asian developing economies as fuel prices rose between 2002 and 2005, poor households paid 120 per cent more for transportation.[60] In rich countries, such as the United States, the poor tend to concentrate in city centers, spend a higher proportion of their income on transportation expenditures, and are highly reliant on public transit.[61] Thus, poor households are vulnerable to the costs and availability of public transportation systems, which are often under-funded and limited; consequently, access to public transit has a significant factor on rates of labor participation and employment of inner-city residents.[62]

A Global Green New Deal should aim to improve the sustainability of transportation systems worldwide, including improving the access to transport by the poor, and at the same time boost short-run economic recovery and create millions of jobs.

Achieving these multiple goals is possible through progress in five main areas:

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[54] World Bank 2006, *Promoting Global Environmental Priorities in the Urban Transport Sector*, *op cit.*
[55] Hymel, Kent. 2009. "Does traffic congestion reduce employment growth?" *Journal of Urban Economics*, in press.
[56] Winston and Langer 2006, *op cit.*
[57] Baker, Judy, Rakhi Basu, Maureen Cropper, Somik Lall and Akie Tkeuchi. 2005. "Urban Poverty and Transport: The Case of Mumbai." *World Bank Policy Research Working Paper 3693.* The World Bank, Washington DC.
[58] Sperling, Daniel and Salon, Deborah. 2002. *Transportation in Developing Countries: An Overview of Greenhouse Gas Reduction Strategies.* Prepared for the Pew Center on Global Climate Change.
[59] Renner, Sweeney and Kubit 2008, *op cit*.
[60] UN ESCAP 2008, *op cit.*
[61] Glaeser, Edward L., Matthew E. Kahn and Jordan Rappaport. 2008. "Why do the poor live in cities? The role of public transportation." *Journal of Urban Economics* 63:1-24.
[62] Sanchez, Thomas W. 1999. "The Connection Between Public Transit and Employment." *Journal of the American Planning Association* 65(3):284-296.

- develop the next generation of fuel-efficient cars, low carbon biofuels and the delivery system infrastructure for the new fuels and cars.
- encourage modal shifts in transportation systems from road transport to rail and public transit.
- reduce the miles traveled in motorized vehicles through smart transport, urban and land use planning
- improve the accessibility to affordable transport by the poor.
- remove transport market distortions and implement, where appropriate, market-based instruments and regulations to improve the sustainability of transport systems.

The next section provides examples of various measures that could be implemented by national governments of all economies, and which would also stimulate new economic sectors, increase the demand for skilled work, create jobs, and thus boost overall economic recovery and sustain growth.

Actions to Make Transport More Sustainable

One of the hallmarks of the current worldwide recession is the slump in global auto sales. In late 2008, car sales fell by 30 per cent over the previous year, and the average annual rate of decline is expected to be at least 8 per cent over 2009.[63] The big three automakers in the United States, Ford, General Motors and Chrysler, have negotiated a $15 billion loan bailout from the US Government. Toyota has predicted its first fiscal year operating loss in its 70 years of operation, and Nissan has reported a decline in global production of more than a third. As the recession deepens, the crisis in the global auto industry is expected to worsen, given that historically employment and income growth have been the key determinants of vehicle sales.

Attempts to revive the world economy go hand-in-hand with the recovery of the global automobile industry. With the industry facing falling sales, especially for its less fuel-intensive passenger vehicles, and becoming more dependent on financial loans and other support from national governments, now is the ideal time to combine a recovery programme for the auto industry with necessary incentives and restructuring to develop the next generation of fuel-efficient vehicles and the biofuels for their use.

An important objective of the Global Green New Deal should be to ensure that the economic recovery of the worldwide automobile industry is "green".

As indicated in Box 10, the employment implications of developing more fuel-efficient vehicles for the global automobile industry could be significant. If the entire worldwide industry moved to similar rates of employment as Japan's auto makers in producing vehicles with cleaner technology, then over 3.8 million jobs could be directly related to the production of vehicles with high fuel efficiency, hybrid and alternative fuel use and low emission technologies. In addition, the ratio of indirect to direct jobs currently ranges from 4 to 1 (Japan) to 6.5 to 1 (United States). If the ratio were 5 to 1 worldwide, then up to 19 million additional ancillary jobs in fuel refining and distribution, sales, repairs and services may be created by developing cleaner vehicle technology. Of course there would also be significant job displacement as traditional vehicle

[63] Gomes, Carlos. *Global Economic Research: Global Auto Report.* Scotia Economics, Toronto, ON, January 8, 2009.

manufacture declines. But in the United States it is estimated that just increasing fuel economy standards could expand fuel-efficient vehicle production and create directly up to 350,000 new net jobs, mostly in the states most affected by the current crisis in the global automobile industry: Michigan, Ohio, California and Indiana.

Developing the next generation of low-carbon biofuels and a national delivery system will be an important complement to the expanding fuel-efficient vehicles in the global automobile industry (see Box 11). Interest in biofuels for motorized vehicles has increased worldwide due to concerns over energy security, reducing greenhouse gas emissions and the need to increase and diversify agricultural and export income. The employment potential could be substantial. Already, at least 1.2 million jobs are involved worldwide in biofuel production, and given the high labor-intensity of biofuels, expansion of global production could easily yield 10 million jobs or more.

However, there are major concerns about the negative consequences of expanded biofuel production globally, including the competing demands for land and water, deforestation and pollution, displacement of small farmers and indigenous people, poor working conditions and labor practices, and the impacts on global food and feed prices. The development of second-generation feedstock that could yield higher gasoline-equivalent fuel productivity, such as algae, castor oil, crop wastes, jatropha, lignin, perennial grasses, short rotation woody crops and forest-industry wastes, may reduce some of these problems and also create more opportunities for employment (see Box 11). Such developments need to be complemented by the adoption and enforcement of labor and environmental regulations worldwide to improve working practices and conditions and to reduce impacts on land and water use, deforestation and the displacement of other agricultural activity, small farmers and indigenous populations.

Public and rail transport is less carbon and energy-intensive than private motorized vehicle travel, and they also have the potential for creating jobs.

Investments in urban public transit and rail networks to transport passengers and freight not only create jobs directly in the employment of transit and railway operators and workers but also have strong multiplier effects on job creation through providing basic infrastructure investments that boost a wide range of construction, engineering and manufacturing jobs at all different skill levels (see Box 12). Public urban transit systems have significant direct employment impacts globally, accounting for 367,000 workers in the United States and 900,000 in the European Union alone. Investment in public urban transit also has major secondary employment effects. In Europe, public transit investments have a multiplier effect of 2 to 2.5 indirect jobs created, but in countries that invest heavily in public transport, such as Switzerland, the multiplier effect rises to 4.1. In addition, the induced employment effect of reducing the costs of transport to the urban poor and improving their mobility may also be significant. Investments in pubic and rail transport, along with land use and urban planning to improve non-motorized transport such as bicycling and walking, may also lead to a "modal shift" in densely populated areas away from vehicular use to these other forms of transport. The result may not only be reduced pollution and greenhouse gas emissions but also net job creation.

The employment and economic gains of public and rail investments can be enhanced in the short run by targeting them carefully. For example, the low carbon strategy advocated for the United States and outlined in Box 6 suggests that the following investments in the country's mass transit system could be implemented immediately:

- expand existing bus and subway services in urban areas
- lower public transportation fares.
- expand federal support for state and municipal transit operation and maintenance budgets
- increase federal subsidies for employer-based mass transit incentives.
- fund critical mass transit programmes currently bottlenecked for lack of federal financing.[64]

A similar set of short-term policies to enhance economic recovery, create employment and improve the sustainability of transportation systems could be adopted by the European Union and other high income economies. In developing economies, priority must be placed on investments that develop safe, reliable and affordable urban transport systems, based on fuel-efficient systems such as compressed natural gas (CNG) buses and Bus Rapid Transport (BRT) systems. Expansion, maintenance and improvements in railway networks for passengers and freight should also be an important goal.

Enhancing the economic, environmental and employment gains from a sustainable transportation strategy will require the removal of transport market distortions and the implementation of market-based instruments and regulations (see Box 13). Removal of market and planning distortions would contribute to less economic waste, reduce pollution and congestion, foster greater transport choice and facilitate sustainable transport strategies that would boost economic recovery and employment. Fiscal policies, such as fuel and vehicle taxes, new vehicle incentives, road fees, user fees, vehicle insurance and fleet vehicle incentives, can have powerful impacts on encouraging the introduction of cleaner, fuel-efficient vehicles. Combining these policies with regulatory measures, such as more stringent greenhouse gas and fuel economy standards, may produce the most important shifts in vehicle demand and use. Such policies are proving increasingly attractive not only to high-income OECD economies but also to large emerging market economies, such as China and India.

Summary and Conclusion

Reducing the carbon dependency of the world economy is increasingly seen as a means to addressing both the twin global objectives of energy security and climate change mitigation. Transitioning to a low-carbon world economy is also imperative for improving the human development prospects of the world's poor, especially combating the worldwide problem of energy poverty. Policies to improve energy efficiency and expand clean energy supply options, if implemented correctly, can create a substantial number of jobs and boost important economic sectors in the short term. Instigating a sizable green fiscal stimulus over the next two years is critical for a GGND and to jump start the transition to a low-carbon economy. The examples of low-carbon strategies for China, the United States and the European Union discussed in this chapter also illustrate the importance of adopting a complementary carbon pricing policy. An important component of any low carbon strategy implemented under a GGND should be policy actions to improve the sustainability of transport, including improving the access to transport by the poor worldwide. Ensuring that the economic recovery of the worldwide automobile industry is "green" requires encouraging the development of fuel-efficient vehicles and the next-

[64] Pollin et al. 2008, *op cit.*

generation biofuels for these vehicles. Public and rail transport is less carbon and energy-intensive than private motorized vehicle travel, and they also have the potential for creating jobs.

The low carbon, "green recovery" strategies advocated in this chapter suggest that programmes amounting to around 0.7 per cent of GDP in the United States and also the European Union are feasible. If such programmes are extended to include the additional policies and investments for sustainable transport discussed above, then a low carbon strategy of about 1 per cent of GDP would have a substantial impact on reducing carbon dependency while providing an immediate boost to economic recovery and job creation. As part of its Green New Deal, South Korea has already adopted this target, spending over 1.2 per cent of its GDP on investments for railroads and mass transit, fuel efficient vehicles and clean fuels, energy conservation and environmentally friendly buildings that will also create 334,000 jobs (see Chapter 2.4). However, as outlined in this chapter, much of the financing of the proposed low carbon measures could come from removing and reallocating perverse energy and transport subsidies and other market distortions as well as from complementary carbon pricing policies, such as the revenues from cap-and-trade or any additional taxes. It seems reasonable, therefore, to suggest that all high-income economies aim for the 1 per cent of GDP target for implementing a low carbon strategy as part of the GGND. Large emerging market economies, such as the example of China discussed in this chapter, could also aim to spend at least 1 per cent of their GDP on the national actions proposed for reducing carbon dependency. Developing economies should also implement many of these measures, especially those that improve the access of the poor to transport, although it is difficult to determine how much these economies should spend on these activities.

2.2 Reducing Ecological Scarcity

The previous chapter emphasized measures towards creating low carbon economies as part of an overall Global Green New Deal that can stimulate economic recovery and create employment over the next 1-2 years while putting the world on a more economically and environmentally sustainable development path. Such a strategy should a priority for all economies – high income OECD economies, large emerging market economies and low income economies.

Although a low carbon strategy is important to a GGND, this chapter addresses another critical area, reducing ecological scarcity, which is crucial to the aim of eliminating poverty worldwide.

A GGND cannot be truly global in scope in less it addresses all the pressing needs of the world economy. A critical need is to tackle urgently the problem of extreme world poverty.

This report emphasizes that the GGND must also contribute to achieving the Millennium Development Goals for developing countries so that by 2015 the goal of ending extreme global poverty is attainable. The following chapter establishes the link between ecological scarcity and the livelihoods of the poor. It then outlines several ways in which national actions can improve these livelihoods while making progress towards reducing ecological damages, improving natural resource management and managing global water scarcity.

Ecological Scarcity and Poverty

Ecological scarcity is the loss of myriad ecosystem benefits, or "services", as these systems are exploited for human use and economic activity.[65]

As noted in Part One, this scarcity problem is accelerating on a global scale, and is manifesting itself in the loss of many vital ecosystem services. The world's ecosystems and freshwater sources will continue to be endangered by a world economic recovery that ignores environmental degradation. Over the past 50 years, ecosystems have been modified more rapidly and extensively than in any comparable period in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber and fuel. The result has been a substantial and largely irreversible loss in biological diversity. Approximately 15 out of 24 major global ecosystem services have been degraded or used unsustainably, including freshwater, capture fisheries, air and water purification, and the regulation of regional and local climate, natural hazards, and pests.[66]

Poor people in developing countries are especially vulnerable to the resulting loss in critical ecological services. [67] Nearly 1.3 billion people in developing economies – over a fifth of the world's population – live in live on lands prone to degradation and water stress, and in upland areas, forest systems, drylands and similar fragile environments (see Box 2). Almost half of this population (613 million) consists of the rural poor.[68] For the world's poor, global water scarcity manifests itself as a water poverty problem. One in five people in the developing world lacks access to sufficient clean water, and about half the developing world's population, 2.6 billion people, do not have access to basic sanitation. More than 660 million of the people without sanitation live on less than US$2 a day, and more than 385 million on less than US$1 a day.[69]

As the world economic crisis deepens and expands, it the economic livelihoods of the poor who are most vulnerable to the economic consequences, and increasing ecological scarcity adds further to the economic vulnerability of the poor.

Thus, a GGND must also tackle urgently the problem of extreme world poverty caused by rising ecological scarcity, as well as implement measures that more directly reduce the vulnerability of the world's poor.

The following chapter outlines several ways in which the vulnerability of the poor can be ameliorated through specific national actions in three main areas in developing economies:

- Policies, investments and reforms to enhance the sustainable and efficient use of natural resources and production processes dependent on them, and to ensure that the sufficient financial returns generated from these activities are re-invested in the industrial activities, infrastructure, health services, and the education and skills necessary for long-term economic development.
- Targeting investments and other policy measures to improving the livelihoods of the rural poor, especially those living in fragile environments.

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[65] Barbier, Edward B. 1989. *Economics, Natural Resource Scarcity and Development: Conventional and Alternative Views.* Earthscan Publications, London, pp. 96-7.
[66] Millennium Ecosystem Assessment. 2005, *op cit.*
[67]OECD 2008, *op cit.* UNDP 2008, *op cit.* Sukhdev 2008, *op cit.*
[68] World Bank. 2003. *World Development Report 2003, op cit*. Comprehensive Assessment of Water Management in Agriculture. 2007, *op cit.*
[69] United Nations Development Programme. 2006, *op cit.*

- Protecting and improving the provision of ecosystem services on which the extreme poor depend.

However, if a Global Green New Deal is to have a lasting impact on reducing worldwide poverty and at the same time ensure that the ensuing global economic recovery is sustainable, then the GGND must also include policy measures to address another looming global ecological scarcity problem – the emerging water crisis.

There are two aspects of this emerging water crisis: the worldwide scarcity of freshwater supplies relative to increasing demand, and the lack of clean water and sanitation available for millions of the poor in developing regions. This chapter also outlines how a GGND must improve water management worldwide in order to meet these two challenges.

Improving the Sustainability of Primary Production

Improving the sustainability of primary production in developing economies is an important means to achieving the goal of reducing worldwide poverty.

Most developing economies, and certainly the majority of the populations living within them, are directly dependent on exploiting natural resources. For many of these economies, primary product exports account for the vast majority of their export earnings, and one or two primary commodities make up the bulk of exports.[70] On average across these countries, agricultural value added accounts for 40 per cent of GDP, and nearly 80 per cent of the labor force is engaged in agricultural or resource-based activities.[71] By 2025, the rural population of the developing world will have increased to almost 3.2 billion.[72]

Much of this rural population in developing countries depend directly on the exploitation of natural resources and the environment for agriculture, livestock raising, fishing, basic materials and fuel – to meet their own subsistence requirements and to sell in markets for cash income. The lack of water supply, sanitation and other infrastructure services suggests that increased public provision of such basic services is highly valued by many households. Rapid land-use change has meant that many natural environments and habitats are disappearing quickly, with the result that critical ecological services are being disrupted or lost, including freshwater, fisheries and other vital benefits. The demise of key ecosystems of the developing world include mangroves (35 per cent either lost or degraded), coral reefs (30 per cent) and tropical forests (30 per cent).[73]

As noted above, the livelihoods of one quarter of the population in developing countries – almost 1.3 billion – are particularly vulnerable to ecological disruption, and they account for much of

[70] Barbier 2005, *op cit.*
[71] World Bank. 2008. *Word Development Indicators 2008, op cit.*
[72] Population Division of the Department of Economics and Social Affairs of the United Nations Secretariat. 2008.*World Urbanization Prospects: The 2007 Revision: Executive Summary*. United Nations, New York.
[73] See, for example, Houghton, R.A. 1995. "Land Use Change and the Carbon Cycle." *Global Change Biology* 1:257-287. MEA 2005, *op cit.* Sukhdev 2008, *op cit.* European Communities, Brussels. United Nations Environment Programme (UNEP). 2006. Marine and coastal ecosystems and human wellbeing: A synthesis report based on the findings of the Millennium Ecosystem Assessment. UNEP, Nairobi. Valiela, I. J.L. Bowen and J.K. York. 2001. 'Mangrove Forests: One of the World's Threatened Major Tropical Environments.' *BioScience* 51(10), 807-815.

the world's extreme poor who live on less than US$2 per day (see also Box 2). These populations live in regions with no access to irrigation systems, farm poor soils or land with steep slopes, and inhabit fragile forest systems. By 2015, despite a decline in the share of the world population living in extreme poverty, there is still likely to be nearly 3 billion people living on less than US$2 a day. As indicated in Box 14, many low and middle-income economies fall into a persistent pattern of resource use that shows a chronic problem of resource dependency, the concentration of large segment of the population in fragile environments, and rural poverty.

Improving the sustainability of primary production in developing countries would therefore allow these economies to achieve multiple development objectives.

For the foreseeable future, primary product exports will remain the main source of export earnings and savings that will facilitate the foreign direct investment, domestic private and public investment and international borrowing necessary for financing sustained economic development. Sustainable income from primary production is not only essential for generating the necessary savings and revenues in the long run but also important to ensure that sufficient financial flows are available for investment in the physical capital, infrastructure, skills, health services and educational opportunities necessary for long-term development.

Encouraging more primary production from a country's natural resource endowment is not truly sustainable unless it also alleviates the persistence of widespread poverty, especially rural poverty, and improves the economic livelihoods of the large numbers of people concentrated in fragile, resource-poor environments. Too often in developing economies the main export-oriented primary production activities are isolated enclaves that have little forward and backward linkages with the rest of the economy. The income and employment benefits are limited to those producers, workers and entrepreneurs fortunate enough to participate in the sector, but the vast majority of rural households, low skilled workers and traditional industries in the economy hardly benefit. Moreover, the economy often specializes in to producing a handful, or even just one or two, main primary product exports. Any processing activities are vertically integrated with the primary production but not necessarily horizontally linked to rest of the economy.

Although the large returns from investments to expand export-oriented primary production attract wealthy investors, the downside is that many developing country governments have overly encouraged such investors by specific sectoral and economy-wide policies that routinely distort markets and incentives in their favor. The result is often the encouragement of wasteful use of natural resources, more costly but less efficient production activities and persistent problems of corruption and poor governance.[74]

[74] See, for example, Ascher, William. 1999, *Why Governments Waste Natural Resources: Policy Failures in Developing Countries,* Johns Hopkins University Press, Baltimore. Auty, Richard M., ed. 2001. *Resource Abundance and Economic Growth.* Oxford University Press, Oxford. Auty, Richard M. 2007. "Natural resources, capital accumulation and the resource curse." *Ecological Economics* 61(4):600-610. Barbier 2005, *op cit.* Gylfason, Thorvaldur. 2001. "Nature, Power, and Growth." *Scottish Journal of Political Economy* 48(5):558-588. Isham, Jonathon, Michael Woolcock, Lant Pritchett and Gwen Busby. 2005. "The Varieties of Resource Experience: Natural Resource Export Structures and the Political Economy of Economic Growth." *World Bank Economic Review* 19(2):141-174. Jensen, Nathan and Leonard Wantchekon. 2004. "Resource Wealth and Political Regimes in Africa." *Comparative Political Studies* 37:816-841. Stijns, Jean-Philippe. 2006. "Natural Resource Abundance and Human Capital Accumulation." *World Development* 34(6):1060-1083. Torvik, Ragnar. 2002. "Natural Resources, Rent Seeking and Welfare." *Journal of Development Economics* 67:455-470. Wunder, Sven. 2003. *Oil Wealth and the Fate of the Forest: A Comparative Study of Eight Tropical Countries.* Routledge, London.

A Global Green New Deal should aim to improve the sustainability of primary production activities worldwide, and at the same time contribute to the goal of reducing substantially extreme world poverty.

The next section provides examples of the type of national actions that can be adopted by developing economy governments to achieve this objective of improving the overall sustainability of primary production, natural resource management and economic development.

Creating More Sustainable Resource-Dependent Economies

Because developing countries differ widely in their natural resource endowments, primary production activities and even their level of economic development, it is difficult to formulate a prescription of the type of policies, investments and reforms that are required by all countries to improve the sustainable and efficient use of natural resources and production processes dependent on them.

These measures should ensure that natural resources and the production processes dependent on them are developed efficiently so as to generate the greatest economic returns from these activities, that the political and legal institutions governing resource management and primary production discourage waste, corruption and illegal activities, and that the financial returns from primary production are reinvested in the economy to develop complementary processing and other industrial capacities, enhance human skills, health and education and create a more diversified economy.

To illustrate the specific strategies that resource dependent developing economies might pursue to achieve these objectives, this report focuses on three economies that have shown a great deal of progress: Malaysia, Thailand and Botswana. All three countries managed to achieve a long-term investment rate exceeding 25 per cent of GDP and long-run average annual growth rates exceeding 4 per cent, which are investment and growth rates comparable to that of high income economies.[75] Malaysia and Thailand represent examples of developing economies which manage to successfully diversify their economies through re-investing the financial gains from primary production for export. Botswana is an example of a resource-rich economy that developed favorable institutions and policies for managing its natural wealth and primary production for extensive economy-wide benefits.

Malaysia has implemented a number of policies to improve the economic returns from its primary production activities, mainly from the mineral and forest products industries, and reinvested these returns in diversifying the economy (see Box 15). The result has been a rapid decline in the resource dependency of the economy in recent decades, the widespread improvement in employment, wages and livelihoods, and the expansion of educational and training opportunities. However, common to many developing economies, Malaysia's fast paced development has been accompanied by significant depletion of mineral, timber and other natural resources as well as agricultural conversion of forests. But, on the whole, the development strategy has succeeded in using investible funds from resource use and primary production to

[75] Gylfason 2001, *op cit.* Indonesia also achieved similarly high rates of investment and per capita GDP growth, but Gylfason concludes that "a broader measure of economic success – including the absence of corruption, for instance – would put Indonesia in less favourable light. Moreover, Indonesia has weathered the crash of 1997-1998 much less well than either Malaysia or Thailand."

finance physical and human capital formation that more than offset the depletion of natural resources.

Thailand's approach to diversifying its economy and sustaining growth was initially similar to that of Malaysia (Box 16). However, Thailand's remarkable success with resource-based development has occurred without the benefit of substantial mineral and timber reserves capable of generating significant economic returns. Instead, this development has been accomplished through considerable investments in agro-industrial industries, with extensive forward and backward linkages to domestic plantation crops, food crops and fisheries. The result has been a relative decline in the agricultural sector relative to the rest of the Thai economy, including a dynamic labor-intensive manufacturing sector, accompanied by rising rural wages and a fall in total planted area, which in turn has reduced pressures for land conversion and deforestation. However, there are problems in some sectors, such as the over-expansion of shrimp aquaculture at the expensive of coastal mangrove systems, and the lack of a coherent development strategy for poorer upland areas. Overall, however, Thailand has demonstrated that economic diversification and development can be achieved through careful policies and investments in a food-export agricultural-based economy and the reinvestment of the resulting economic returns.

Botswana, demonstrates that an African economy and a country entirely dependent on mineral export earnings are not barriers to achieving substantial and sustained economic progress (Box 17). One of the keys to Botswana's success has been the adoption of appropriate and stable economic policies during commodity booms and busts. Such policies include managing the exchange rate to avoid excessive appreciation during boom periods; using windfalls to build up international reserves and government balances that provide a cushion when booms end; avoiding large-scale increases in government expenditure and instead targeting investments to public education and infrastructure; and finally, pursuing an economic diversification strategy that has led to modest increases in labor-intensive manufactures and services. Botswana has also developed complementary legal and political institutions for facilitating the long-term management of the economy, fostering political stability and low corruption, and investing in universal education. Botswana's continued success will depend on progress in reducing its over-reliance on public sector investment, encouraging the transition of manufacturing from producing non-tradable to export goods, and developing a successful agricultural strategy aimed at the rural poor and populations living in fragile environments.

Several lessons for improving the sustainability of primary production in other resource-dependent economies can be learned from these three country examples.

First, the type of natural resource endowment and primary production activities is not necessarily an obstacle to implementing a successful strategy. Botswana's economy is largely dependent on minerals, Thailand started out as almost exclusively an agricultural-based food exporter and Malaysia built its success first on mineral and timber reserves, then plantation tree crops, and finally, by developing a highly diversified economy.

Second, because resource endowments, primary production activities and the historical, cultural, economic and geographical circumstances of each country are different, the type of development strategy adopted by each will also vary. For example, Thailand and Malaysia initially embarked on similar strategies to encourage sustainable primary production and resource use, but the primacy of agriculture in Thailand plus differing economic and social conditions meant that its diversification strategy eventually diverged from that of Malaysia.

Third, the development strategy has to be comprehensive. Targeting the main primary production activities of an economy to improve their competitiveness, attain their export potential, limit resource over-exploitation and waste, and generate increased returns and revenues is necessary but not sufficient. All three countries' policies show that the financial returns and funds generated from primary production activities must be re-invested in the industrial activities, infrastructure, health services, and the education and skills necessary for long-term economic development.

Finally, no strategy is perfect. In all three countries, important sectors and populations have yet to gain significantly from improving the sustainability of the main primary producing sectors. In Malaysia, there is concern about the continuing destruction of forests, especially in the more remote Sabah and Sarawak Provinces, and the plans to expand oil palm plantations. In Thailand, the loss of mangroves, growing pollution problems and the failure to instigate development in upland regions are major issues. Botswana has still to grapple with a stagnant agricultural sector, large numbers of people living in fragile environments and widespread rural poverty. Finding ways to broaden the benefits of measures to improve the sustainability of resource-dependent economies must be an important additional goal.

Improving the Livelihoods of the Poor

The high concentration of poor populations in the fragile environments and marginal lands of many developing economies is a pressing concern in the efforts to reduce extreme global poverty.

Not only do these rural households depend directly on exploiting the land and natural resources available in these environments for their economic livelihoods but poor people are particularly vulnerable to the deteriorating ecological conditions in these environments, which are resulting from the widespread loss of tropical forests, coral reefs, mangroves and other ecosystems. Box 18, for example, provides many examples of this complex inter-relationship from across the developing world. Thus managing these environments and ecosystems is an important aspect of efforts to improve the economic livelihoods of the poor. Equally, fostering more economic opportunities and raising the standard of living of the poor located in fragile environments can contribute to lessening pressure on surrounding ecosystems.

Both approaches have a role in a GGND that aims to improve the livelihoods of the poor. Current efforts to reconcile development pressures with maintaining key ecosystem benefits focus on payment for environmental services and other incentives to protect critical ecosystems and habitat in developing countries. To the extent that such payments and incentives benefit the poor directly, the result will be to improve their livelihoods and conserve more critical habitats. But geographical targeting and other means of tackling poverty more directly should also be considered. Designing investment programmes and policies targeted to the poor is likely to reduce the development pressures on fragile environments and ecosystems as well.

If the livelihoods of the poor depend on ecosystem services, then developing markets that provide incentives for protecting critical ecosystems and habitat may also help reduce poverty. Such markets to establish "payment" for providing ecosystem services in developing regions has largely focused on forest systems, and mainly four services from such systems: carbon

sequestration, watershed protection, biodiversity benefits and landscape beauty.[76] Beginning in the 1990s, payment for ecosystem services started principally in Latin America, but in recent years it has been adopted in Sub-Saharan Africa and Asia. Hydrological services from watershed protection tend to predominate, although carbon sequestration schemes through the Clean Development Mechanism (CDM) of the Kyoto Protocol have expanded in recent years. One reason that countries and companies are increasingly eager to finance forestry sector CDM projects in developing countries to meet Kyoto obligations is that carbon sequestration costs in tropical regions are significantly lower compared to other locations; e.g., forest CDM projects in Europe cost around US$777 per tonne of carbon sequestered whereas in the tropics the most expensive projects cost US$128 per tonne of carbon sequestered.[77]

There are three principal ways in which market mechanisms for ecosystem services might also alleviate poverty. First, if payments for ecosystem services are made directly to poor rural households to maintain or enhance these services, then they provide needed cash income. Second, whether or not the rural poor receive direct payments, they may benefit indirectly from any resulting improvement in the provision of ecosystem services. Third, the rural poor may also gain from any additional economic opportunities created by payment schemes, such as the employment created by reforestation or other conservation investments. However, in all these instances, there appears to be limits on the success of payment schemes in alleviating poverty.

To date, the main purpose of introducing payment for ecosystem services is to influence land-use decisions by enabling landholders to capture more of the value of these environmental services than they would have done in the absence of the mechanism. While in some cases participants in such schemes do not have to demonstrate formal land titles to be eligible for payments, many of the rural poor in developing regions lack not only formal but also actual access to land. Others are near-landless or have holdings so small that they would have difficulty in participating in forest protection or planting schemes on their land. In Latin America, the land users who receive payments for preserving the hydrological services of watersheds tend to be wealthier households, and in at least one case such as Costa Rica's programme, many participants were urban dwellers with substantial nonagricultural income.[78] Similarly, the payment for forest ecosystem services in Mexico is specifically targeted to community-owned forests, and although 86.3 per cent of the hectares enrolled belong to poor communities, only 31 per cent of the participating households are classified below the poverty line.[79]

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[76] See, for example, Alix-Garcia, Jennifer, Alain de Janvery, Elisabeth Sadoulet and Juan Manuel Torres. 2005. "An Assessment of Mexico's Payment for Environmental Services Programme." Report for the Comparative Studies Service, Agricultural and Development Economics Division, United Nations Food and Agriculture Organization (FAO). FAO, Rome. Barbier, Edward B. 2008. "Poverty, Development, and Ecological Services." *International Review of Environmental and Resource Economics* 2(1):1-27. Grieg-Gran, Mary-Anne, Ina Porras and Sven Wunder. 2005. "How Can Market Mechanisms for Forest Environmental Services Help the Poor? Preliminary Lessons from Latin America." *World Development* 33(9):1511–1527. Landel-Mills, Natasha and Ina T. Porras. 2002. "Silver Bullet or Fool's Gold? A Global Review of Markets for Forest Environmental Services and Their Impact on the Poor." Instruments for Sustainable Private Sector Forestry Series. International Institute for Environment and Development, London. Pagiola, Stefano, Agustin Arcenas and Gunars Platais. 2005. "Can Payments for Environmental Services Help Reduce Poverty? An Exploration of the Issues and the Evidence to Date from Latin America." *World Development* 33(2):237-253. Ravnborg, Helle Munk, Mette Gervin Damsgaard and Kim Raben 2007. "Payments for ecosystem services – issues and pro-poor opportunities for development assistance." DIIS Report 2007:6. Danish Institute for International Studies, Copenhagen. Sukhdev 2008, *op cit.*

[77] van Kooten, G. Cornelius and Brent Sohngen. 2007. "Economics of Forest Ecosystem Carbon Sinks: A Review." *International Review of Environmental and Resource Economics* 1:237-269.

[78] Pagiola et al. 2005, *op cit.*

[79] Alix-Garcia et al. 2005, *op cit.*

Programmes paying for ecological services may have unintended side effects on the poor, both positive and negative. In Indian watersheds, community cooperation in managing forest commons was enhanced for villages participating in payment schemes. But the livelihoods of the landless who could not participate, such as women and herders, were harmed if their access to forest commons for gathering non-timber products was restricted by the schemes.[80] In Latin America, some programmes are thought to have improved tenure security by granting legal status to idle forest land and providing protection against squatting or land invasions. However, by increasing the value of marginal land, some payment schemes for ecosystem services have created incentives for more wealthy groups to appropriate the land, especially if tenure and ownership are in dispute.[81] Finally, payment programmes can also have mixed effects on employment opportunities for the landless poor. Ecosystem service schemes that result in considerable replanting or afforestation in rural areas can generate significant demand for unskilled labor; alternatively, if the introduced schemes set aside large areas of local forests that would otherwise have been logged or converted to agriculture, then there may be less work for the landless poor.[82]

In sum, because their primary aim is to provide incentives to landowners for protecting critical ecosystems and habitat, payment programmes for ecosystem services cannot always be targeted to areas of high poverty. Nor can such schemes always guarantee high participation rates by the rural poor or that their livelihoods will be significantly improved. By definition, the landless and near landless are often excluded. Nevertheless, wherever possible, the payment schemes should be designed to enhance the participation of the poor, to reduce any negative impacts on nonparticipants while creating additional job opportunities for rural workers, and to provide technical assistance, access to inputs, credit and other support to encourage poor smallholders to adopt the desired land use practices. More effort must be devoted to designing projects and programmes that include the direct participation of the landless and near landless.

The alternative to investing in the enhancement of ecosystem services, and hoping that rural poverty is also reduced as a consequence, is instead to target investments directly to improving the livelihoods of the rural poor, thus reducing their dependence on exploiting environmental resources.

Such "geographical targeting" of the rural poor has shown to be successful if designed correctly.[83]

For example, in Ecuador, Madagascar and Cambodia "poverty maps" have been developed to target public investments to geographically defined sub-groups of the population according to their relative poverty status, which substantially improved poverty alleviation.[84] The maps in particular benefitted the design and implementing of the investments by targeting smaller

[80] Kerr, John. 2002. "Watershed Development, Environmental Services, and Poverty Alleviation in India." *World Development* 30(8):1387–1400.
[81] Pagiola et al 2005, *op cit.* Landell-Mills and Porras 2002, *op cit*.
[82] Grieg-Gran et al 2005, *op cit*.
[83] Barbier 2005 and 2008, *op cit.* Coady, David, Margaret Grosh and John Hoddinott. 2004. "Targeting outcomes redux." *World Bank Research Observer* 19(1):61–85. Binswanger, Hans P. and Klaus Deininger. 1997. "Explaining Agricultural and Agrarian Policies in Developing Countries." *Journal of Economic Literature* 35:1958-2005.Dasgupta, Susmita, Uwe Deichmann, Craig Meisner and David Wheeler. 2005. "Where is the Poverty-Environment Nexus? Evidence from Cambodia, Lao PDR, and Vietnam." *World Development* 33(4):617-638. Elbers, Chris, Tomoki Fujii, Peter Lanjouw,Berk Özler and Wesley Yin. 2007. "Poverty alleviation through geographic targeting: How much does disaggregation help?" *Journal of Development Economics* 83:198-213.
[84] Elbers et al 2007, *op cit.*

administrative units, such as districts or villages. However, some gains were partially offset by the higher costs of administrating schemes at the village as opposed to the district or province level. In addition, it is unclear whether wealthy and powerful local groups were able to influence the allocation of targeted investments.

A World Bank study examined 122 targeted programmes in 48 developing countries to analyze their effectiveness in reducing poverty.[85] The study concluded that the median programme transfers 25 per cent more benefits to households in the bottom income groups than would be the case in programmes without targeting. However, some targeted programmes, such as those including food subsidies were regressive, yielding less benefits to the poor compared to universal allocation. In comparison, geographic targeting programmes that included a mandatory work requirement were associated with an increased share of benefits going to the poorest 40 per cent of the population. The institutional context in which targeted schemes operated, such as the effectiveness and accountability of government, the security of tenure and property rights and bureaucratic competence, influenced greatly the ability of the schemes to alleviate rural poverty. Clearly, the careful design and implementation of geographic targeting programmes will have considerable impact on the outcome and the chances of success in alleviating poverty.

In some cases, targeting "institutional failures", such as the inability of governments to deliver or manage services effectively to the remote areas where the poor are located, may itself be important to overcoming obstacles to improving the livelihoods of the poor in fragile environments. A variety of case studies of managing irrigation water, potable water, fisheries and forest land in developing countries show that, in the absence of effective governance, encouraging private sector participation in natural resource management can enhance a variety of environmental benefits while achieving development and poverty goals.[86] However, developing complementary regulatory capacity and monitoring by government is the key to securing long-term public environmental benefits and their widespread distribution to the poorest members of the population, and in addition, the effective functioning of markets will vary from place to place, depending on legal, economic, and cultural factors.

For persistent problems of poor institutional arrangements for managing natural resources for the benefit of local communities, entirely new institutional frameworks may need to be developed. For instance, one study found that the lack of effective property rights and conflicts between local communities and outside investors were persistent problems underlying the problem of excessive mangrove conversion by shrimp aquaculture expansion and other commercial developments in coastal areas of Thailand.[87] Developing a new institutional framework for coastal mangrove management in Thailand could enhance the incentives to restore and protect local mangroves while improving the economic livelihoods of local communities. Such a framework might contain the following features. First, remaining mangrove areas should be designated into conservation (i.e. preservation) and economic zones. Shrimp farming and other extractive commercial uses (e.g., wood concessions) should be restricted to the economic zones only. However, local communities who depend on the collection of forest and fishery products from mangrove forests should be allowed access to both zones, as long as such harvesting activities are conducted on a sustainable basis. Second, the establishment of community mangrove forests should also occur in both the economic and conservation zones. The decision

[85] Coady et al 2004, *op cit.*
[86] Johnstone, Nick and Joshua Bishop. 2007. "Private Sector Participation in Natural Resource Management: What Relevance in Developing Countries?" *International Review of Environmental and Resource Economics* 1: 67–109.
[87] Barbier, Edward B. and S. Sathirathai, ed. 2004. *Shrimp Farming and Mangrove Loss in Thailand.* Edward Elgar, London.

to allow such local management efforts should be based on the capability of communities to enforce effectively their local rules and manage the forest to prevent over-utilization, degradation and conversion to other land uses. Moreover, such community rights should not involve full ownership of the forest but be in the form of user rights. Third, the community mangrove forests should be co-managed by the government and local communities. Such effective co-management will require the active participation of existing coastal community organizations, and will allow the representatives of such organizations to have the right to express opinions and make decisions regarding the management plan and regulations related to the utilization of mangrove resources. Finally, the government should provide technical, educational and financial support for the local community organizations participating in managing the mangrove forests. For example, if only user rights (but not full ownership rights) are granted to local communities, then the latter's access to formal credit markets for initiatives such as investment in mangrove conservation and replanting may be restricted. The government may need to provide special lines of credit to support such community-based activities.

Targeting the poor is even more urgent during major economic crises. Under-investment in human capital and lack of access to financial credit is a chronic feature of the extreme poor, especially those poor households concentrated on fragile land. These households generate insufficient savings, suffer chronic indebtedness and rely on informal credit markets with high short-term interest rates.

As a result, private investment in human capital improvement is a luxury for most poor rural households, and similarly the lack of education and marketable skills limits not only the earning potential of the rural poor but also their political bargaining power relative to wealthier rural and urban households.[88] The lack of financial and human capital available to the poor makes them particularly vulnerable to the economy-wide shocks during crises. In addition, during prolonged crises the poor often take drastic action to salvage their livelihoods in the short term; they incur greater household debt, they sell important assets such as land and livestock, and they forego educational expenses. The impacts of an economy-wide shock can therefore have a lasting impact on the poor. For example, a study of the longer term impacts of the 1997-1998 East Asian crisis found that about half of Indonesia's poverty count in 2002 was attributed to the effects of the crisis even though the recovery of the Indonesian economy occurred well before then.[89]

Two types of policies and investment programmes targeted to the poor are essential in these circumstances.

The first is the design and targeting of specific social safety net programmes, which effectively act as insurance for those who lack any or face high costs of self-insurance. Although under normal economic conditions even the poor have access to informal sources of insurance, unsually through community or family-based risk-sharing, large economy-wide crises often affect entire communities and even regions, thus negating informal insurance mechanisms. Unfortunately, many developing countries have weak safety net programmes, which provide limited protection to the poor during an economic crisis. Even worse, governments often hastily

[88] See, for example, Barbier 2005, *op cit.* Binswanger and Deininger 1997, *op cit.* Development Research Group. 2008. "Lessons from World Bank Research on Financial Crises." Policy Research Working Paper 4779. World Bank, Washington DC. Ravallion, Mark. 2008. " Bailing out the World's Poorest." Policy Research Working Paper 4763, World Bank, Washington DC. World Bank. 2006. *World Development Report: Equity and Development.* Oxford University Press, New York.

[89] Ravallion, Martin and Michael Lokshin. 2007. "Lasting Impacts of Indonesia's Financial Crisis." *Economic Development and Cultural Change* 56(1):27-56.

implement inefficient programmes, such as economy-wide food and fuel subsidies, which entail huge financial costs, rarely benefit the poor and are difficult to reverse. As discussed in Box 19, however, it is possible to design a comprehensive and targeted safety net for the poor that adequately insures them in time of crisis. The ideal programme involves a relief work component that assists the working poor who are either temporarily unemployed or underemployed as a result of the crisis and cash or food transfers that are often conditional on ensuring that poor households do not forego educational or health expenditures.

During a crisis, educational and health services targeted at the poor should be maintained, and if possible, expanded. The economic impacts of a crisis on the poor are long lasting and can continue well after the recovery of the rest of the economy has recovered, as the example of Indonesia during the 1997-8 East Asia financial crisis illustrates. Primary education and health services, especially for the poor, rural inhabitants, and women, are important for mitigating the long-term impacts of a crisis, not only because such investments foster growth and help reduce poverty but also because they reduce income inequality. Unfortunately, during financial and economic crises, publicly funded health and education services are often the first expenditures reduced by developing country governments.

As noted in Box 19, a comprehensive safety net programme also confers important economy-wide benefits, and may be linked with health and educational expenditures directed at the poor to enhance longer term poverty alleviation. If an economic crisis does create the opportunity for implementing an effective safety net for the poor, then it should become a permanent and automatic policy, expanding in times of crises but still functioning under normal economic conditions to alleviate persistent poverty problems in some areas. Some of the features of the programme, such as incentives to encourage poor families to keep up education and health care or using relief work to build assets of value to poor communities, could be maintained to enhance longer term poverty reduction in the economy. The safety-net programme should also provide an additional and immediate stimulus to aggregate demand in the economy. The extra income earned by the poor is likely to translate rapidly into increased consumption in the local and wider economy.

Asking national governments of developing economies to implement policies, reforms and investments to improve the sustainability of primary production, invest in social safety net programmes and maintain if not enhance educational and health services seems a tall order during a deepening global economic crisis. As argued by the World Bank in its submission to the G20 meeting in November 2008, developing countries, and especially low-income economies, "will be impacted through slower export growth (global trade is projected to decline in 2009), reduced remittances, lower commodity prices (which will reduce incomes in commodity exporters) and the potential for reduced aid from donors. The crisis may also lead to a reduction in private investment flows, making weak economies even less able to cope with internal vulnerabilities and development needs….Higher commodity prices have raised the current account deficits of many oil-importing countries to worrisome levels (they exceed 10 per cent of GDP in about one-third of developing countries), and after having increased substantially, the international reserves of oil-importing developing countries are now declining as a share of their imports. Moreover, inflation is high, and fiscal positions have deteriorated both for cyclical

reasons and because government spending has increased to alleviate the burden of higher commodity prices."[90]

However, the World Bank also argues that, during a crisis, "the countries that are likely to perform better are those that have managed to reduce macro-financial vulnerabilities, increase investment rates, diversify export markets, and restore productivity growth….Developing countries must ensure that resources are put to their best and most efficient use, including by putting in place well-targeted social safety nets and improving the targeting of resources provided to the poor."[91]

In a major economic recession, the main policy priorities should be improving the sustainability of primary production activities, with the aim of ensuring that they generate sufficient investible funds for diversifying the economy, building up human capital, and investing in social safety nets and other investments targeted at the poor. In addition, the failure to implement such policies simply makes the problem of addressing extreme poverty in developing economies worse and raises the costs of implementing these measures once economic conditions improve.

For example, the World Bank estimates that a 1 per cent reduction in growth in developing economies could consign 20 million more people to poverty. As a result of the food and fuel crises, the number of extremely poor was estimated to have increased by at least 100 million. Many of those already poor are slipping even more deeply into poverty; for instance, 88 per cent of the recent increase in extreme urban poverty arose from poor households becoming poorer and only 12 per cent from households falling into poverty. Because of these impacts, 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.[92]

Moreover, too many developing economies are wasting their scarce resources on short-term but inefficient responses to these crises, such as tax reductions to offset higher prices and increased spending on economy-wide subsidies and income support. A recent International Monetary Fund (IMF) study of 161 developing countries found that, in response to the fuel, food and economic crises, nearly 57 per cent of countries reduced taxes on food while 27 per cent lowered taxes on fuels. Almost one in five countries increased food subsidies while 22 per cent raised fuel subsidies.[93] As noted in Box 19, the reliance on such "across the board" tax reductions and subsidies are a poor and costly substitute for a comprehensive safety net and other investments targeted at the poor. General tax reductions and subsidies are often more regressive, more costly, and more difficult to remove once in place. Fuel subsidies are usually much more regressive than food subsidies and often have further adverse environmental consequences. Reliance on such inefficient fiscal measures also means that developing country governments will have less fiscal resources to invest in increasing the size and scope of targeted safety nets and publicly funded health and education services, which as this report has argued are much more essential policies during prolonged economic crises.

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[90] World Bank. "Global Financial Crisis and Implications for Developing Countries." Paper for G-20 Finance Ministers' Meeting. São Paulo, Brazil. November 8, 2008.
[91] World Bank 2008 "Global Financial Crisis and Implications for Developing Countries.", *op cit.* See also Development Research Group 2008, *op cit.*
[92] World Bank 2009, *Global Economic Prospects*, *op cit.* World Bank 2008 "Global Financial Crisis and Implications for Developing Countries.", *op cit.*
[93] As quoted in World Bank 2008 "Global Financial Crisis and Implications for Developing Countries.", *op cit.*

Improving Water Management

As noted in the introduction to this chapter, the emerging worldwide water crisis is one global ecological scarcity problem that the Global Green New Deal must address if it is to have a lasting impact on reducing worldwide poverty and at the same time ensure that the ensuing global economic recovery is sustainable.

There are two aspects of this emerging water crisis: the scarcity of freshwater supplies relative to increasing demand, and the lack of clean water and sanitation available for millions of the poor in developing regions.

Experts may debate whether or not there is an impending global water scarcity problem. But the pressures on available freshwater supplies are mounting, for four principal reasons. First, there is the increasing demand from growing populations. Second, as the world's population becomes urbanized, more water has to be allocated to meet highly concentrated and larger sources of demand. Third, as economic development increases and poverty diminishes, per capita water consumption will also rise. Fourth, climate change and modification of freshwater ecosystems and watersheds are likely to affect the availability of water supplies.[94]

There is no clear agreement on the definition of "water scarcity" and it measurement, and limited evidence of how its impacts will be manifested (see Box 20). Developing countries already account for 71 per cent of global water withdrawal, and their demand is expected to grow by 27 per cent by 2025. Although current evidence suggests that water availability is not constraining economic growth in most countries, the exceptions are countries in the West Asia/North Africa region that exhibit moderate or extreme water scarcity, which is expected to worsen in the near future. By 2025 Asia is also expected to show signs of medium to high stress. The two most populous countries, China and India, account for around 35 per cent of global water withdrawal. Both countries are already displaying medium to high water stress, which is expected to worsen by 2025. However, the problem is worse still for specific river basin regions within each country. Some of these river basins have or will have in coming years criticality ratios exceeding 100 per cent, suggesting chronic problems of extreme water scarcity. Other countries facing worsening water stress and scarcity include Pakistan, the Philippines, South Korea and Mexico.

There is a consensus that growing scarcity and competition for water are major threats to poverty alleviation, especially in the rural areas of developing economies, or as UN-Water states, "first and foremost, water scarcity is an issue of poverty."[95]

Several indicators of water availability, sanitation and health point to the scale of the problem in the developing world. About 700 million people in 43 countries live currently under conditions of water stress (less than 1,700 cubic meters per person), including 538 million people in northern China. By 2025, as water stress and scarcity intensifies in developing regions (see Box 20), 1.8 billion people will be living in countries or regions with moderate or extreme water scarcity, and 3 billion could face water stress. Today, one in five people in the developing world lacks access to sufficient clean water, and the urban poor typically pay 5-10 times more per unit

[94]United Nations Development Programme. 2006, *op cit.* UNDP, New York. United Nations Environment Programme. 2004. 2007. *Global Environmental Outlook. GEO-4: Environment for Development.* UNEP, Geneva, Ch. 4 Water. UN-Water. 2007. *Coping with Water Scarcity: Challenge of the Twenty-First Century.* United Nations, New York, UN Water Day, March 22, 2007. UN-Water and World Water Assessment Programme (WWAP). 2006. *Water: A Shared Responsibility.* The United Nations World Water Development Report 2. UN-Water and WWAP, New York.

[95] UN-Water 2007, *op cit.*

of water than do people with access to piped water. The poorest 20 per cent of households in El Salvador, Jamaica and Nicaragua spend on average 10 per cent of their household income on water, whereas in comparison, paying 3 per cent of household income for water is considered a hardship in the United Kingdom. Millions of women in developing regions spend several hours a day collecting water, which is an extra non-monetized cost of water supply. About half the developing world's population, 2.6 billion people, do not have access to basic sanitation. More than 660 million of the people without sanitation live on less than US$2 a day, and more than 385 million on less than US$1 a day. Close to half of the population in the developing world have endured health problems linked to unclean water and poor sanitation, which is the second leading cause of deaths in children after acute respiratory infection. Sickness in children from water-related illness has also led to the loss of 443 million school days each year.[96]

In many economies, including high-income countries, freshwater is routinely wasted and inefficiently used because of considerable distortions in the way in which water is allocated. The problem is particularly serious in irrigated agriculture, which uses about 70 to 90 per cent of the world's freshwater supplies. In addition, many of the world's surface water irrigation system lose between one half and two thirds of the water in transit between source and crops. In many countries, irrigation water is subsidized so that the price does not reflect the costs of delivery to farmers, let alone its value in use. Thus managing the demand for all water consumption, and reducing inefficiency in irrigated water use in particular, is an important objective in a world where freshwater is increasingly scarce relative to competing uses. Water pricing, tradable water rights and other market-based instruments are increasingly being employed as means to ensuring the efficiency of future water management activities.[97] Some institutional reforms have also encouraged a greater role of the private sector in providing certain water services to improve more efficient delivery and utilization. For example, around 7 per cent of the world's population is currently supplied with water and wastewater services by privately financed water companies or projects.[98]

A further complication in water management is that many of the world's important river basins and other major sources of freshwater do not respect international boundaries (see Box 21). Two

[96] UNDP 2006, *op cit.* UN-Water 2007, *op cit.*

[97] See, for example, Cantin, Bernard, Dan Shrubsole and Meriem Ait-Ouyahia. 2005. "Using Instruments for Water Demand Management: Introduction." *Canadian Water Resources Journal* 30(1):1-10. Easter, K. William and Sandra Archibald. 2002. "Water Markets: The Global Perspective." *Water Resources Impact* 4(1):23-25. Howitt, Richard and Kristiana Hansen. 2005. "The Evolving Western Water Markets." *Choices* 20(1):59-63. Rosegrant, Mark W. and Sarah Cline. 2002. "The Politics and Economics of Water Pricing in Developing Countries." *Water Resources Impact* 4(1):5-8. Schoengold, Karina and David Zilberman. 2007. "The Economics of Water, Irrigation, and Development." In Robert Evenson and Prabhu Pingali, eds. *Handbook of Agricultural Economics, Vol 3.* Elsevier, Amsterdam. Stavins, Robert N. 2003. "Experience with Market-Based Environmental Policy Instruments." In Karl-Göran Mäler and Jeffrey Vincent, eds. *The Handbook of Environmental Economics, Vol1.* North-Holland/Elsevier, Amsterdam. Tsur, Yacov, Terry Roe, Rachid Doukkali and Ariel Dinar. 2004. *Pricing Irrigation Water: Principles and Cases from Developing Countries.* Resources for the Future, Washington DC. Young, Mike and Jim McColl. 2005. "Defining Tradable Water Entitlements and Allocations: A Robust System." *Canadian Water Resources Journal* 30(1):65-72.

[98] Allison, Peter. 2002. "Global Private Finance in the Water Industry." *Water Resources Impact* 4(1):19-21. Brook, Penelope J. 2002. "Mobilizing the Private Sector to Serve the Urban Poor." *Water Resources Impact* 4(1):9-12. Dosi, Cesare and K. William Easter. 2003. "Water Scarcity: Market Failure and the Implications for Markets and Privatization." *International Journal of Public Administration*26(3):265-290. Johnstone, Nick and Libby Wood, eds. 2001. *Private Firms and Public Water: Realizing Social and Environmental Objectives in Developing Countries.* Edward Elgar, London.

out of five people in the world live in rivers shared by more than one country, and 39 countries currently receive most of their water from external sources. While most countries have institutional mechanisms and policies for allocating internal water resources and resolving water disputes, negotiating and implementing workable agreements to manage and share international water resources has proved more difficult.

A Global Green New Deal should aim to improve water management worldwide, and at the same time contribute to the goal of providing water services to the poor. Achieving these objectives is possible through progress in three main areas in all economies:

- Targeting investments and other policy measures to improve the supply of clean water and sanitation services to the poor.
- Removing subsidies and other incentive distortions and implementing, where appropriate, market-based instruments and other measures to improve the efficiency of water delivery and utilization and to manage water demand.
- Facilitate transboundary water governance and cooperation over shared management and use.

The next section provides examples of the type of national actions that can be adapted by all governments in these three areas.

Managing Water Scarcity, Risk and Vulnerability

The most pervasive manifestation of the global water scarcity problem is that the poorest people in the world have the least access to clean water and sanitation but pay some of the highest prices, and bear the highest risks, for the water they do obtain and use. Thus providing safe drinking water and improved sanitation are critically important development and poverty alleviation goals that should be a key focus of the Global Green New Deal.

The United Nations has set as a Millennium Development Goal (MDG) the objective of halving, by 2015, the proportion of people in the world without sustainable access to safe drinking water and basic sanitation. Even if this target is met, there will still be more than 800 million people without clean water and 1.8 billion without sanitation in 2015.[99] Already before the current economic crisis, however, there was concern about whether international efforts were on track to meet the clean water and sanitation MDG by 2015. The safe drinking water target is already achieved in South Asia and in Latin America and the Caribbean, and could be attained by East Asia and the Pacific by 2018, but Sub-Saharan Africa and the Arab states were unlikely to reach the target before 2040. All of Asia, the Arab states, Latin America and the Caribbean were projected to meet the sanitation target by 2015 or soon thereafter, but Sub-Saharan Africa would not halve the proportion of its population without sanitation before 2076. As discussed earlier in the chapter, a major concern about the current worsening and deepening global economic recession is that developing country governments are already reducing expenditures on health and related expenditures. Private investment has also declined significantly, and official development assistance has not increased adequately. Thus, the current global recession is seriously endangering the efforts of developing regions to achieve these MDG targets.

[99] UNDP 2006, *op cit.*

A top priority of the GGND must be to revive the necessary investments to attain the MDG for clean water and sanitation by 2015.

The United Nations Development Programme (UNDP) estimates that the minimum additional costs of achieving the MDG for clean water and sanitation is an additional US$10 billion a year globally.[100] To achieve this target, the UNDP recommends that governments in developing economies – which before the recession typically spent less than 0.5 per cent of GDP on provision of clean water and sanitation – should aim at a minimum of 1 per cent of GDP for water and sanitation spending.

As part of the GGND, all developing economies should follow the UNDP recommendation and allocate at least 1 per cent of GDP to clean water and sanitation investments.

The UNDP estimates that the total economic benefits of the global investment in achieving the MDG would amount to about $38 billion annually. The benefits for Sub-Saharan Africa alone would amount to $15 billion annually, which equals approximately 60 per cent of the continent's current aid flows. Other benefits include around 1 million children's lives saved over the next decade as the investments are made, averaging 203,000 fewer child deaths per year by 2015. In addition, there would be 272 million days gained in school attendance as a result of reduced illness from diarrhea alone. As summarized in Box 22, poor households would also benefit from the income gains from the reduced number of days spent ill, the money savings from less health service use and expenditures on medicines, and the increased time spent on income and productive activities of the household. Across all developing countries, when such wider benefits are included, the return on US$1 invested in clean water and sanitation interventions ranged from US$5 to US$11, and from US$5 to US$28 for some low-cost interventions.

Large-scale improvements in water supplies, sanitation and hygiene require substantial investments in major projects and management programmes. The resulting increases in water quality often yield multiple benefits, including opportunities for increased employment for the poor. As Box 23 shows in the case of the Ganges Action Plan (GAP) in India, the latter employment benefits can be substantial. The net present value of the GAP in terms of unemployment of skilled labor amounted to nearly US$55 million in terms of employment of unskilled labor. If greater weight is attached to employing unskilled laborers from poor households, the present value of these benefits rises to nearly US$190 million.

Removing water subsidies and other incentive distortions, adopting market-based instruments and implementing other measure to increase the efficiency of water allocation should be implemented by all economies.

Reform of pricing policies and other allocation methods is critical to improving the performance of water services and the productivity of water in all sectors of the economy. Enhancing public-private partnerships in the delivery of water services, including sanitation, might also be significant. As noted above, the use of such measures is growing globally, not just in high-income economies but also in developing countries. Active water markets are emerging in Australia, Canada and the United States, but also in Brazil, China, Chile, Mexico, Morocco, South Africa and Turkey, as well as in many other countries and regions. As shown in Box 24, the application of market-based instruments and water market reforms are proving to be varied and tailored to the needs of specific sectors.

[100] UNDP 2006, *op cit.*

Although the use of market-based instruments and reforms across a wide range of water sectors and applications is growing, their potential for improving the efficiency of allocating water and providing services has not been realized. One problem with the spread of water markets and trading, as outlined in Box 24, is that these mechanisms are only effective if certain conditions are met. For example, one reason why establishing irrigation water pricing in Egypt has proven less successful than in Morocco is that the irrigation system in Egypt is not designed for the use of volumetric charges and tradable water rights compared to the system in Morocco. Similar problems exist with the irrigation systems in India and Indonesia. There are also no legally defined groundwater rights in Egypt and India. In the Ukraine, there are problems with the smaller scale of privatized farms relative to the larger "block" supply of irrigation water. Finally, in all countries, farmers are resistant to switching to water markets when the predominant method of allocation has been rationing of irrigation water, which does not involve charges to recover costs.[101]

Currently, there are around 200 treaties and agreements that govern transboundary water allocation. Such agreements are necessary because of the interdependencies that such shared resources imply. For example, how an upstream country uses a river will affect the availability, timing and quality of water downstream. Countries that share an aquifer or lake are also affected by the common water use. In recent years, the international community has adopted conventions, declarations, and legal statements concerning the management of international transboundary water bodies, while countries sharing river basins have established integrated basin management initiatives. However, many international river basins and other shared water resources still lack any type of joint management structure, and some international agreements and joint management structures need to be updated or improved. Although the potential for armed conflict between countries over shared water resources remains low, cooperation to resolve disputes over water is often lacking.[102] In some cases, like the shrinkage of Lake Chad in Sub-Saharan Africa, the lack of cooperation is having a detrimental effect on the shared water system.[103] In South Asia, the 1996 Ganges River Treaty between India and Bangladesh may be in serious jeopardy because of projected future water uses relative to basin supply, unless the treaty is extended to allow augmentation of river flows through water transfers from Nepal.[104]

Facilitating transboundary water governance and cooperation over shared management and use must therefore be an important objective of the GGND.

Summary and Conclusion

A Global Green New Deal should aim to reduce ecological scarcity worldwide, and at the same time contribute to the goal of reducing substantially extreme world poverty. Targeting the poor is even more urgent during major economic crises. Under-investment in human capital and lack of access to financial credit is a chronic feature of the extreme poor, especially those poor households concentrated on fragile land. In a major economic recession, the main policy

[101] Hellegers, Petra J.G. and Chris J. Perry. 2006. "Can Irrigation Water Use Be Guided by Market Forces? Theory and Practice." *Water Resources Development* 22(1):79-86.
[102] Giordano, Meredith A. and Aaron T. Wolf. 2003. "Sharing waters: Post-Rio international water management." *Natural Resources Forum* 27:163-171. Woolf, Aaron T. 2007. "Shared Waters: Conflict and Cooperation." *Annual Review of Environment and Resources* 32:3.1-3.29.
[103] UNDP 2006, *op cit.*
[104] Bhaduri, Anik and Edward B. Barbier. 2008. "International water transfer and sharing: the case of the Ganges River." *Environment and Development Economics* 13:29-51.

priorities should be improving the sustainability of primary production activities, with the aim of ensuring that they generate sufficient investible funds for diversifying the economy, building up human capital, and investing in social safety nets and other investments targeted at the poor. In addition, the failure to implement such policies simply makes the problem of addressing extreme poverty in developing economies worse and raises the costs of implementing these measures once economic conditions improve.

The global scarcity of freshwater supplies relative to increasing demand and the lack of clean water and sanitation available for millions of the poor in developing regions must also be priorities addressed by a GGND. Because providing clean water and sanitation is fundamental to the poverty alleviation and economic development goals of developing economies, and can also yield wider employment, health and other economic benefits, developing country governments should spend at least 1 per cent of GDP on this sector, as recommended by the UNDP. All economies should consider removing water subsidies and other incentive distortions, adopting market-based instruments and implementing other measure to increase the efficiency of water allocation in all sectors, and especially in agricultural irrigation. National efforts to facilitate transboundary water governance and cooperation over shared management and use should also be an important objective of the GGND.

2.3 Challenges Facing Developing Economies

The various proposed actions for reducing carbon dependency and ecological scarcity discussed in the previous two chapters pose a number of difficulties for low and middle-income economies. This chapter reviews the main constraints.

Developing economies in particular face a number of important challenges in their efforts to move quickly to a low-carbon economic growth path, such as lack of finance, a technology and skills gap, and uncertainty over a future global carbon market.

Access to financing is a major constraint if developing economies are expected to invest in clean and low-carbon energy alternatives. Large-scale adoption of low carbon and clean energy technologies by rapidly developing low and middle income economies will be necessary over the coming decades to reduce their greenhouse gas emissions and improve energy security. This will require, in turn, a massive injection of capital investment. For example, for all Asian economies seek to reach a target of 20 per cent of total supply from clean energy sources by 2020 would require capital financing of almost US$1 trillion by 2030, of which nearly US$50 billion a year would be required until 2020.[105] Similarly, if all developing countries honor their commitment to the International Action Programme (IAP) agreed at the 2004 Bonn International Conference for Renewable Energies, this would mean an additional 80 gigawatts (GW) of renewable energy capacity by 2015, requiring about US$10 billion per year in investments. Official development assistance currently contributes on average $5.4 billion per year to all forms of energy projects in developing countries worldwide, and is unlikely to contribute to less than a fifth of current commitments under the Bonn IAP.[106] Sufficient capital is available from the private sector, both

[105] As quoted in Carmody and Ritchie 2007, *op cit*.
[106] *Content Analysis of the International Action Programme of the International Conference for Renewable Energies*, renewables2004 Bonn, 1-4 June 2004, available at http://www.renewables2004.de/pdf/IAP_content_analysis.pdf
UN ESCAP 2008, *op cit.*

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.

In addition to the "capital gap" there is also a substantial "skills and technological gap" for low and middle income economies in adopting clean 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 need to develop and apply low-carbon technologies. Instead, most low and middle income countries, with possibly the 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 clean energy and low-carbon innovations.[107]

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 (see Box 25). Certainly, the CDM has achieved success in securing the financing and transfer of clean and low-carbon technologies in developing countries, and above all, in effectively creating a global trading market. But some problems remain with the current system. One concern is the geographical concentration of CDM projects in a handful of large emerging market economies, such as China, India, Brazil and Mexico, and the virtual absence of projects in low-income economies and in particular Africa. 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. A further problem is the growing investment uncertainty over the future of the CDM and the global carbon market after 2012. This uncertainty arises from the lack of an international consensus to date on a post-Kyoto climate change agreement. The result could be a large decline in the future expected number of projects approved and CERs earned as 2012 approaches. Similar uncertainty faces the Joint Implementation (JI) scheme of the Kyoto Protocol, which allows recipient countries to earn Emission Reduction Units (ERUs), each equivalent to one tonne of CO_2. In contrast to the CDM, the JI mechanism targets projects in industrialized countries, although it is particularly aimed at transition economies. Investment uncertainty over a post-2012 global carbon market and price is also likely to affect future JI projects in these economies and the ability to attract ERU credits.

Developing economies face similar challenges in implementing the sustainable transport strategy outlined in Chapter 2.1. The constraints on progress in implementation are similar to those that developing countries face in adopting a low-carbon development path generally: shortfalls in public and private financial capital mobilization; lack of skills, knowhow and R&D capacity to

[107] Ockwell, David G., Jim Watson, Gordon MacKerron, Prosanto Pal and Farhana Yamin. 2008. "Key policy considerations for facilitating low carbon technology transfer to developing countries." *Energy Policy* 36:4104-4115.

absorb, adapt and develop novel transportation and vehicular technologies; and the failure of international mechanisms and institutions to help developing economies overcome such challenges.

For example, the United Nations Framework Convention on Climate Change (UNFCCC) estimates that a global transport strategy similar to the one outlined in Chapter 2.1 would require additional investments worldwide of approximately US$ 88 billion by 2030, or an increase of about US$3 billion annually from now until 2030, of which 40 per cent needs to be targeted at developing economies.[108] Globally, US$79 billion is necessary for the development of hybrid and other alternative fuel vehicles and for improved fuel efficiency in all motorized transport, and the remaining US$9 billion is for biofuels. Around two thirds of the investment should be financed domestically, one sixth from foreign direct investment and the remaining one sixth financed from international debt and official development assistance.

In contrast, currently in the five largest developing economies that are rapidly expanding their transport networks (Brazil, China, India, Mexico and South Africa), domestic finance accounts for 90 per cent of transport investment, foreign direct investment for approximately 8 per cent and international debt and development assistance less than 1 per cent. Across all developing countries, total development assistance in transport amounts to US$8.2 billion, which represents just 4 per cent of the US$211 billion total investment in the transport sector of developing economies today. 66 per cent of the development assistance went to Asia, 24 per cent to Latin America, and 10 per cent to Africa (excluding South Africa). Thus, all forms of public and private investment flows to developing economies, but especially foreign direct investment, international debt financing and development assistance, need to be increased rapidly if the goal of developing sustainable transport systems globally is to be attained.

A further difficulty for developing economies is that existing international funding sources, such as the Clean Development Mechanism (CDM), currently do not provide much financing for transportation projects. Although transportation was designated as a priority for the CDM, at present the sector currently accounts for 0.12 per cent of all registered CDM projects.[109] These projects include a Bus Rapid Transit (BRT) system in Bogotá, Colombia, and an urban railway system in Delhi, India. There appears to be a growing consensus that, as currently structured, the CDM is not well suited as a financing mechanism for fostering sustainable transportation in developing economies.[110]

Most developing economies, with perhaps the exception of large emerging market economies such as Brazil, China, India, Malyasia, Mexico, South Africa, South Korea and Thailand, lack the R&D capacity and skilled workforce capable of adapting and developing the technology and knowhow necessary for widespread adoption of clean and fuel efficient vehicles, rapid transit systems, second-generation biofuels and other advances necessary for rapid progress in sustainable transportation. The necessary training in sustainable land use and urban planning ideas to complement such a strategy is also lacking in many low income countries. Similarly, many of these economies also have limited financial and administrative capability to implement some of the more sophisticated transport economic and regulatory instruments, such as road

[108] United Nations Framework Convention on Climate Change (UNFCCC). 2007. *Investment and Financial Flows to Address Climate Change.* UNFCCC, Bonn.
[109] CDM Statistics, available at http://cdm.unfccc.int/Statistics/index.html.
[110] Sanchez, Sergio. 2008. "Reforming CDM and Scaling Up: Finance for Sustainable Urban Transport." In Karen Holme Olsen and Jørgen Fenhann, eds. *A Reformed CDM – including new Mechanisms for Sustainable Development.* Capacity Development for CDM (CD4CDM) Project, UNEP Rise Centre, Denmark, pp. 111-126.

pricing, vehicle taxation, fuel economy or greenhouse gas emission standards and even fuel taxes.

The current global economic crisis also imposes serious constraints on the capacity of developing economies to implement the policy priorities emphasized in Chapter 2.2. Of particular concern is the decline in global trade coupled with the continuing lack of agreement by the international community on key aspects of primary production trade in the Doha Round. Fluctuating commodity prices are also disruptive to the finances of developing economies and their ability to plan and implement appropriate policy responses. Shortfalls in development assistance impose a severe handicap, especially since such assistance will be essential for developing countries to design and implement comprehensive and targeted social safety nets, maintain or expand health and education expenditures, and develop and expand payment for ecosystem services schemes.

For many low income countries, especially in Sub-Saharan Africa, just meeting the MDG of halving the proportion of the population without access to clean water and sanitation will mean that development assistance is critical. Even before the current economic crisis, not only has overall development assistance to poor countries fallen in real terms over the previous decade, but the share of assistance to the water and sanitation sector of developing economies has declined even more. For example, in its 2006 report on water, the UNDP estimated that the sector accounted for less than 5 per cent of development assistance, and aid flows would need to double to bring the MDG within reach, rising by US$3.6 to US$4 billion annually.[111] With the advent of the current economic crisis and the fall in revenues of national governments, addressing the gap in overseas aid for clean water and sanitation in developing economies needs to be a priority of the international community under a GGND.

Developing economies will need technical and institutional assistance as well. Transfer of technologies may be important for developing large-scale water supply and sanitation projects, but the lack of skills and R&D capacity to absorb, adapt and develop new technologies is a problem. For example, a major obstacle to more efficient and productive groundwater utilization in developing economies is not the availability of supplies but poor data on the extent of the resource, underdeveloped regulatory frameworks for governing groundwater use, and the limited knowledge of water authorities on managing the resource. Basic technologies available in richer countries for managing water resources, such as geographical information systems and remote sensing, are scarce in many developing economies or under-utilized. Advanced technologies, such as desalinization plants, have become more cost-effective and affordable to large emerging market economies, such as China, Mexico, and Turkey, and to the Gulf States but the technology has yet to be disseminated to many low income economies, even though it would be ideal for small island states and countries with large coastal populations.[112]

As discussed in Chapter 2.2, the effective implementation of market-based instruments and reforms in the water sector is dependent on overcoming a number of specific conditions. Many low-income countries need assistance in assessing which measures are appropriate for application in their economies. Unfamiliarity with public-private partnerships in providing clean water, sanitation and other water services may also be a factor deterring the more widespread use of this activity in developing economies.

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[111] UNDP 2006, *op cit.*

[112] Lopez-Gunn, Elena and Manuel Ramó Llamas. 2008. "Re-thinking water scarcity: Can science and technology solve the global water crisis?" *Natural Resources Forum* 32:228-238.

2.4 National Priorities for a Global Green New Deal

The major components proposed in this report for the Global Green New Deal have been shaped by the four main crises that have afflicted the world in recent years: the current global recession, the fuel and food crisis of the past several years, and the emerging water crisis. The GGND must also consider actions today that can address urgently the impending problems of global climate change and extreme poverty worldwide.

Part Two has been concerned with actions by national governments under a Global Green New Deal. In suggesting these actions, this report has focused on measures in two principal areas – reducing carbon dependency and ecological scarcity – and policies, investments and reforms that current evidence suggests that governments can enact fairly swiftly, i.e. in the next one or two years.

This chapter concludes Part Two by summarizing the main national actions that are essential for success of the proposed GGND. In January 2009, South Korea announced a Green New Deal plan that adopts many of the national actions proposed for reducing carbon dependency and ecological scarcity. The plan involves spending US$36 billion over three years to create nearly a million jobs. The final section of this chapter describes the South Korean Green New Deal in more detail.

Proposed National Actions

As emphasized in Part One, to be truly global, a GGND strategy must encompass widespread adoption by national governments of fiscal measures and other policies over the short term that will expedite economic recovery and create jobs while being consistent with the medium term objectives of reducing carbon dependence, environmental deterioration and extreme world poverty. The national actions suggested in Part Two generally fit these criteria.

Some actions, however, have clearly identifiable and immediate impacts in terms of stimulating an economic recovery and creating jobs. While these measures are also likely to reduce world poverty, it is more difficult to assess their impact on this goal. Other actions tackle the pressing problems faced by the world poor more directly, and in doing so should stimulate growth and employment, but the latter effects are often harder to evaluate.

It has also been difficult to put a precise "price tag" on the costs to the national governments of the proposed actions. It is possible to give an approximate indication of what governments should spend in two broad priority areas of the GGND.

For instance, Chapter 2.1 describes a "green recovery" programme for high-income OECD countries that combines stimulus policies aimed at immediate economic recovery and job creation that also promote the transition to a low-carbon economy through removal of fuel subsidies, clean energy investments and market-based incentives. This programme is based on a green recovery proposal for the United States, which is estimated to cost US$100 billion, or approximately 0.7 per cent of US GDP, spend over the next two years, and which would create 2 million new jobs (see Box 6). The proposal also encompasses one part of the sustainable transport strategy also outlined in Chapter 2.1, which advocates investing in the expansion of mass transit and freight rail. Including the other elements to improve the sustainability of transport would increase the cost of the green recovery programme implemented over the next one to two years in the United States and other high income economies to at least 1 per cent of

GDP. Such a strategy leads to the following recommendation for national action under the GGND.

The United States, the European Union and other high income OECD economies should spend over the next two years at least 1 per cent of their GDP on the national actions proposed for reducing carbon dependency, including removing subsidies and other perverse incentives and adopting complementary carbon pricing policies.

As indicated in Chapter 2.1, China is not only a major world economy but now the leading source of global greenhouse gas (GHG) emissions. The elements of a comprehensive green recovery programme for China were suggested in Box 5. As noted in the chapter, China also needs urgently to invest and implement other measures to improve the sustainability of its transport. Although it is unclear what the final cost would be for China over the next two years, it could easily reach at least 1 per cent of GDP as well. But China is not alone among large emerging market and transition economies in needing to implement such a strategy. Moreover, if more of these economies, such as Brazil, India, Indonesia, Mexico and Russia, as well as the remaining developing economies comprising the G20 group, joined China in such a strategy, then the effects of the GGND would be magnified. [113] The global economy and employment would recover more quickly, and world energy use and GHG emissions would decline more rapidly.

The remaining middle and high income economies of the G20 should aim, as far as possible, also to spend over the next two years at least 1 per cent of their GDP on the national actions proposed for reducing carbon dependency.

If the world's 20 biggest rich and emerging economies, which together account for almost 80 per cent of the world's population, 90 per cent of global gross domestic product (GDP), and at least three quarters of global GHG emissions, adopted this national action strategy for reducing carbon dependency, it would be a powerful signal to the rest of the world that these measures are critical for reviving the world economy and sustainable development. As discussed in Chapter 2.1, there are also considerable economic, employment and poverty alleviation benefits for developing economies to adopt the proposed actions. Thus, it is in their interest to pursue the recommended strategy, even though it is difficult to determine the costs.

Developing economies should also implement over the next two years the national actions proposed for reducing carbon dependency. Under the current economic conditions it is difficult to determine how much each economy should spend on these activities.

Chapter 2.2 identifies two urgent priority areas for developing economies as part of the GGND. Because the poor are most vulnerable during economic crises, it is imperative that these countries design and implement as soon as possible a comprehensive safety net programme targeted to the poor, and that they maintain, if not expand, educational and health services. To address the problem of the lack of safe drinking water and sanitation for millions of the poor in developing regions, low and middle income economies should follow the UNDP recommendation and spend at least 1 per cent of their GDP for improved water and sanitation.

[113] The members of the G20 are Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, the United Kingdom and the United States, plus the European Union.

These two measures will also generate important economy-wide benefits, which are difficult to quantify, but should translated into immediate economic stimulus and job creation effects.

Developing economies should spend at least 1 per cent of their GDP on improving clean water and sanitation for the poor. They should also develop urgently comprehensive, well-targeted safety net programmes and maintain, if not expand, educational and health services for the poor.

Chapter 2.2 also highlights a number of other important national actions that developing economies should adopt to improve the sustainability of their primary production activities. As discussed in the chapter, adopting such measures is even more important during a major economic recession, especially if improving the sustainability of primary production generates sufficient investible funds for diversifying the economy, building up human capital, and investing in social safety nets and other investments targeted at the poor.

Developing economies should adopt the other national actions for improving the sustainability of their primary production activities, although under the current economic conditions it is difficult to determine how much each economy should spend on these activities.

Chapter 2.2 also suggests other national actions that all economies need to adopt to improve water management globally.

All economies should consider removing water subsidies and other distortions, adopting market-based instruments or similar measures to increase water efficiency, and facilitating transboundary water governance.

Finally, Chapter 2.3 outlines the key challenges facing developing economies in implementing the above national actions. These challenges can only be overcome through concerted action and cooperation at the international level. In addition, through greater cooperation and coordination of policy efforts, the international community can also ensure the effectiveness and success of the GGND. Part Three of this report addresses the necessary international actions required for the Global Green New Deal.

The South Korean Green New Deal[114]

Concerned by the fall in growth rate and employment in late 2008, in January 2009 the Ministry of Strategy and Finance of South Korea announced a Green New Deal plan. At a cost of around U$36 billion over 2009 to 2012, the initiative aims to create 960,000 jobs. It is expected that 149,000 jobs will be created in 2009 alone, mainly in construction.

As the table below indicates, the bulk of the Green New Deal will be based on nine major projects involving a range of actions similar to those advocated in this report for reducing carbon dependency and ecological scarcity. The low-carbon projects include developing railroads and mass transit, fuel efficient vehicles and clean fuels, energy conservation and environmentally friendly buildings. These measures alone will account for over 1.2 per cent of GDP, which indicates that South Korea is already conforming to the recommendation of this report that G20

[114] I am grateful to Heewah Choi, Peter Poschen and Kristof Welslau of the International Labor Organization (ILO) for providing me with this information on the South Korean Green New Deal. The source of this information is from a "Briefing Note for Foreign Correspondents", Ministry of Strategy and Finance, Government of South Korea. January 19, 2009.

economies should spend at least 1 per cent their GDP on a low carbon strategy. There are also three major projects in the South Korean plan that aim to improve water management and ecological protection, including restoration of four major rivers, building small and midsize dams and forest restoration. By launching this initiative, the South Korean government is committing expenditures equivalent to around 3 per cent of its GDP on the Green New Deal.[115]

In addition to the Green New Deal, the South Korean government has also announced that it plans to establish a US$72.2 million renewable energy fund to attract private investment in solar, wind and hydroelectric power projects, including developing technologies and plant construction.[116] It is hoped that the development of renewable energy will create 3.5 million jobs by 2018, with 2,000 additional jobs created in 2009 with the initial projects.

South Korea's Green New Deal

Project	**Employment**	**US$ million**
Expanding mass transit and railroads	138,067	7,005
Energy conservation (villages and schools)	170,702	5,841
Fuel efficient vehicles and clean energy	14,348	1,489
Environmentally friendly living space	10,789	351
River restoration	199,960	10,505
Forest restoration	133,630	1,754
Water resource management (small and midsize dams)	16,132	684
Resource recycling (including fuel from waste)	16,196	675
National green information (GIS) infrastructure	3,120	270
Total for the nine major projects	**702,944**	**28,573**
Total for the Green New Deal	**960,000**	**36,280**

Source: Ministry of Strategy and Finance, Government of South Korea.

[115] Estimates of the GDP shares of the Green New Deal are based on 2007 estimated GDP in terms of purchasing power parity from the US Central Intelligence Agency *The World Factbook*, available at https://www.cia.gov/library/publications/the-world-factbook/rankorder/2001rank.html. In 2007, the GDP of South Korea was estimated at US$1,206 billion.

[116] http://www.upi.com/Energy_Resources/2009/02/02/South_Korea_creates_renewable_energy_fund/UPI-41851233616799/.

PART THREE: The Role of the International Community

The various national actions proposed in Part Two are necessary components of the Global Green New Deal. But they are not sufficient.

To overcome the challenges facing developing economies will require additional actions by the international community. International cooperation and coordination of policy across countries will also assist the effectiveness of the national actions described in Part Two. The purpose of Part Three is to suggest how the international community can facilitate the adoption of a GGND strategy by national governments and enhance the benefits gained from such policies in terms of stimulating economic recovery, generating jobs, reducing poverty and sustaining economic development.

Chapter 2.3 in Part Two identifies a number of international challenges common to more than one component of the GGND.

For example, there is a serious "capital gap" preventing developing economies from implementing the proposed national actions over the next one to two years. Equally constraining is the "skills and technology gap"; most developing economies, with the possible exception of Brazil, China, India, Russia and other large emerging market economies, do not have the research and development (R&D) capacity or the skilled workforce to import and adapt the new skills and technology for many of the proposed investments. Both of these gaps can be overcome by increased financing, but during the current global economic crisis, new financial flows are in short supply. Potential aid flows from donors are likely to be reduced and not increased. The crisis has certainly reduced private investment flows, especially to more risky investments with longer term returns. The political will to develop new and innovative financial mechanisms to spur global investments may also weaken. Such a financial climate is likely to affect the ability of all national governments to implement the proposed actions in Part Two over the next two years, but it will especially inhibit developing economies.

Trade is also an important incentive for some actions proposed under the GGND. However, the volume of world trade is projected to decline in 2009 as global per capita income contracts.[117] In addition, the last few years have seen tremendous volatility in international commodity prices, especially for energy and food, with prices first rising and then falling sharply as the global recession has deepened. Developing economies, especially those who are highly resource dependent, face balance of payment problems and uncertainty over export and government revenues. Under such conditions it is difficult to implement investments and reforms, such as those required to improve the sustainability of primary production activities, increased health and educational expenditures, developing comprehensive safety net programmes targeted at the poor and financing of clean energy and transport technologies. The current economic climate also deters the progress needed in the Doha Round of world trade negotiations that are necessary to support the GGND.

[117] World Bank 2009 "Global Economic Prospects", *op cit.* United Nations. 2009. *World Economic Situation and Prospects 2009.* United Nations, New York.

The recommendations of Part Two highlight the need for global policy coordination to overcome these financial and trade challenges and make the GGND effective. There are also a number of failures in current global governance that have to be addressed. In the absence of a post-Kyoto climate change agreement, there is growing investment uncertainty over the future of the global carbon market and the Clean Development Mechanism (CDM) after 2012. Future Joint Implementation (JI) projects may also be affected. New trade and financial mechanisms are required, and international agreements on transboundary pollution and water management need to be negotiated, but what is the appropriate global policy forum for promoting these initiatives over the next few years?

These challenges can only be overcome if the international community agrees to actions and mechanisms in support of the GGND. There are three areas in which these actions are needed:

- **Promoting global governance.**
- **Facilitating access to financing.**
- **Enhancing trade incentives.**

In formulating international actions in these three areas, an important criterion must be whether significant progress and agreement can be made by the international community within the next one to two years. The GGND is an urgent priority, given the current recession and the multiple crises facing the world. If the proposed global initiatives are to be effective in facilitating the GGND and enhancing its benefits, then they must be implemented at the same time as the actions by national governments advocated in Part Two.

The following chapters discuss the specific international actions proposed for each one of the above three areas.

3.1 Promoting Global Governance

Improving global governance is crucial to meeting the financial, trade and policy coordination challenges to implementing the Global Green New Deal. The key question is whether there is an appropriate global policy forum that can provide over the next couple of years the key leadership necessary to overcome these global challenges and facilitate the GGND.

This report suggests that the most likely global policy forum for promoting urgent international action on the GGND is the G20 forum of the world's 20 largest rich and emerging economies, although all international fora, and especially the UN system, have a role to play in promoting, developing and enhancing the GGND.

There are several reasons why the G20 is the appropriate forum for coordinating and innovating international policy in support of the GGND.

For one, this report recommends concerted action by the G20 nations in key areas of the GGND. As outlined in Part Two, the G20 economies should spend over the next two years at least 1 per cent of their GDP on the national actions proposed for reducing carbon dependency and improving the sustainability of transport. The high income OECD members and the European Union should adopt this target; so should the other middle income and emerging economy G20 members, if economic conditions allow it. In addition, this report recommends that the G20 consider other actions, such as removing water subsidies and other distortions, adopting market-

based instruments or similar measures to increase water efficiency, and facilitating transboundary water governance. If applicable, the developing economy G20 members should also spend at least 1 per cent of their GDP on improving clean water and sanitation for the poor, as recommended by the UNDP. They should develop comprehensive, well-targeted safety net programmes, maintain – and preferably expand – educational and health services for the poor and improve the sustainability of primary production activities.

In addition, the G20 has emerged as the global forum for coordinating policy action during the immediate economic crisis. The G20 is therefore well placed to consider the proposed GGND actions of this report as part of its response to the current crisis. Some experts on global governance have already recommended that it do so: "The communiqué of the November 15, 2008 Summit locked in the next G20 summit and hence ordained a sequel that appears to have enshrined the G20 as the new format to address the current global and financial and economic crisis over the coming months and perhaps years….we strongly believe that it is best for the new U.S. administration to focus its attention on making the G20 summit format work, in terms of its ability to address the immediate crisis, and in terms of subsequently dealing with other pressing problems, such as global warming and global poverty."[118]

This report agrees with the recommendation but with one important caveat. The problems of global warming, world poverty and the need for a green economic recovery should not be relegated to a future agenda of the G20 but needs to be considered at the next summit in April 2, 2009 in London. Already, it has been proposed that at the April meeting the G20 should launch its own initiative to develop framework ideas for the post-Kyoto climate change conference at Copenhagen in December 2009.[119]

At its April 2009 London meeting, the G20 should consider proposals for a Global Green New Deal, such as the actions recommended by this report, and help develop framework ideas towards securing a global climate change agreement at Copenhagen in December 2009.

The G20 economies together account for almost 80 per cent of the world's population, 90 per cent of global gross domestic product (GDP), and at least three quarters of global GHG emissions. The lead economies in the G20 are also the dominant sources of international aid, including funding of multilateral institutions. If the G20 leads the coordination and innovation in international policy required for support of the GGND, it would be an important message to the rest of the world that this strategy is critical for reviving the world economy and addressing pressing global challenges. As noted above, for example, the G20 could help in developing and securing a post-Kyoto global climate change framework.

A post-Kyoto international agreement is urgent. Many of the low carbon and sustainable transport investments advocated in this report as part of the GGND will be affected by the growing uncertainty over the future global carbon market after 2012 when the Kyoto treaty expires. Although it helps that the European Union has agreed a 20 per cent cut reduce greenhouse gas (GHG) emissions by 2020, and to increase this reduction to 30 per cent within the framework of "an ambitious and comprehensive global agreement in Copenhagen on climate

[118] Bradford, Colin, Johannee Linn and Paul Martin. 2008. "Global Governance Breakthrough: The G20 Summit and the Future Agenda." Brookings Policy Brief Series #168, Brookings Institution, Washington DC.
[119] Bradford et al. 2008, *op cit.*

change", rapid progress is needed in climate change negotiations.[120] Both uncertainty over future global climate policy and the delay caused by inaction increase sharply the costs of an agreement.[121] Delay in adopting effective climate policies will affect the cost of future agreements that will be required to abate an even larger amount of emissions. Such inaction in the short term increases significantly the costs of compliance in the long term, which is compounded by the effects of uncertainty on investment and policy decisions.

Any new climate change agreement must also include developing economies, especially those countries whose emissions are expected to rise rapidly in coming years (see Box 3). The longer participation of developing economies in a global agreement is delayed, the higher the costs of an agreement, and the less efficient it is in reducing global GHG emissions.[122] Various policy frameworks have been proposed, with the general consensus being that a more flexible framework is likely to work the best in accommodating developing economies, such as China, Russia and other large emerging economies.[123]

One of the most comprehensive frameworks has been suggested by Cameron Hepburn and Nicholas Stern, in which each country takes on its own responsibilities and targets within a larger global agreement, which in turn contains the following six features:

- A pathway to achieve the world target of 50 per cent reductions by 2050, where rich countries contribute at least 75 per cent of the reductions.
- Global emissions trading to reduce costs.
- Reform of the CDM to scale up emission reductions on a sectoral or benchmark level.
- Scaling up of R&D funding for low-carbon energy.
- An agreement on deforestation.
- Adaptation finance.[124]

Whether or not the final post-2012 climate change agreement follows this exact structure, such comprehensive frameworks should be the basis for negotiations towards such an agreement. As inclusion of all the G20 high income and emerging market economies is fundamental to the successful conclusion of such an agreement, the next G20 summit is an ideal opportunity for these 20 large economies to begin the negotiation process.

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[120] Council of the European Union. 2008. "Brussels European Council 11 and 12 December 2008: Presidency Conclusions." Council of the European Union, Brussels, 12 December 2008.

[121] Bosetti, Valentina, Carlo Carraro, Alessandra Sgobbi and Massimo Tavoni. 2008. "Delayed Action and Uncertain Targets: How Much Will Climate Policy Cost?" Nota di Lavora 69.200. Fondazione Eni Enrico Mattei, Milan.

[122] Bosetti, Valentina, Carlo Carraro and Massimo Tavoni. 2008. "Delayed Participation of Developing Countries to Climate Agreements: Should Action in the EU and US be Postponed?" Nota di Lavora 70.2008. Fondazione Eni Enrico Mattei, Milan. Hepburn, Cameron and Nicholas Stern. 2008. "An new global deal on climate change." *Oxford Review of Economic Policy* 24(2):259-279. McKibbin, Warwick J., Peter J. Wilcoxen and Wing Thye Woo. *Preventing the Tragedy of the CO_2 Commons: Exploring China's Growth and the International Climate Framework.* Global Economy & Development Working Paper 22, July 2008. Nordhaus, William D. 2007. "To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming." *Review of Environmental Economics and Policy* 1(1):26-44. Wheeler, David. 2008. "Global Warming: An Opportunity for Greatness." Ch. 2 in Nancy S. Birdsall, ed. *The White House and the World. A Global Development Agenda for the Next US President.* Center for Global Development, Washington DC.

[123] See, for example, Bosetti et al. 2008, "Delayed Participation of Developing Countries to Climate Agreements: Should Action in the EU and US be Postponed?" *op cit.* Hepburn and Stern 2008, *op cit.* Lewis, Joanna and Elliot Diringer. 2007. "Policy-Based Commitments in a Post-2012 Climate Framework: A Working Paper." Pew Center on Global Climate Change, May 2007. McKibben et al. 2008, *op cit.* Nordhaus 2007, *op. cit.* Wheeler 2008, *op cit.*

[124] Hepburn and Stern 2008, *op cit.*

Two of the most important features of any new international climate policy are the enhancement of global emissions trading to reduce costs and reform of the CDM. As argued in this report, guaranteeing the future of a global carbon market and CDM mechanism beyond 2012 is essential to the success of many actions under the proposed GGND. It has been suggested that, in lieu of an inclusive international climate agreement, the continued existence of a global carbon market that would allow developing economies to finance their mitigation measures would still allow attainment of global GHG emission reduction targets.[125]

As discussed in Part Two, although the CDM has achieved success in securing the financing and transfer of clean and low-carbon technologies in developing economies, there are three concerns about the current CDM.

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. For example, more projects in low-income economies like the micro-credit scheme pioneered by Grameen Shakti in Bangladesh to provide a range of affordable renewable energy technologies to the rural poor (see Box 9) or the transfer of second-generation cellulose biofuel technology to Sub-Saharan Africa (see Box 11) need to be funded through the CDM.

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.[126]

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.[127] Such ideas should help the international community agree on the best way to extend the CDM and global carbon market beyond 2012.

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[125] Bosetti et al. 2008. "Delayed Participation of Developing Countries to Climate Agreements: Should Action in the EU and US be Postponed?" *op cit.*

[126] Hepburn and Stern 2008, *op cit.*

[127] Collier, Paul, Gordon Conway and Tony Venables. 2008. "Climate change and Africa." *Oxford Review of Economic Policy* 24(2):337-353. Lloyd, Bob and Srikanth Subbarao. 2009. "Development challenges under the Clean Development Mechanism (CDM)-Can renewable energy intitiatives be put in place before peak oil?" *Energy Policy* 37:237-245. Hepburn and Stern. 2008. *op cit.*. Holme Olsen, Karen and Jørgen Fenhann, eds. *A Reformed CDM – including new Mechanisms for Sustainable Development.* Capacity Development for CDM (CD4CDM) Project, UNEP Rise Centre, Denmark, pp. 59-72.Schneider, Malte, Andreas Holzer and Volker H. Hoffmann. 2008. "Understanding the CDM's contribution to technology transfer." *Energy Policy* 36:2930-2938. Wheeler 2008, *op cit.*

The international community should reach agreement on extending the CDM 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 global GHG emission reductions.

There are other areas of global governance that need to be improved if the certain actions proposed in the GGND are to be effective.

In Chapter 2.2, it was noted that payment for ecosystem services is becoming an important mechanism in some developing regions for ensuring the long-term management of critical ecosystems, especially protection of watersheds and forests for carbon capture. But the success of current payment schemes in alleviating poverty has been limited. Greater international effort needs to be devoted to improve the design of payment of ecosystem service schemes so as to increase the coverage of ecosystems protected, to enhance the participation of the poor, small land owners and the landless.

Chapter 2.2 also discusses the increasing importance of managing transboundary water resources, especially given the pressures of increasing water scarcity and the growing number of developing economies who depend heavily on these shared resources for freshwater supply. Although there are around 200 treaties and agreements that govern transboundary water allocation, many international river basins and other shared water resources still lack any type of joint management structure, and some international agreements and joint management structures need to be updated or improved. A key recommendation of the chapter is that countries should work to facilitate transboundary water governance and cooperation over shared management and use. Such efforts would be greatly enhanced if there was more support from the international community for greater collaboration on shared water issues globally.

The international community should support efforts to improve payment for ecosystem services targeted to the poor and to include more ecosystems, and efforts to improve governance and shared use of transboundary water resources.

3.2 Facilitating Access to Finance

If enacted, the international actions and reforms advocated in the previous chapter should facilitate the global financing and technology transfer necessary for the GGND. But problems will still remain in access to finance globally.

One difficulty is the expected continuing decline in private financial investment flows. A major reason for this ongoing problem is the lack of confidence in the international financial system coupled with the worldwide contraction of credit as the global economy readjusted to rid the system of overvalued and bad assets. The global financial system suffered a near meltdown in 2008, and although the massive bailout of the global financial system may have averted a major catastrophe in world credit and capital markets, it has proven insufficient to avoid the worst international economic crisis since the Great Depression. Not surprisingly, private financial investment flows have suffered accordingly, and this has led to demands for a new framework for the global financial system.

Although reform of the financial system is beyond the scope of this report, a healthy system is necessary for the success and effectiveness of the GGND. The recommendations in Part Two call for increased investment in a number of activities worldwide as part of this global strategy.

Private investment flows and credit are important for achieving these objectives. Consequently, it is important for this report to consider what general improvements in the financial system might be required to assist the implementation of the GGND over the next couple of years.[128]

Most discussion seems to assume that a new framework will mean more regulation of financial markets. However, this assumption may be erroneous in several respects.

For one, the existing crisis may have more to do with a failure of governance and a lack of transparency rather than a lack of regulation. The financial system is already governed by many regulations and procedures. Most countries have a multitude of agencies supervising every aspect of financial activity – central and private banks, stock exchanges, securities, mortgage lenders and even other public agencies involved in the system. There are also independent assessors, such as credit rating agencies and research analysts, and all financial institutions have their own internal credit and audit procedures. In addition, the financial crisis did not originate in poorly regulated emerging markets but in the most heavily regulated markets of Europe and the United States. Thus, reforms of the financial system should focus on better governance and not more regulation. Indeed, simply adding more regulation could reduce transparency and could in fact worsen governance.

Improving governance of the financial system must satisfy two important criteria: (1) transparency and simplicity, and (2) aligned incentive structures. These criteria could be met by the following reforms.

- Lending norms must be harmonized by central banks to disallow imprudent lending and to set conservative benchmarks. As an example, housing loans should be allowed up to 70 per cent of the market value of the property, as against observed lending of 100-110 per cent of collateral value that occurred in the sub-prime mortgage markets in the United States and some European countries.
- Credit research, including ratings, should be paid for by investors and lenders, not by debt issuers, to prevent conflict of interest. Equity research is somewhat better aligned in terms of incentive structures because investors indirectly pay for broker research. However, ideally all forms of research must be commissioned by investors or exchanges, and paid for by them.
- Senior executive pay in financial institutions must be reported transparently to the governing board and must be aligned to long-term performance rather than short term earnings.
- Derivatives trading and hedge funds should be required to provision or reserve earnings more conservatively for future risks and costs, including the cost of future capital which may be needed to service risk-weighted assets which arise in future due to current transaction streams. Previous practices, such as the flexibility provided by Basle capital norms to derivatives trading banks to use their own risk-management systems for risk and capital assessment, should be eliminated or restricted.

Such governance reforms are straightforward and could be implemented fairly rapidly throughout the global financial system. Adopting these actions as soon as possible is necessary to revive confidence in the global credit system and stimulate private investment flows. Because

[128] The following discussion of general financial reforms was written with the assistance of Sanjeev Sanyal. I am grateful to him for these suggestions of reform and his input on the topic.

ensuring a healthy global financial system and credit availability should be considered an essential goal of a GGND, this report recommends that the above reforms be implemented immediately.

The international community should adopt as soon as possible reforms to the governance of the financial system that increase transparency and simplicity, and improve the alignment of incentive structures.

A second problem for financing many of the initiatives outlined in the GGND is the shortfall in development assistance, especially in those sectors that are the key targets of the global strategy. Even before the current economic crisis, official development assistance contributed US$5.4 billion annually to 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.[129] Across all developing countries, total development assistance in transport amounts to US$8.2 billion, which represents just 4 per cent of the US$211 billion total investment in the transport sector of developing economies today. Yet, as discussed in Part Two, the UNFCC recommends that 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. Shortfalls in development assistance will also impose a severe handicap on the necessary improvements in the sustainability of primary production in developing economies. It was also noted that the water and sanitation sector in 2006 accounted for less than 5 per cent of development assistance, yet aid flows would need to double, rising by US$3.6 to US$4 billion annually to bring within reach the MDG of halving the proportion of the population without these services by 2015.

These estimates in the gap in development assistance are sobering, as no doubt the situation has worsened because of the current global recession. However, there is some positive news.

Because of the economic crisis, the World Bank is planning to step up its development assistance.[130] Over the next three years, the Bank could make new commitments of up to US$100 billion. Lending in 2009 could almost triple to more than US$35 billion compared to US$13.5 billion lent in the previous year. The Bank is also creating a financial crisis facility to fast-track funds to developing countries. The new facility will expedite approval processes for money from a US$42 billion fund aimed at the world's poorest economies. An initial US$2 billion from this fund is being expedited to these countries, and the money is likely to support public spending on infrastructure, education, health, and social safety net programmes, such as school and maternal feeding programmes. Such increased support is consistent with the GGND strategy of improving the livelihoods of the poor during the current crisis. More lending and development institutions should follow the lead of the World Bank and not only increase their aid to the poorest economies over the next few years but also target it to the poor living within these economies.

As the current economic crisis is expected to exacerbate the worldwide problem of poverty, the President of the World Bank, Robert Zoellick, has called for every high-income economy to pledge 0.7 per cent of its stimulus package to a global "vulnerability fund" that would be used to finance in developing economies a comprehensive and targeted safety net for the poor,

[129] UN ESCAP 2008, *op cit.* and Wheeler 2008, *op cit*.
[130] This information on World Bank Group lending plans is from the official website http://www.worldbank.org/html/extdr/financialcrisis/.

investments in infrastructure including low-carbon technology projects and support for small and medium-sized enterprises and micro-finance institutions.[131] Similarly, the UN High Level Task Force on the Global Food Crisis has called on donor countries to double financing for food assistance, other types of nutritional support and safety net programmes, and for an increase in the percentage of aid to be invested in food and agricultural development from the current 3 per cent to 10 per cent within five years.[132]

Bilateral and multilateral aid donors should increase their development assistance over the next few years, and target it to the sectors and actions that comprise the key components of the GGND.

The international community may also consider developing innovative financial mechanisms to facilitate attainment of the GGND goals. This report describes briefly three relevant proposals.

The first proposal is the expansion of the International Finance Facility (IFF), which was developed by the HM Treasury and the Department for International Development of the United Kingdom. The intention of the IFF is to mobilize resources from international capital markets by issuing long-term bonds that are repaid by donor countries over 20 to 30 years. This approach has already been applied to the IFF for immunization (IFFim), which was launched by the UK, other European countries and South Africa in 2006. These countries have pledged to contribute US$5.3 billion over 20 years.[133] IFFim raise finance by issuing bonds in the capital markets to convert these long-term government pledges into funds for immediate investment. The government pledges are then used to repay the IFFim. The initial offering in 2006 raised US$1 billion, and a second offering in 2008 added US$223 million. The investments are disbursed through the Global Alliance on Vaccines and Immunization (GAVI), a public-private partnership of major stakeholders in immunization in the developing world.

Gordon Brown and Ngozi Okonjo-Iweala have proposed that a similar IFF facility to IFFim could be set up to meet the MDG for clean water and sanitation investments in developing economies.[134] Meeting this goal is also an important objective of the GGND (see Chapter 2.4). Brown and Okonjo-Iweala suggest that the IFF mechanims of making funds immediately available for investment while repayment is deferred until much later is ideal for water and sanitation projects, as their rates of return are extremely favorable (see Chapter 2.4).

A study comparing the IFF approach to other potential new sources of international development financing, such as the currency transactions tax (otherwise known as the Tobin tax), taxes on airline travel or fuel, and establishing special drawing rights for development, found that the alternatives to the IFF were less desirable as they need international agreement involving many countries.[135] However, another study questions whether the IFF approach can raise sufficient funds either to supplement the shortfalls in development assistance necessary to achieve the MDG.[136] If an IFF for water and sanitation emulated IFFim and raised US$1.2 billion from the bond market over three years, this amount would contribute to the estimated US$3.6 to US$4

[131] Zoellick, Robert B. "A Stimulus Package for the World." *The New York Times*. January 22, 2009.
[132] High-Level Task Force (HLTF) on the Global Food Crisis. 2008, *op cit.*
[133] This information is from the IFFim website www.iff-immunisation.org.
[134] See "Special Contribution: Frontloading financing for meeting the Millennium Development Goal for water and sanitation in UNDP 2006, *op cit.*
[135] Addison, Tony, George Mavrotas and Mark McGillivray. 2005. "Aid, Debt Relief and New Sources of Finance for Meeting the Millennium Development Goals." *Journal of International Affairs* 58(2):113-127.
[136] Moss, Todd. "Ten Myths of the International Finance Facility." Working Paper Number 60, Center for Global Development, Washington, DC, May 2005.

billion required annually to achieve the MDG of halving the proportion of the population without these services by 2015, but the IFF funds would not provide the necessary financing on its own. Still, an IFF for sanitation and water, and possibly other specific investments advocated in the GGND, might prove to be an innovative financial mechanism.

Another potential new source of finance is the Climate Investment Funds (CIF), which currently consist of the Clean Technology Fund (CTF) and the Strategic Climate Fund (SCF) administered by the World Bank and other multilateral developments. The funds will be disbursed to developing economies as grants, concessional loans and risk mitigation instruments. The CTF will invest in projects and programmes that facilitate the transfer and adoption of low carbon technologies in power generation, transportation and energy efficiency.[137] The SCF will target funding to programmes that pilot new development approaches or scaled-up activities aimed a specific climate change challenge or economic sector.[138] Initial programmes include a pilot programme for climate resilience, a forest investment programme and a scaling-up renewable energy programme.

The CIF is new, and thus it is too early to assess its performance. The United States first proposed a Clean Technology Fund in January 2008, and committed US$2 billion to the fund over its first three years. Since then other donors have pledged financing to the CIF, including the United Kingdom (US$1.5 billion), Japan (US$1.2 billion), Germany (US$887 million) and France (US$500 million), totally over US$6.1 billion.[139]

One proposal is that the CIF, and especially the Clean Technology Fund, be expanded and incorporated into the next global climate change agreement.[140] If the next global agreement includes permit auction funds, then some of these funds could be allocated to increase the funding of the CIF. It is estimated that at least an additional $12 billion for the CIF could be raised in this way. If this amount was matched by bilateral donations, then the CIF would contain investible funds four times larger than its current funding.

The final financing proposal is a US-led Global Clean Energy Cooperation programme, suggested by the National Renewable Energy Laboratory of the United States.[141] The proposal recommends three implementation strategies for the United States. The first strategy involves revitalizing the portfolio of US clean energy investment-facilitation programmes. The government's existing international clean investment programmes could be consolidated and expanded to increase significantly investment by US firms in energy efficiency and renewable energy worldwide. The second strategy calls for accelerating global cooperation in renewable energy and energy efficiency technologies. Global development and use of these technologies could be scaled up through strategic R&D, demonstration and deployment partnerships. The third strategy recommends expanding partnerships with major developing economies to accelerate clean energy market transformation in these economies. The partnerships could be targeted at large emerging market economies, such as Brazil, China and India, and through

[137] World Bank. "The Clean Technology Fund". World Bank, Washington DC, June 9, 2008.
[138] World Bank, "The Strategic Climate Fun.". World Bank, Washington DC, June 9, 2008.
[139] Based on the World Bank website http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTCC/0,,contentMDK:21713769~menuPK:4860081~pagePK:210058~piPK:210062~theSitePK:407864,00.html
[140] Wheeler 2008, *op cit.*
[141] National Renewable Energy Laboratory. *Strengthening U.S. Leadership of International Clean Energy Cooperation.* Technical Report NREL/TP-6A0-44261. NREL, Golden, CO, December 2008.

regional efforts in Africa, Asia, Latin America and the transition economies of Europe and Central Asia.

Although it is difficult to estimate the total costs of these strategies, the proposal argues that they will yield considerable benefits for the United States and globally. The strategies take advantage of the current US R&D capacity to innovate and develop clean energy technologies, which gives the United States an unparalleled opportunity to lead a global clean energy market transformation in cooperation with international partners. It is estimated that, by 2020, these strategies will generate up to US$40 billion a year in new clean energy exports for the United States and between 250,000 to 750,000 new jobs. In addition, there would be around US$10 to US$50 billion in savings from reduced oil prices and other economic and energy efficiency gains. The anticipated global benefits include up to US$1 trillion a year in new investments in clean energy technologies, reduced GHG emissions of 50 to 80 per cent by 2050 relative to 2005 levels and reduced global oil use of 40 per cent by 2050 relative to 2005 levels.[142]

Other major industrialized economies with significant capacity for clean energy innovation, such as the European Union and Japan, might consider similar global strategies, either on their own or in collaboration with the United States or all G20 economies. Although highly ambitious, such a proposal for global cooperation and partnership on innovative clean energy technological development address directly the issue of financing and transfer of key technologies that is critical to the success and effectiveness of the GGND.

The international community should develop and expand innovative financing mechanisms, such as the International Finance Facility, Climate Investment Funds and Global Clean Energy Cooperation, as possible means to fund key components of the GGND.

3.3 Enhancing Trade Incentives[143]

The current financial and economic crisis is having a significant impact on trade volumes and revenue because of falling global demand and a tightening of trade financing. The slowing of global trade is particularly daunting for those countries that depend on export-led growth. Low-income economies, and particularly those resource-dependent economies with a high share of primary products to total exports, will feel the consequence of the crisis more significantly through trade channels.[144]

Although trade is projected to decline as the global economic downturn worsens, it is less clear what role trade policy can play in either addressing the immediate crisis or in supporting the implementation of the GGND. As trade was not the underlying cause of the current economic crisis, it is doubtful that changes in trade policy, at least in the short term, will be able to reverse the current economic climate. Despite this caveat, one clear opportunity may be to focus new trade financing and trade facilitation financing packages to promote the initiatives outlined in the GGND. There is also a good argument for ensuring trade policies "do no harm" in the short term

[142] NREL 2008, *op cit.*

[143] This chapter was written with the assistance of Ben Simmons, who provided much of the content. I am grateful to him for his inputs on the topic.

[144] United Nations 2009, *World Economic Situation and Prospects 2009*, *op cit.* World Bank 2009, *Global Economic Prospects, op cit.*

through the adoption of protectionist measures. Finally, trade policy will have a critical role over the medium term in promoting some of the key components of the GGND.

Trade and Trade Facilitation Financing

It is estimated that more than 90 per cent of trade is financed with some form of short-term credit, insurance or guarantee. However, in the wake of the international financial crisis this credit has begun to dry up. Exporters are increasingly demanding that overseas buyers obtain letters of credit from banks and these are becoming more expensive and harder to get.[145] The problem is being felt most acutely by traders and banks in emerging economies. The World Trade Organization (WTO) estimates that the current liquidity gap in trade finance is about US$25 billion.[146] This lack of trade financing, coupled with waning demand, is exacerbating the downward trend in global trade.

As the world economic recession deepens, it will become increasingly important to ensure that trade flows continue, which is why adequate trade financing is so critical. Maintaining or enhancing these flows will be essential to attaining some of the components of the GGND, especially the need for developing economies to improve the sustainability of primary production and generate sufficient investible funds for diversifying the economy, building up human capital, and investing in social safety nets and other investments targeted at the poor.

Several national export credit agencies (ECAs) and international financial institutions have announced new trade finance facilities to address the problem.[147] For instance, in December 2008 the US and China announced a new partnership to increase trade-related financing for emerging markets. The US plans to provide US$4 billion in new short-term trade finance facilities and US$8 billion in medium- and long-term trade financing for US goods and services to emerging markets. For its part, China has promised to provide US$8 billion in finance for export of Chinese goods to emerging markets.[148]

International financial institutions are also responding to the crisis. The International Finance Corporation (IFC) has announced plans to double its Global Trade Finance Programme from US$1.5 billion to US$3 billion. According to the IFC, this expanded facility would benefit participating banks based in 66 countries.[149]

These new financing facilities also provide a unique opportunity to promote the expansion of trade finance focused specifically on projects and products that could support actions advocated for the GGND. In some cases, such programmes already exist. For instance, the US Import-Export Bank has supported an Environmental Exports Programme since 1994, which has provided financing in excess of US$3 billion.[150] In the case of the United States, some of its

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[145] The New York Times, *Trade Losses Rise in China, Threatening Jobs*, 14 January 2009.
[146] World Trade Organization, *Lamy Warns Trade Finance Situation "Deteriorating"*, 12 November 2008.
[147] Between 1988 and 1996 export credits increased four-fold from US$26 billion to $105 billion per year. In 2002, it was estimated that ECAs accounted for between US$50-$70 billion annually in support of large industrial and infrastructure projects in developing countries. Knigge, Markus et al., *The Use of Environmental and Social Criteria in Export Credit Agencies' Practices*, GTZ, 2003. The US Export-Import Bank authorized US$12.6 billion in financing alone in its fiscal year 2007. Export-Import Bank of the United States, *Press Release – Export-Import Bank To Provide Liquidity to Small Business Exporters*, 25 November 2008.
[148] Export-Import Bank of the United States, *Press Release - United States and China Announce $20 Billion in Finance Facilities that Will Create up to $38 Billion in Annual Trade Finance to Assist Global Trade*, 5 December 2008.
[149] World Bank, *Trade is Key to Overcome Economic Crisis*, 1 December 2008.
[150] See http://www.exim.gov/products/policies/environment/index.cfm)

US$12 billion of increased trade financing envisioned could be focused specifically on expanding this programme and to directing it to support the transfer of technology and capital goods necessary for the GGND. Similar initiatives could be taken with other national export credit agencies and international financial institutions. However, it may be necessary to receive exemptions for such initiatives under WTO rules, as they amount to discriminatory practices under existing provisions governing the use of trade financing.

Likewise, there is an opportunity to mobilize committed trade facilitation financing in support of the GGND. The OECD estimates that trade-related development assistance amounts to approximately US$25 to US$30 billion a year, which represents around 30 per cent of total development assistance. The aid typically goes to one of four main areas: (a) trade policy and regulation; (b) building productive capacity; (c) economic infrastructure; and (d) trade-related structural adjustment.[151]

At the WTO Hong Kong Ministerial meeting in 2005, it was agreed that the WTO Aid for Trade programme, which supports export industries and infrastructure, should be expanded. During the meeting, the European Union and the United States pledged to increase annual spending on Aid for Trade to US$2.7 billion annually by 2010, and Japan announced that it would spend US$10 billion over three years for developing economies. The World Bank is also expanding its trade facilitation services, including the establishment of a Trade Facilitation Facility (TFF), in the amount of US$30 million over the next three years.[152]

As in the case with trade financing, there is an opportunity to promote within trade facilitation financing a focus on the projects and initiatives advocated in the GGND. The United Nations Environment Programme (UNEP) has already been active in advocating that sustainable development should be one of the goals for structuring Aid for Trade and similar initiatives and investments.[153]

The international community should develop and expand new trade financing and trade facilitation financing packages, and use them to target support to the GGND.

Trade Protectionism

There is increasing concern that the economic crisis and accompanying job losses will lead to an increase in trade protectionism and competitive devaluations. So far, the use of protectionist measures has been limited. According to the International Trade Commission (ITC) and WTO, the number of antidumping cases jumped 40 per cent in the first half of 2008 and only a few nations raised tariffs in 2008.[154] The World Bank notes that a range of trade policy restrictions, such as export restrictions, biofuel subsidies, tariffs and mandates have contributed to the rise in global food and other commodity prices since 2003, and there is concern that countries might resort to these measures as the global recession worsens.[155] Of more direct relevance to the GGND, biofuels policies that subsidize production, impose high tariffs and mandate consumption are on the increase, even though such measures have led to the rapid expansion of

[151] World Trade Organization (WTO), *Aid for trade fact sheet*, website: http://www.wto.org/english/tratop_e/devel_e/a4t_e/a4t_factsheet_e.htm
[152] World Bank, *Trade is Key to Overcome Economic Crisis*, 1 December 2008.
[153] UNEP, *Aid for Trade for Sustainable Development*, Aid for Trade and Development: Global and Regional Perspectives, UNCTAD, 2008.
[154] See the website http://www.usitc.gov/trade_remedy/731_ad_701_cvd/index.htm
[155] World Bank 2009, *Global Economic Prospects, op cit.*

biofuels produced from food crops, such as maize and vegetable oils, contributing to higher food prices and environmental degradation.[156] A rise in protectionism would not only undermine the current WTO Doha negotiations, including important environmental issues such as fisheries subsidies and the liberalization of environmental goods and services, but also risks placing additional pressure on ecosystems as countries begin producing what otherwise would have been produced more efficiently abroad.

The international community should review existing trade agreements and shape future agreements to identify and minimize barriers to enhance effective support of the proposed GGND actions.

Trade Liberalization

The current Doha Round negotiations offer a number of opportunities for promoting a global Green New Deal, albeit in the medium rather than short term.

For example, current negotiations are focused on limiting fisheries subsidies. These subsidies are estimated to be valued at US$15-35 billion annually and include such items as direct cash grants, tax breaks, and loan guarantees.[157] Although some subsidies directed at fishery management promote responsible fishing practices, most subsidies directly contribute to overfishing. This is a grave challenge given that the Food and Agriculture Organization of the United Nations (FAO) estimates that more than three-quarters of the world's fisheries have already been fished to their biological limits or beyond.[158] The threat facing these fisheries is not only an environmental issue; fisheries provide nutrition and employment for millions around the world. Successfully negotiating new WTO rules that limit fisheries subsidies that contribute to overfishing and overcapacity is crucial to ensuring more sustainable primary production activities in all economies.

Another opportunity is the current negotiations aimed at reducing tariff and non-tariff barriers on environmental goods and services. As noted by WTO Director-General Pascal Lamy, in addressing Trade Ministers in Bali, Indonesia during the UNFCCC Conference of Parties, "there is no doubt that an immediate contribution that the WTO can make to the fight against climate change is to indeed open markets to clean technology and services." [159] Although these negotiations hold the potential for increasing the international flow of climate-friendly technologies, there is currently disagreement among WTO members about how they should be liberalized and whether liberalization itself will increase their use if it is not accompanied by a transfer of know-how and the building of local capacity. However, in considering tariff and non-tariff barrier liberalization for a number of clean energy technologies, a World Bank study found that liberalization could result in a 7-13 per cent increase in trade volumes in these technologies.[160] Thus, the potential benefits of overcoming obstacles to liberalizing this trade

[156] World Bank 2009, *Global Economic Prospects, op cit.*
[157] United Nations Environment Programme (UNEP). *Fisheries Subsidies: A Critical Issue for Trade and Sustainable Development at the WTO*. UNEP, Geneva, May 2008.
[158] Food and Agricultural Organization (FAO) of the United Nations. 2007 *The State of World Fisheries and Aquaculture 2006*. FAO, Rome.
[159] Hadi Soesastro, *What should world leaders do to halt protectionism from spreading?*, VoxEu.org Publication, 2008.
[160] World Bank, *Warming Up to Trade: Harnessing International Trade to Support Climate Change Objectives*, 2007.

suggest that it is worth exploring how to ensure a successful outcome of these negotiations at the WTO.

Perhaps the biggest gains to a GGND could from the ongoing negotiations to liberalize agricultural trade.[161] For decades, global agricultural protectionism has encouraged inefficient agricultural production in high-income economies and discouraged efficient and more sustainable production in developing economies. The World Bank estimates that the kind of agricultural trade barrier reductions under consideration in the Doha negotiations might lead to higher global commodity prices in the short run but in the long run should generate a more transparent, rules-based and predictable agricultural trading system that would raise incomes worldwide. If concluded successfully, removal of agricultural protectionism could reduce global poverty by as much as 8 per cent.[162]

The international community needs to reach successful conclusion of the Doha Round trade negotiations, especially on fishery subsidies, clean technology and services and reducing agricultural protectionism.

3.4 International Priorities for a Global Green New Deal

Promoting global governance, facilitating access to financing and enhancing trade incentives are the three priority areas for actions by the international community in support of a Global Green New Deal. Without these actions, the effectiveness of the GGND may be severely constrained.

This report is recommending an expanded global policy role for the 20 rich and emerging economies that comprise the G20 forum. This recommendation is consistent with the strategy outlined in Part Two that the G20 economies should spend over the next two years at least 1 per cent of their GDP on reducing carbon dependency and improving the sustainability of transport. Other components of the GGND should also be adopted by the G20 countries, including the recommendation that developing economies should spend at least 1 per cent of their GDP on water and sanitation. Thus, this report has already envisioned an important role for the leading 20 economies in the world in implementing the GGND. However, development of any GGND is not the exclusive priority of the G20; all international fora have a role to play in promoting, developing and enhancing a GGND.

An expanded leadership role for the G20 in implementing the GGND is timely, given that it has emerged recently as the global forum for coordinating policy initiatives during the immediate economic crisis. The G20 is also likely to take a decisive role in promoting a global agreement on climate change, a role that this report also endorses. Such an agreement needs to address the urgent issue of ensuring that a global carbon market and a reformed CDM is extended beyond 2012. Improved global governance is also needed to facilitate targeting the payment of ecosystem services to the poor and managing shared use of transboundary water resources.

General reforms of the global financial system should focus on improving governance rather than more regulation. These reforms should increase transparency and simplicity and better align incentive structures. Reforming the existing system is necessary to facilitate access to financing for the GGND but it is not sufficient. The problem of declining development assistance and the

[161] Mattoo, Aaditya and Arvind Subramanian. "Multilateralism Beyond Doha." Working Paper Number 153. Center for Global Development, Washington DC, October 2008. United Nations 2009, *World Economic Situation and Prospects 2009*, *op cit.* World Bank 2009, *Global Economic Prospects, op cit.*

[162] World Bank 2009, *Global Economic Prospects, op cit.*

lack of funding of the key sectors and investments identified in the GGND is of critical concern. At a time of global economic crisis, aid should be increasing and better targeted. The report recommends that bilateral and multilateral donors should increase aid over the next few years and target it to the sectors and actions advocated by the GGND. Finally, to support further the aims of the GGND, the international community should also consider developing and expanding innovative financing mechanisms, such as the International Finance Facility, Climate Investment Funds and the Global Clean Energy Cooperation.

Trade policy may not appear to have a direct role in promoting the GGND, but specific trade measures may provide important incentives for the strategy. There may be a way of designing new trade and trade facilitation financing initiatives so to assist the projects and actions advocated in the GGND. On the other hand, trade protectionism, which may increase as a result of the deepening global recession, is an anathema to the GGND. Support for the strategy requires that trade protectionism be avoided, including the growing practice in some countries of implementing biofuels policies that subsidize production, impose high tariffs and mandate consumption. Successful conclusion of the Doha Round trade negotiations, especially on fishery subsidies, clean technology and services and reducing agricultural protectionism, may not assist the GGND in the short term but should provide an important stimulus to the medium and long term effectiveness of the strategy.

PART FOUR: A Greener World Economy

As stated in Part One, the premise of this report is that the current global economic crisis has spurred governments to instigate a worldwide recovery. This provides a unique opportunity to address important other global economic and environmental challenges as well. The Global Green New Deal outlined in this report is aimed at achieving both objectives.

In sum, the GGND is not just about creating a greener world economy. It is about ensuring that the correct mix of economic policies, investments and incentives reduce the carbon dependency of the world economy, protect vulnerable ecosystems and alleviate poverty while fostering economic recovery and creating jobs.

The GGND also recognizes that the looming global problems of climate change, water scarcity and extreme global poverty means that the world should not rely solely on massive fiscal stimulus packages for reviving the economy and creating jobs. Instead, what is called for is a balance of policies and measures in a Global Green New Deal to meet the multiple economic and environmental challenges.

However, reviving the world economy is a necessity. That is why this report has included as part of the proposed GGND actions that can be implemented over the next couple of years and will have an immediate and effective impact on the main objectives of the strategy. These objectives are:

- Enhancing global economic recovery and creating new jobs while improving the long run environmental and economic sustainability of the world economy.
- Identifying key actions that national governments can adopt to attain a sustained and greener economic recovery.
- Identifying key actions that the international can adopt to help overcome critical challenges to implementing a GGND.

The policies and measures that fit these criteria had to be chosen carefully. In addition, it was necessary to take into account that the specific priorities, policies, investments and incentive mechanisms adopted by each national government will differ with the economic, environmental and social conditions of the economy. Three types of economies in particular differ markedly: high income (mainly OECD) economies, large emerging market economies and low income economies. Where necessary, the recommendations of this report have stressed which actions are relevant to each group of economies.

With all these factors in mind, this report suggests that a GGND should be aimed at two broad areas:

- Reducing carbon dependency.
- Reducing ecological scarcity.

Part Two of this report provided details of the specific national actions required by governments towards achieving these aims. Part Three outlined the complementary international actions of improving global governance, facilitating access to finance and enhancing trade incentives necessary for implementing an effective GGND over the next few years.

Part Four concludes this report with two additional items. The first is an examination of policy simulations that examine the long term economic, environmental and employment impacts of certain GGND policies advocated in this report. The policy simulations considered are a series of low-carbon policies in energy and transport implemented for the United States economy, and impacts of energy efficiency and clean technology investments for the cement and iron and steel sectors of China (see Appendix 1). The final section summarizes the main GGND recommendations of this report.

Modeling Scenarios for the United States and China

Part Two examined various proposals to reduce the carbon dependency of the United States and China (see Boxes 5 and 6 also). The possible economic and environmental implications of implementing such policies were not explored in great detail, however.

United States

The Peterson Institute for International Economics (PIIE) and the World Resources Institute (WRI) have conducted a study that provides a modeling framework for assessing the economic and environmental impacts of a green recovery programme for the United States. The programme represents a set of policy options, combining specific low-carbon strategy investments, pricing policies, regulations and other measures that could be considered part of a comprehensive US recovery effort. Many of these policies are currently included in the US$827 billion stimulus package proposed by the Obama Administration; others are not. Details of the PIIE-WRI study are provided in Appendix 1.[163]

Using the National Energy Modeling System (NEMS) and input-output tables, the authors were also able to evaluate the employment impact of energy cost savings to households, firms, and the federal government, as well as the corresponding reduction in revenue to the energy industry, resulting from each scenario. The policy options modeled were household weatherization; retrofitting federal buildings; greening schools, a production tax credit; an investment tax credit; carbon capture and storage demonstration projects; cash for clunkers; a hybrid tax cut; a mass transit investment; battery R&D; and smart metering. The economic and environmental effects of the measures were compared against those of traditional stimulus initiatives, such as tax cuts and road building.

The overall findings of the analysis were that the decreased cost and consumption of energy from the entire programme have the potential to save the US economy an average of US$450 million per year for every US$1 billion invested. In addition, every $1 billion in government spending would lead to approximately 30,000 job-years and reduce annual US greenhouse gas (GHG) emissions by 592,600 tons between 2012 and 2020.[164] Employment effects are measured in job-

[163] This appendix is based on Houser, Trevor, Shashank Mohan and Robert Heilmayr. 2009. *A Green Global Recovery? Assessing US Economic Stimulus and the Prospects for International Coordination.* Policy Brief Number PB09-3. Peterson Institute for International Economics and World Resources Institute, Washington, DC, February. I would like to thank the authors, Manish Bapna, Ed Tureen, the Peterson Institute and World Resources Institute for allowing me to use the results of this study and copyrighted material in this appendix and report.

[164] The employment and GHG emission impacts exclude the effects of the transmission policy. See Houser et al. 2009, *op cit.* for further details.

years, or the number of full-time equivalent jobs lasting one year. The employment gains represent a 20 percent increase in jobs creation over more traditional infrastructure spending.

The relatively high employment effects of the green recovery package relative to conventional infrastructure investments are related to two factors. First, the green programmes are expected to stimulate additional private sector investment, thus multiplying direct, indirect and induced job creation. Second, the PIIE-WRI study finds that the net employment effects of reducing energy costs to the economy as a whole are significant. Energy efficiency improvements and green tax credits have employment effects that continue well beyond the initial investment period. In contrast, the jobs created by conventional tax cuts and road infrastructure investments end once the money is spent.

The timing for implementing these different green policies is likely to vary considerably. The building efficiency programmes (e.g., household weatherization, retrofitting federal building and greening schools) could be implemented swiftly, and provide immediate stimulus to the construction industry. Smart meter deployment and "shovel ready" mass transit investments could also be initiated fairly rapidly. The Cash for Clunkers and hybrid tax credit programmes could also be adopted quickly, but it may take longer for consumers to respond to these incentives. The remaining programmes are likely to require a longer lead time before implementation.

China

For this report, the Millennium Institute (MI) employed their Threshold 21 (T21) model to simulate the impacts of energy efficiency and clean technology investments for the cement and iron and steel sectors of China. developed for the United States and China. The details of the model scenarios are depicted in Appendix 2.[165]

China's cement and iron and steel sectors are highly dependent on energy, much of which is from coal (directly or indirectly). 50 per cent of cement production goes into residential housing, 10 per cent into commercial building, and 20 per cent into infrastructure. 45 per cent of steel production goes into building, 10 per cent into infrastructure and part of the rest into motorized vehicles and housing appliances.

The simulations for China consider both low-carbon policies on the supply side (e.g., increase investments in new plants using cleaner technologies; improvements in the energy efficiency of existing plants; and reducing GHG emission content of inputs) as well as the demand side (e.g., reduce the growth rate in the size of residences; reduce the amount of cement and steel used in construction; increase the quality and lifespan of buildings; and reduce the cement and steel use per unit of public expenditures on infrastructure). The effects of these programmes are similar in both industries due to the similarity in their overall structures and the common source of much of the demand.

The results demonstrate the extent to which investment in improved technology can reduce the growth of GHG emissions in China's energy-intensive cement and iron and steel sectors. The scenarios also reveal the scale factor of growing demand as the overall economy and population

[165] This appendix was written with the assistance of John Shilling and Andrea Bassi of the Millennium Institute. Andrea Bassi ran the T21 model policy simulations, and John Shilling provided the write up of the scenario results that are included in this appendix. I am grateful to them for their input. For more information on the Millennium Institute and the T21 integrated planning model, see http://www.millenniuminstitute.net/.

expand. The outcomes imply an overall increase in GHG emissions through 2030 as the demand for these products for construction grows rapidly. It becomes clear that changes in demand as well as production processes are needed to actually reduce GHG emissions, at least until new technologies are developed to generate the energy required in these sectors while producing significantly less emissions.

Looking at the cement and iron and steel sectors alone, these policies will reduce demand for their products, which will lead to somewhat lower output and employment levels for these sectors than in the base case. However, since these are capital-intensive industries, the effects on employment are relatively small. It is possible that the increased activity in construction and other sectors from the energy efficiency investment in buildings will create net new jobs.

Complementary Pricing Policies

Throughout this report, the need to adopt complementary pricing policies to enhance the effectiveness of and sustain GGND measures has been stressed. Such policies include both additional taxes, tradable permits and other market-based instruments for providing the correct incentives for reducing carbon dependency and ecological scarcity and the removal of perverse subsidies and other market distortions that inhibit these objectives.

For example, in Chapter 2.1 it was argued that the removal of fossil fuel subsidies eliminates perverse incentives in energy markets. The resulting financial savings of US$80 billion in OECD economies and US$220 annually in developing countries could also be redirected to investments in clean energy R&D, renewable energy development and energy conservation. Complementary pricing incentives might include energy and carbon taxes, carbon and other tradable permit schemes and temporary subsidies to initiate clean energy R&D. Removal of transport market and planning distortions would contribute to less economic waste, reduce pollution and congestion, foster greater transport choice and facilitate sustainable transport strategies that would boost economic recovery and employment. Fiscal policies, such as fuel and vehicle taxes, new vehicle incentives, road fees, user fees, vehicle insurance and fleet vehicle incentives, can have powerful impacts on encouraging the introduction of cleaner, fuel-efficient vehicles. Combining these policies with regulatory measures, such as more stringent greenhouse gas and fuel economy standards, may produce the most important shifts in vehicle demand and use.

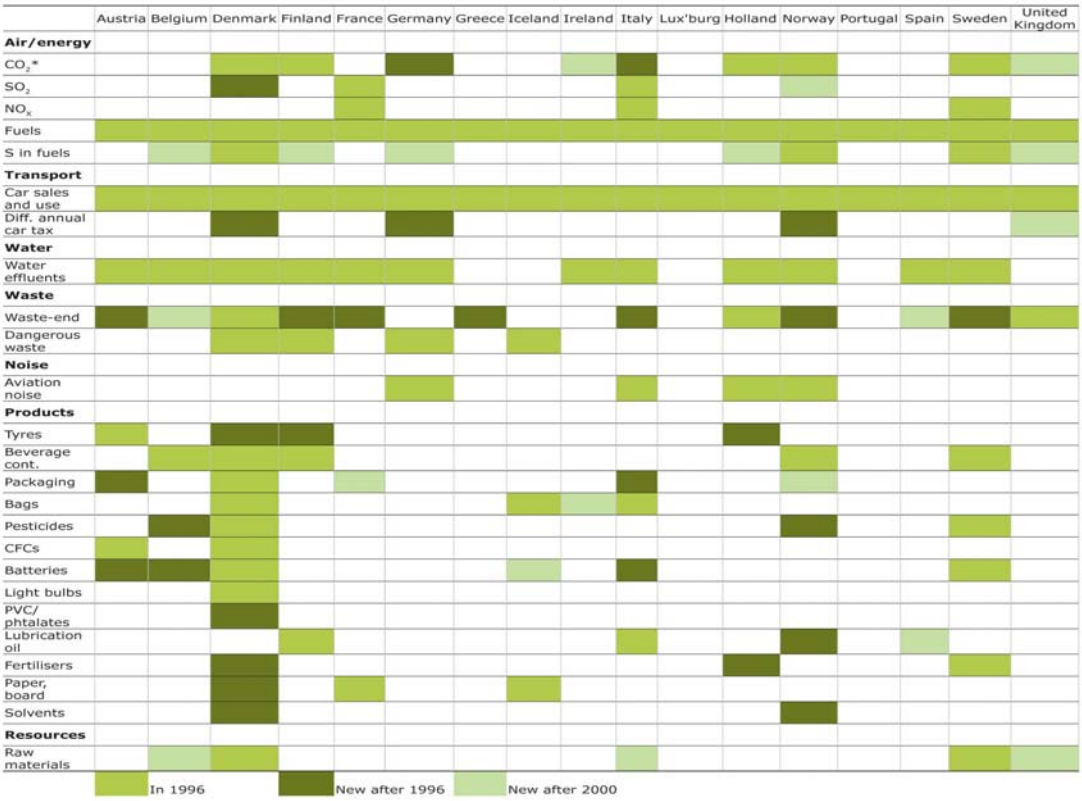
In Chapter 2.2 it was suggested the complementary pricing policies and market reforms in developing economies were important for enhancing the sustainable and efficient use of natural resources and production processes dependent on them, and to ensure that the financial returns generated from these activities are re-invested in the industrial activities, infrastructure, health services, and the education and skills necessary for long-term economic development. Removing subsidies and other incentive distortions and implementing, where appropriate, market-based instruments and other measures to improve the efficiency of water delivery and utilization were also considered essential to managing global water demand.

Evidence suggests that, as economies and governments become more familiar with the use of such complementary pricing policies, they tend to develop these policies, improve their effectiveness and extend them to a variety of environmental management areas. An assessment by the European Environment Agency, for example, found that since 1996 the increased use of a variety of market-based instruments across a growing number of sectors and economies is

developing an emerging "environmental tax base".[166] The figure below illustrates the spread of this base in Europe. One of the advantages of the proposed GGND could be that it helps economies worldwide develop and enhance a similar environmental tax base for sustaining a healthy and efficient green economy of the future.

[166] European Environment Agency (EEA). 2005. *The European environment – State and outlook 2005 –Part A: Integrated Assessment.* EEA, Copenhagen.

The Emerging Environmental Tax Base in Selected European Countries



Source: European Environment Agency (EEA). 2005. *The European environment – State and outlook 2005 –Part A: Integrated Assessment.* EEA, Copenhagen, Figure 10.2, p. 236.

Summary of Recommendations

The long-run scenarios from the United States and China give some indication of the type of impacts, as well as adjustments, which will take place under a Global Green New Deal.

In developing such a strategy, this report has focused on measures that fit within the two major aims of the GGND – reducing carbon dependency and ecological scarcity – and policies, investments and reforms that current evidence suggests that governments can enact fairly swiftly, i.e. in the next one or two years. In addition, actions were identified that need to be taken urgently at both the national and international level. The following is a summary of the main recommendations suggested for each level.

National Actions Proposed for the Global Green New Deal

1. The United States, the European Union and other high income OECD economies should spend over the next two years at least 1 per cent of their GDP on the national actions proposed for reducing carbon dependency, including removing subsidies and other perverse incentives and adopting complementary carbon pricing policies.
2. The remaining middle and high income economies of the Group of 20 (G20) should aim, as far as possible, also to spend over the next two years at least 1 per cent of their GDP on the national actions proposed for reducing carbon dependency.
3. Developing economies should also implement over the next two years the national actions proposed for reducing carbon dependency. Under the current economic conditions it is difficult to determine how much each economy should spend on these activities.
4. Developing economies should spend at least 1 per cent of their GDP on national actions proposed for improving clean water and sanitation for the poor. They should also develop urgently comprehensive, well-targeted safety net programmes and maintain, if not expand, educational and health services for the poor.
5. Developing economies should adopt the other national actions for improving the sustainability of their primary production activities, although under the current economic conditions it is difficult to determine how much each economy should spend on these activities.
6. All economies should consider removing water subsidies and other distortions, adopting market-based instruments or similar measures to increase water efficiency, and facilitating transboundary water governance.

International Actions Proposed for the Global Green New Deal

1. The most likely global policy forum for promoting urgent international action on the GGND is the G20 forum of the world's 20 largest rich and emerging economies, although all international fora, and the UN system especially, have a role to play in promoting, developing and enhancing the GGND.

2. At its April 2009 London meeting, the G20 should consider proposals for a GGND, such as the actions recommended by this report, and help develop framework ideas towards securing a global climate change agreement at Copenhagen in December 2009.
3. The international community should reach agreement on extending the CDM beyond 2012, preferably as part of a global climate change agreement, and reforming the mechanism to increase the coverage of developing economies, the sectors and technologies and the overall financing of global GHG emission reductions.
4. The international community should support efforts to improve payment for ecosystem services targeted to the poor and to include more ecosystems, and efforts to improve governance and shared use of transboundary water resources.
5. The international community should adopt as soon as possible reforms to the governance of the financial system that increase transparency and simplicity, and improve the alignment of incentive structures.
6. Bilateral and multilateral aid donors should increase their development assistance over the next few years, and target it to the sectors and actions that comprise the key components of the GGND.
7. The international community should develop and expand innovative financing mechanisms, such as the International Finance Facility, Climate Investment Funds and Global Clean Energy Cooperation, as possible means to fund key components of the GGND.
8. The international community should develop and expand new trade financing and trade facilitation financing packages, and use them to target support to the GGND.
9. The international community should review existing trade agreements and shape future agreements to identify and minimize barriers to enhance effective support of the proposed GGND actions.
10. The international community needs to reach successful conclusion of the Doha Round trade negotiations, especially on fishery subsidies, clean technology and services and reducing agricultural protectionism.

Supporting Boxes

Box 1: Fiscal stimulus measures proposed or considered by the G20 countries

Country	Total (date announced)	Specific "green" measures included
Argentina	US$21.21 billion (Nov 25)	
Australia	US$7.25 billion (Oct 14)	The Australian Greens are seeking to have the $1.5 billion housing package lead into a four year, $4.7 billion plan aimed at creating thousands of green-collar jobs and assisting all homeowners. http://greens.org.au/node/3355
China	US$586 billion (Nov 9)	Includes 12 percent for direct energy efficiency and environmental improvements. Doubles—to US$85 billion—investment in rail transport as a lower-carbon alternative to road and air transport. Adds $70 billion for new electricity grid infrastructure. http://www.wri.org/stories/2008/11/green-lining-chinas-economic-stimulus-plan
Denmark	US$1.83 billion (Nov 17)	Research in energy sector to increase tenfold from US$183.4 million to US$1.83 billion by 2012. Binding incremental emission caps in Danish industry. Revenue to be used in a green tax reform. A green tax reform that decreases taxes on labour and increases taxes on pollution. Introduction of green vehicle tax that will make it cheaper to buy energy efficient vehicles but more expensive to use a cars. http://www.venstre.dk/index.php?id=4761&tx_ttnews[tt_news]=2359&tx_ttnews[backPid]=4606&cHash=7130827263
France	US$24billion (Dec 4)	
Germany	US$29 billion (Nov 5)	Funds available for renovation work on buildings aimed at cutting CO_2 emissions will be raised by US$3.78 billion from 2009 through to 2011. Urgent investment in transport will be accelerated and in 2009 and 2010, a new programme of US$1.26 billion in each of those years, will be introduced. The expansion of rail and waterways will be subsidised. The amount that is tax-deductible for housing repairs and modernisation will be doubled to over US$1,500. New cars will be tax free for one year and those with low emissions will be tax free for two years. The tax break will end on Dec. 31, 2010. http://www.fxstreet.com/news/forex-news/article.aspx?StoryId=e2d9eedd-cf3b-4987-8b98-3705f5fa0f35

Turkey	Finalizing an economic stimulus package and negotiating with the IMF to access US$20-40 billion in credit (Nov 27)	
Italy	US$101 billion (Nov. 21)	
Japan	US$275 billion (Oct 30)	
Russia	US$20 billion (Nov 20)	
South Korea	US$36 billion (Jan 19)	Green New Deal over 2009-2012 to develop railroads and mass transit, fuel efficient vehicles and clean fuels, energy conservation and environmentally friendly buildings; restore rivers and forests; manage water; recycle waste; and develop a green information system. The GND is expected to create 960,000 jobs. South Korea also announced a US$72.2 million renewable energy fund to attract private investment in solar, wind and hydroelectric projects, which is expected to create 3.5 million jobs by 2018. (See Chapter 2.4 for further details).
United Kingdom	US$30 billion (Nov 24)	The 2008 UK Renewable Energy Programme is also expected to be a US$146 billion stimulus and create160,000 green jobs from 2008 to 2020 http://www.envirovaluation.org/

United States	US$827 billion (Feb 8)	Double the production of renewable energy in the next three years; improve the energy efficiency of more than 75 per cent of federal buildings and two million households; build a "smart grid" to reduce transmission losses and improve use of clean energy. A budget of US$15 billion per year over the next two years, including a "green jobs" component for the weatherizing of hundreds of thousands of homes, the installation of "smart meters" to monitor and reduce home energy use, and grants to state and local governments for mass transit and infrastructure projects. Also likely to involve tax breaks or direct government subsidies for a variety of clean energy projects, including solar arrays, wind farms, advanced biofuels and technology to capture carbon dioxide emissions from coal-burning power plants. (See Chapter 2.1 for more details)
European Union	US$259 billion (Nov 26)	The EU plans to spend US6.3 billion of already pledged money on energy infrastructure and broadband communications in 2009 and 2010 Includes US$6.4 billion for a "European green cars initiative" http://www.iht.com/articles/2008/11/26/business/26euecon.php

Box 2. The global poor and fragile environments

The table below indicates that over one quarter of the people in developing countries – almost 1.3 billion – survive on "fragile lands", which are defined by the World Bank as "areas that present significant constraints for intensive agriculture and where the people's links to the land are critical for the sustainability of communities, pastures, forests, and other natural resources".[167] These populations living on fragile land in developing countries account for many of the people in extreme poverty, living on less than $2 per day, and include 518 million living in arid regions with no access to irrigation systems, 430 million on soils unsuitable for agriculture, 216 million on land with steep slopes and more than 130 million in fragile forest systems. In other words, the economic livelihoods of the people living on fragile lands are directly and indirectly affected by the services provided by surrounding ecosystems.

The figure below further illustrates that rural poverty is correlated with the fraction of the population in developing countries found on fragile lands. As the figure indicates, the sample of 60 countries which have substantial numbers of people living in fragile environments – ranging from 20 to 30 per cent of the population to over 70 per cent - also have a high percentage of the rural population living in extreme poverty (45.3 per cent on average). What is more, the incidence of rural poverty rises as developing countries have more of their populations concentrated on fragile lands.

[167] World Bank 2003 *op cit*, p. 59.

The tendency for the rural poor to be clustered in the most marginal environments is also supported by studies at the regional and country level, although there can be important differences within and between countries. For example, researchers from the World Bank have examined the "poverty-environment nexus" in three of the poorest countries in Southeast Asia – Cambodia, Laos and Vietnam.[168] In Cambodia, the core poor in rural areas appear to be located in areas that already heavily deforested; on the other hand, poor populations tend to be more concentrated in the lowlands rather than steeply sloped lands. In Laos, the poorest provinces in the north and northeast also have the highest incidence of poor rural populations, who appear to be concentrated in forested areas and the highlands. In Vietnam, large poor populations confined to steep slopes exist in the provinces comprising the Northern and Central Highlands, but extensive rural poverty is also found along the North Central Coast and the Red River Delta.

Distribution of World's Population and Rural Poor on Fragile Land

(a) Distribution of World's Population[a]

Region	Population in 2000 (millions)	Population in fragile lands	
		Number (millions)	Share of total (per cent)
Latin America and the Caribbean	515.3	68	13.1
Middle East and North Africa	293.0	110	37.6
Sub-Saharan Africa	658.4	258	39.3
South Asia	1,354.5	330	24.4
East Asia and Pacific	1,856.5	469	25.3
Eastern Europe and Central Asia	474.7	58	12.1
OECD Group[b]	850.4	94	11.1
Other	27.3	2	6.9
Total	**6,030.1**	**1,389**	**23.0**
Total Developing Economies[b]	**5,179.7**	**1,295**	**25.0**
Total Latin America, Africa and Asian Developing Economies[c]	**4,677.7**	**1,235**	**26.4**

[168] Dasgupta, Susmita, Uwe Deichmann, Craig Meisner and David Wheeler. 2005. "Where is the Poverty-Environment Nexus? Evidence from Cambodia, Lao PDR, and Vietnam." *World Development* 33(4):617-638. Minot, Nicholas and Bob Baulch. 2002. "The Spatial Distribution of Poverty in Vietnam and the Potential for Targeting." Policy Research Working Paper 2829. World Bank, Washington DC.

(b) Distribution of Rural Poor in Developing Regions[e]

Region	Rural poor on favored lands (millions)	Rural poor on fragile lands	
		Number (millions)	Share of total (percent)
Central and South America	24	47	66
West Asia and North Africa	11	35	76
Sub-Saharan Africa	65	175	73
Asia	219	374	63
Total	**319**	**613**	**66**

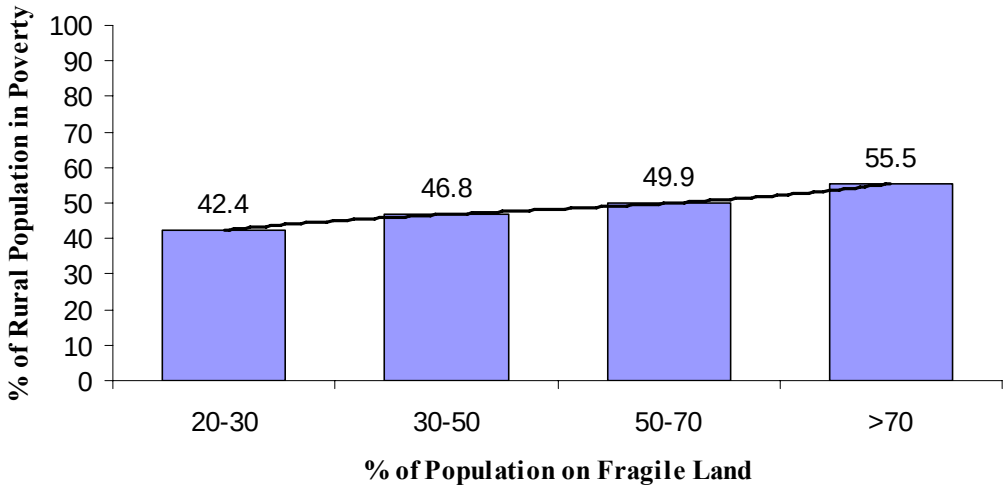
Notes: [a]From Barbier, Edward B. 2005. *Natural Resources and Economic Development* Cambridge University Press, Cambridge, UK, Table 1.7 and adapted from World Bank. 2003. *World Development Report 2003*. World Bank, Washington DC, Table 4.2, which defines fragile lands as areas that present significant constraints for intensive agriculture and where the people's links to the land are critical for the sustainability of communities, pastures, forests, and other natural resources; they include arid regions with no access to irrigation, areas with soils unsuitable for agriculture, land with steep slopes and fragile forest systems.

[b]OECD stands for Organization for Economic Cooperation and Development, and the OECD Group of countries include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States.

[c]World Total less OECD Group.

[d]World Total less OECD Group, East Europe and Central Asia and Other.

[e]Adapted from Comprehensive Assessment of Water Management in Agriculture. 2007. *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture.* Earthscan, London and International Water Management Institute, Colombo, Sri Lanka., Table 15.1, which equates fragile lands with marginal lands, or areas with the greatest potential for land and water degradation; i.e., land with highly weathered soils, steep slopes, inadequate or excess rainfall, and high temperatures.



Notes: Developing regions are defined as low and middle-income countries in Africa, Latin America, Asia and Oceania, based on World Bank definitions (countries with 2003 Gross National Income per capita of $9,385 or less), from World Bank. 2006. *World Development Indicators*. The World Bank, Washington DC. Percentage of rural population in poverty is also from World Bank. 2006. *World Development Indicators*. The World Bank, Washington DC. Percentage of population on fragile land is from World Bank. 2003. *World Development Report 2003*. World Bank, Washington DC, Table 4.3. Number of observations = 60 countries, of which 24 (20-30 per cent of population on fragile land), 29 (30-50 per cent), 5 (50-70 per cent) and 2 (> 70 per cent). The average rural povery rate across all countries is 45.3 per cent, and the median is 43.1 per cent.

Box 3. Greenhouse gas emissions, carbon dependence and the world economy

In 2005, the top ten emitters of greenhouse gases (GHG) were either rich economies (e.g. the United States, European Union, Japan and Canada) or large emerging market economies (e.g. China, Russia, India, Brazil, Mexico and Indonesia). Together, the top emitters accounted for over 70 per cent of the world's total GHG. Over the last period of sustained growth in the world economy, from 1990 to 2005, world GHG emissions rose by over a quarter, but at an even faster rate in countries other than the top ten emitters.

Global Greenhouse Gas Emissions (million tonnes of CO_2 equivalent), 1990-2005[a]

	1990	2005	Change	Average annual growth	Total growth	Share of 2005 world total
China	3,593.5	7,219.2	3,625.6	4.8 %	100.9 %	18.6 %
United States	5,975.4	6,963.8	988.5	1.0 %	16.5 %	18.0 %
European Union[b]	5,394.8	5,047.7	-347.1	-0.4 %	-6.4 %	13.0 %
Russia	2,940.7	1,960.0	-980.7	-2.7 %	-33.3 %	5.1 %
India	1,103.7	1,852.9	749.2	3.5 %	67.9 %	4.8 %
Japan	1,180.0	1,342.7	162.6	0.9 %	13.8 %	3.5 %
Brazil	689.9	1,014.1	324.2	2.6 %	47.0 %	2.6 %
Canada	578.6	731.6	153.0	1.6 %	26.4 %	1.9 %
Mexico	459.5	629.9	170.4	2.1 %	37.1 %	1.6 %
Indonesia	332.6	594.4	261.8	3.9 %	78.7 %	1.5 %
Top 10 emitters	**22,248.7**	**27,356.3**	**5,107.6**	**1.4 %**	**23.0 %**	**70.6 %**
Rest of world	**8,456.2**	**11,369.6**	**2,913.4**	**2.0 %**	**34.5 %**	**29.4 %**
World	**30,704.9**	**38,725.9**	**8,021.0**	**1.6 %**	**26.1 %**	

Notes: [a]Excludes land use change as a source of greenhouse gas (GHG) emissions. In 2005, world GHG emissions consisted of carbon dioxide (CO_2, 73.6 % of total), methane (CH_4, 16.5 %), nitrous oxide (N_2O, 8.5 %), hydrofluorocarbons (HFCs, 1.0 %), perfluorocarbons (PFCs, 0.3 %) and sulfur hexafluoride (SF_6, 0.2 %).

[b]Includes all 27 economies comprising the European Union. In 2005, the top 3 emitters in the EU were Germany (977.4 million tonnes of CO_2 equivalent), the United Kingdom (639.8 million tonnes) and Italy (565.7 million tonnes).

Source: Climate Analysis Indicators Tool (CAIT) Version 6.0. 2008. World Resources Institute, Washington, DC.

Because carbon dioxide (CO_2) alone accounts for nearly three-quarters of the world's greenhouse gas emissions, and with other carbon-based gases contributes to over 90 per cent of total emissions, the CO_2- equivalent measure of GHG emissions is a good approximation of the overall carbon dependency of the world's economy. This dependency is therefore reflected in the greenhouse gas intensity of economies, the tonnes of CO_2 equivalent GHG emissions per million international dollars of gross national product. With the exception of Brazil, from 1990 to 2005 all the top ten emitters reduced the GHG intensity of their economies, with the largest reductions occurring in China, the European Union and India. The rest of the world, however, only reduced the GHG intensity of their economies modestly, by around 13 per cent. Overall, there was about a one-fifth decline in the GHG intensity of the world economy.

Global Greenhouse Gas Intensity of Economies (Tonnes of CO_2 equivalent per million 2000 international US$), 1990-2005[a]

	1990	2005	Change	Average annual growth	Total growth
China	2,869.4	1,353.6	-1,515.8	-4.9 %	-52.8 %
United States	751.2	561.7	-189.5	-1.9 %	-25.2 %
European Union[b]	561.5	387.4	-174.2	-2.4 %	-31.0 %
Russia	1,570.2	1,154.4	-415.8	-2.0 %	-26.5 %
India	1,076.6	759.1	-317.5	-2.3 %	-29.5 %
Japan	368.2	346.9	-21.3	-0.4 %	-5.8 %
Brazil	637.7	640.6	2.8	0.0 %	0.4 %
Canada	774.6	647.4	-127.1	-1.2 %	-16.4 %
Mexico	601.7	536.6	-65.1	-0.8 %	-10.8 %
Indonesia	894.9	839.7	-55.2	-0.4 %	-6.2 %
Top 10 emitters	**1,010.6**	**722.7**	**-287.9**	**-2.2 %**	**-28.5 %**
Rest of world	**753.6**	**656.1**	**-97.5**	**-0.9 %**	**-12.9 %**
World	**882.1**	**689.4**	**-192.7**	**-1.6 %**	**-21.8 %**

Notes: [a]Excludes land use change as a source of greenhouse gas (GHG) emissions. In 2005, 75.2 % of world GHG emissions were from energy, 16.7 % from agriculture, 4.9 % from industrial processes and 3.8 % from waste. In the energy sector, 32.6 % of world emissions came from electricity and heat generation, 14.2 % from transportation, 13.7 % from manufacturing and construction, 10.0 % from other fuel combustion and 4.6 % from fugitive emissions.

[b]Includes all 27 economies comprising the European Union.

Source: Climate Analysis Indicators Tool (CAIT) Version 6.0. 2008. World Resources Institute, Washington, DC.

Although the declining GHG intensity of the world economy is encouraging, the trend does not suggest that overall carbon dependency of economies and regions is being reduced significantly. Projections suggest that the growth in GHG emissions for most economies and regions will continue until 2030. The energy sector currently accounts for over three-quarters of the world's GHG emissions, and almost all is from the combustion of fossil fuels. As global populations increase, the world economy grows and poorer countries develop, the increased use of fossil fuel energy will cause GHG emissions to rise. Thus, reviving economic growth in today's carbon-dependent world economy will simply contribute to both the rising demand for and combustion of fossil fuels and increased GHG emissions.

In 2030, a carbon-dependent world economy will produce close to 60 per cent more GHG emissions from energy combustion than it does today. Growth in emissions will occur in the high-income OECD economies, but just 17.4 per cent higher than today. Japan's emissions might fall, and the European Union's emissions may increase by less than 6 per cent. Much of the growth in OECD emissions is likely to come from the US, which may show a 19 per cent increase. However, the large increase in global GHG emissions is likely to come from transition and developing economies. Emissions by 2030 will more than double for developing economies, led by large increases in India and China. Emissions from transition economies will rise by nearly 30 per cent, led by Russia. By 2030, China's share of GHG emissions could be close to one third the world total, and all developing economies could account for the majority of emissions.

Global Greenhouse Gas Emissions (million tonnes of CO_2 equivalent), 2005-2030[a]

	2005	2030	Change	Average annual growth	Total growth	Share of 2030 world total
World	26,620	41,905	15,285	1.80 %	57.40 %	
OECD[b]	12,838	15,067	2,229	0.60 %	17.40 %	36.0 %
European Union	3,944	4,176	232	0.20 %	5.90 %	10.0 %
Japan	1,210	1,182	-28	-0.10 %	-2.30 %	2.8 %
United States	5,789	6,891	1,102	0.70 %	19.00 %	16.4 %
Transition economies[c]	2,538	3,230	692	1.00 %	27.30 %	7.7 %
Russia	1,528	1,973	445	1.00 %	29.10 %	4.7 %
Developing economies[d]	10,700	22,919	12,219	3.10 %	114.20 %	54.7 %
China	5,101	11,448	6,347	3.30 %	124.40 %	27.3 %
India	1,147	3,314	2,167	4.30 %	188.90 %	7.9 %

Notes: [a]International Energy Agency (IEA) projections from energy sources of greenhouse gas (GHG) emissions only.

[b]Organization for Economic Cooperation and Development, which includes, from Europe, Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Republic of Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom, and from other regions, Australia, Canada, Japan, Mexico, New Zealand, South Korea, and the United States.

[c]Economies of the former Soviet Union and Eastern Europe.

[d]Low and middle-income economies from Africa, Asia, Latin America and the Middle East.

Source: Climate Analysis Indicators Tool (CAIT) Version 6.0. 2008. World Resources Institute, Washington, DC.

Box 4. The Vulnerability of the World's Extreme Poor to Climate-Induced Impacts[169]

The United Nations Development Programme has identified five key transmission channels through which climate-induced impacts affect severely the livelihoods of the poor.

Transmission Channel	Physical Impacts of Climate Change	Effects on Vulnerable Populations
Agricultural production and food security	Affects rainfall, temperature and water availability for agriculture in vulnerable areas.	Drought affected areas in sub-Saharan Africa could expand by 60-90 million hectares (ha) by 2060. All developing countries could experience losses in agricultural production by 2080. The number of malnourished globally could rise to 600 million by 2080.
Water stress and water insecurity	Changed run-off patterns and glacial melt will affect water availability for irrigation and human settlements.	An additional 1.8 billion people could be living in a water scarce environment by 2080.
Rising sea levels and exposure to climate disasters	Sea levels could rise rapidly with accelerated ice sheet disintegration, and warming seas could fuel more intense tropical storms.	330 million people could be displaced through flooding, including 70 million people in Bangladesh, 22 million in Vietnam, 6 million in Egypt and the populations of small island states in the Caribbean and Pacific. 344 million people could experience more devastating tropical cyclones. The 1 billion people currently living in urban slums on fragile hillsides or flood prone river banks face acute vulnerabilities.
Ecosystems and biodiversity	Around one half of coral reef systems have suffered bleaching from global warming, and increasing ocean acidity is a long-term threat to marine ecosystems. With 3^{o}C of warming, 20-30 % of terrestrial species could face extinction.	The economic livelihoods of the 1.3 billion rural poor living in fragile environments of developing regions (see Box 2) will be severely impacted.
Human health	Major diseases could spread.	An additional 220 to 400 million people could be exposed to malaria; dengue fever is also expected to spread.

[169]United Nations Development Programme (UNDP). 2008. *Human Development Report 2007/2008. Fighting Climate Change: Human Solidarity in a Divided World.* UNDP, New York.

Box 5. Reconciling Carbon Dependency and Economic Development in China[170]

The adoption of measures to reduce fossil fuel energy use in China, and thus its greenhouse gas emissions, is driven in large part by energy security concerns, especially its over-reliance on coal. From 2000 to 2005, China's energy consumption rose by 60 percent, accounting for almost half of the growth in world energy consumption, and since 1990 its GHG emissions rose by 80 per cent. Coal accounts for nearly 70 per cent of China's energy consumption, mostly for electricity generation. Currently, China imports almost half of the oil it consumes, and it is likely to be importing 60 to 80 per cent of its oil by 2020.

China's current energy security initiatives with potential climate mitigation impacts include a number of measures to improve energy efficiency and conservation as well as to expand its energy supply options. China's 11th Five-Year plan has the overall goal of reducing energy consumption per unit GDP by 20 per cent below 2005 levels by 2010. Meeting this target is projected to reduce China's GHG emissions by over 1.5 billion tonnes of CO_2 equivalent, or 10 per cent below current emission trends. The overall national target is allocated among all provinces and industrial sectors, including the most energy-intensive, and incentives are included to encourage enterprises to meet targets. In addition, China is embarking on policies to retire inefficient coal-fired power plants and industrial factories. There is also a range of policies to increase energy efficiency in buildings, industry and consumer goods. China has also set a target of producing 16 per cent of primary energy from renewable sources, including hydropower, by 2020, which is more than double its current capacity.

China is also the largest source of Clean Development Mechanism (CDM) carbon emission reduction credits, accounting to date for over one quarter of registered projects and over one half of average annual reductions in emissions from the CDM. Most of China's CDM credits arise from reductions of hydrofluorocarbons (HFCs) as well as the capture of landfill methane and nitrous oxide. A significant portion of the US$2 billion in tax revenues collected by these CDM credits in China is being used to finance investments in further CDM projects, in renewable energy supply, and in R&D in climate change mitigation and adaptation technology.

Although adopting improved energy saving and alternative energy supply options are important components in any climate mitigation strategy for China, recent proposals have suggested that China could achieve more ambitious reductions in its carbon dependency through adopting a carbon tax policy along with complementary economic instruments and subsidies. A study by Kristin Aunan and colleagues shows that carbon taxation could be used to reduce overall GHG

[170] The sources for this box are: Aunan, Kristin, Terje Berntsen, David O'Connor, Therese Hindman Persson, Haakon Vennemo and Fan Zhai. 2007. "Benefits and cost to China of a climate policy." *Environment and Development Economics* 12:471-497. Brenner, Mark, Matthew Riddle and James K. Boyce. 2007. "A Chinese sky trust? Distributional impacts of carbon charges and revenue recycling in China." *Energy Policy* 35:1771-1784. Downs, Erica. *The Brookings Foreign Policy Studies Energy Security Series: China.* The Brookings Institution, Washington DC, December 2006. Renner, Sweeney and Kubit 2008, *op cit.* Heggelund, Gørild. 2007. "China's Climate Change Policy: Domestic and International Developments." *Asian Perspective* 31(2):155-191. http://cdm.unfccc.int/Statistics/index.html. Kim, Margaret J. and Robert E. Jones. 2008. "China: Climate Change Superpower and the Clean Technology Revolution." *Natural Resources & Environment* 22(3):9-13. McKibbin, Warwick J., Peter J. Wilcoxen and Wing Thye Woo. *Preventing the Tragedy of the CO_2 Commons: Exploring China's Growth and the International Climate Framework.* Global Economy & Development Working Paper 22, July 2008.Pew Center on Global Climate Change. *Climate Change Mitigation Measures in the People's Republic of China.* International Brief 1, April 2007.UN ESCAP 2008, *op cit.* Wang, Hao and Toshihiko Nakata. 2009. "Analysis of the market penetration of clean coal technologies and its impact in China's electricity sector." *Economic Policy* 37:338-351. Zeng, Ning, Yihui Ding, Jiahua Pan, Hijun Wang and Jay Gregg. 2008. "Climate Change-The Chinese Challenge." *Science* 319:730-731. Zhang 2008, *op cit.*

emissions by 17.5 per cent and still produce net economic gains for the economy. The costs of the policy would be more than offset by the ancillary health benefits from improved air quality in urban areas and the gains in agricultural productivity and higher rural incomes. Carbon tax revenues could be used to fund research in energy efficiency, renewable energy, carbon sequestration and low-energy urban development. Mark Brenner and colleagues have suggested that carbon charges could be implemented through a Chinese "sky trust" whereby revenues are recycled to the public on an equal per capita basis to reduce income inequality and poverty. The authors find that around 70 per cent of the population would emerge with more net income from the sky trust, and poverty across China would be reduced by 20 per cent. Scenarios developed by Wang and Nakata show that a carbon tax combined with a sulfur dioxide emissions charge could generate revenues to develop clean coal technology for electricity generation. Up to 25 per cent of sulfur dioxide emissions and 29 per cent of CO_2 could be eliminated, and clean coal technology would provide around one third of all future electricity generation with an overall net gain for the Chinese economy in terms of electricity prices.

Increased investments in China's burgeoning renewable energy sector and other "clean technologies" could have a major impact on developing new economic growth and export sectors. China has set ambitious targets for biomass generation from sugar cane (20 GW by 2020), and is already the world's third-largest ethanol producer. China has now surpassed the United States as the world's third-largest producer of solar panels, which are currently mostly for export, and is already the largest global producer of solar water heaters. China already produces 80 per cent of the world's energy-saving lights and is planning to become a major wind turbine manufacturer. Investments in clean technologies in China increased from US$170 million in 2005 to US$420 million in 2007.

Development of these new industries could have a significant impact on employment in China. As the table shows below, the renewable energy sector of China has a value of nearly U$17 billion and already employs close to a million workers, including 600,000 in solar thermal, 266,000 in biomass generation, 55,000 in solar photovoltaics (PV) and 22,200 in wind power.

Employment in China's Renewable Energy Sector, 2007[a]

	Wind power	**Solar PV**	**Solar thermal**	**Biomass**	**Total**
Generation	6,000	2,000		1,000	9,000
Manufacturing	15,000	38,000	400,000	15,000	468,000
Service	1,200	15,000	200,000	250,000	466,200
Total	22,200	55,000	600,000	266,000	943,200
Output value (US$ million)	3,375	6,750	5,400	1,350	16,875

Notes: [a] From Renner, Michael, Sean Sweeney and Jill Kubit.2008. *Green Jobs: Towards a Decent Work in a Sustainable, Low-Carbon World.* UNEP/ILO/IOE?ITUC, Geneva.

Box 6. Reconciling Economic Recovery and Carbon Dependency in the United States[171]

As indicated in Box 1, the US government under the incoming Obama administration is already considering as part of its massive fiscal stimulus package investments to create "green jobs" through energy conservation as well as tax breaks or subsidies for a variety of clean energy projects, including solar arrays, wind farms, advanced biofuels and technology to capture carbon dioxide emissions from coal-burning power plants. In addition, there is cautious optimism about the introduction of a comprehensive cap-and-trade system to limit CO_2 emissions in 2009. Consequently, over the next two years an ideal opportunity exists in the United States to merge concerns over creating more job opportunities and stimulating economic recovery with creating a more low-carbon economy. Various studies have shown that such objectives are complementary.

For example, the Union of Concerned Scientists, backed by leading scientists and economists, has called for an 80 per cent reduction in US greenhouse gas emissions below 2000 levels by 2050. A 2007 report by the Center for American Progress (CAP) outlines a 10-year strategy, including increased energy efficiency, investments in clean energy, and a carbon pricing policy, that would realign the US economy along such a low-carbon development path. The carbon pricing policy has two key components: an economy-wide cap-and-trade system to reduce greenhouse gas emissions by 50-80 per cent below 2000 levels by 2050 and the elimination of the $6 billion per year federal tax breaks and subsidies for the US oil and gas industry. The proposed cap-and-trade system would auction all the permits across all businesses in the economy, but companies unable to meet their emission quotas would have to purchase permits from the federal government or from other companies. An initial 10 per cent of the projected $75 billion a year in revenues generated could be allocated to businesses operating in energy intensive sectors to compensate their shareholders, employees and local communities. Half of the remaining revenues could be distributed to low and moderate-income household to help offset any energy price increases that may occur during the transition to less carbon-intensive energy use. Any other cap-and-trade revenues would be invested in R&D and investments for raising the energy efficiency of the economy and the development of clean energy technologies.[172]

The policies envisioned in the 2007 CAP report aim to develop a 10-year strategy for transforming the US into a low-carbon economy. A second CAP report in 2008 demonstrates that a "green economic recovery" programme enacted over the next two years could start the transition to the low-carbon economy, revitalize US economic growth and create millions of

[171] The sources for this box are: Becker 2008, *op cit*. Goulder, Lawrence. 2004. "Induced Technological Change and Climate Policy." Pew Center on Global Climate Change, Washington, DC. Jorgenson, Dale W., Richard J. Goettle, Peter J. Wilcoxen, Mun Sing Ho, Hui Jin and Patrick A. Schoennagel. 2008. "The Economic Costs of a Market-based Climate Policy." Pew Center on Global Climate Change White Paper, Pew Center on Global Climate Change, Washington, DC. McKibbin and Wilcoxen 2007, *op cit*. Podesta 2007, *op cit*. Pollin et al. 2008, *op cit.* U.S. Scientists and Economists' Call for Swift and Deep Cuts in Greenhouse Gas Emissions. Union of Concerned Scientists, May 2008. Available at http://www.ucsusa.org/global_warming.html

[172] As an alternative to such an economy-wide cap-and-trade system for the United States, Rob Stavins of Harvard and Bob Repetto for the Presidential Climate Action Project advocate the implementation of an "upstream" cap-and-trade system that limits sales of fossil fuels in the US economy. Under such a system, permits would be calibrated to the carbon content of each fuel type and would be required of first sellers of such fuels, which would be enforced at petroleum refineries, natural gas distribution points, coal mine shipping centers and ports for imported fuels. First sellers could trade their permits, and overall greenhouse gas emission targets would be imposed to limit the total permits issued. See Repetto, Robert. 2007. "National Climate Policy: Choosing the Right Architechture". Prepared for the Presidential Climate Action Project, June 2007. Stavins, Robert N. 2008. "Addressing climate change with a comprehensive US cap-and-trade system." *Oxford Review of Economic Policy* 24(2):298-321. For an assessment of different cap-and-trade policy options and their distributional implications for the United States, see Burtraw, Dallas, Richard Sweeney and Margaret Walls. 2008. "Crafting a Fair and Equitable Climate Policy: A Closer Look at the Options." *Resources* 170:20-23.

high-skilled jobs. The report proposes a $100 billion initiative over the next two years, which could be paid with proceeds from auctions under a greenhouse gas cap-and-trade programme that is implemented over the same period. This fiscal stimulus would create 2 million jobs by investing in four energy efficiency and renewable energy strategies:

- Retrofitting buildings to improve energy efficiency
- Expanding mass transit and freight rail
- Constructing a "smart" electrical grid transmission system
- Developing renewable energy, i.e. wind power, solar power and next-generation biofuels (i.e., cellulosic rather than corn-based fuels, such agricultural plant waste or dedicated crops such as grasses and algae) and other bio-based energy.

Such a $100 billion programme, equivalent to just over 0.7 per cent of US GDP, could be readily incorporated into the existing $827 billion conventional fiscal stimulus package proposed by the Obama Administration for implementation over the next two years. The additional 2 million jobs created by the green recovery programme would involve, as the table below indicates, over 935,000 jobs directly across a range of highly specialized as well as general industries. In addition, another 586,000 jobs would be created indirectly in manufacturing and service sectors associated with the main energy efficiency and renewable energy sectors. Finally, nearly half a million new retail and wholesale jobs would be created across the United States through the induced effects of additional spending of income by the directly and indirectly employed workers.

Other studies and proposals suggest, such as those by the Presidential Climate Action Project, that a $500 billion investment over 10 years would create 5 million new jobs across the United States. Additional income and employment opportunities could occur if substantial induced technological changes arise in the US economy through complementary policies that promote "climate-friendly technological change", along the lines suggested above. A report by Larry Goulder for the Pew Center on Global Climate Change points out that combining "direct emission policies", such as a cap-and-trade system, with R&D subsidies for encouraging private sector investment in increased energy efficiency and clean energy technologies may have a powerful induced technological innovation effect. Similarly, another Pew study by Dale Jorgenson and colleagues demonstrates that the right combination of carbon pricing policies, complementary fiscal policies, and redistribution of revenues substantially reduce the costs of any climate mitigation policy for the US economy.

Job Creation by a US Green Recovery Programme[a]

Direct Employment Activity	Type of Job Created (Total jobs: 935, 200)
Building retrofitting	Electricians, heating/air conditioning installers, carpenters, construction, roofers, insulation workers, truck drivers, building inspectors
Mass transit/freight rail	Civil engineers, rail track layers, electricians, welders, metal fabricators, engine assemblers, bus drivers, dispatchers, locomotive engineers, railroad conductors
Smart grid	Computer software engineers, electrical engineers, operating engineers, electrical equipment assemblers and technicians, machinists, team assemblers, construction, electrical power line installers and repairers

Wind power	Environmental engineers, industrial production workers, managers and supervisors, iron and steel workers, millwrights, sheet metal workers, machinists, electrical equipment assemblers, construction, equipment operators, truck drivers
Solar power	Electrical engineers, electricians, industrial machinery mechanics, welders, metal fabricators, electrical equipment assemblers and installers, construction equipment operators, construction
Advanced biofuels	Chemical engineers, chemists, chemical equipment operators and technicians, machine operators, farmers, agricultural workers and supervisors, truck drivers, agricultural inspectors
Indirect Employment Effects	**Type of Job Created (Total jobs: 586,000)**
Associated manufacturing and service job creation	Forest products, hardware, iron & steel, transportation
Induced Employment Effects	**Type of Job Created (Total jobs: 496,000)**
Additional job creation through increased income expenditures	Retail and wholesale

Notes: [a]From Pollin, Robert, Heidi Garrett-Peltier, James Heintz, and Helen Scharber. 2008. *Green Recovery: A Programme to Create Good Jobs and Start Building a Low-Carbon Economy.* Center for American Progress, Washington DC.

Box 7. The Triple-Twenty Strategy and Economic Recovery in the European Union[173]

In November 2008 the European Commission announced its "Triple Twenty" targets as part of its 2nd Strategic Energy Review. The goals include a commitment to reduce the greenhouse gas emissions in the European Union (EU) 20 per cent below 1990 levels by 2020, increasing the share of renewable sources in total energy consumption by 20 per cent and improving energy efficiency by 20 per cent. The Commission sees this Triple Twenty agenda as being the essential first steps in the transition to a low-carbon EU economy by 2050 as well as securing the future energy security of the European Union. The hallmarks of the plan are likely to include improvements in the EU legislation on the energy performance and design of buildings and on energy labeling, and large-scale investments in energy efficiency, renewable energy supplies (which currently comprise 9per cent of EU energy consumption), and clean use of fossil fuels.

To fulfill its Triple Twenty agenda, the European Union will need to develop further a complementary carbon pricing policy. Such a policy already exists in the EU, which was the first region to set up a broad carbon market in the form of the European Emissions Trading System (ETS), which started functioning in January 2005. The initial goals of the ETS have generally been met: a European-wide carbon price has been established; businesses began incorporating this price in their decisions; and the market infrastructure for multilateral trading in carbon has been set up. To achieve the Triple Twenty goals, however, the existing ETS will need to be expanded. Future allocation scenarios analyzed by Demailly and Quirion find that that the most cost-effective options for the ETS appear to be auctioning of permits, possibly combined with border-tax adjustments to maintain the competitiveness of some European industries, or alternatively, output-based allocation of permits in sectors exposed to international competition and auctioning in electricity generation.

There is also likely to be important synergies in emission reductions and economic gains across the EU's Triple Twenty targets. The ETS is expected to generate US$68.5 billion in permit revenues per year in the next implementation phase, and a substantial amount of these revenues could be invested in energy conservation and supporting the development of renewable energy. Loreta Stankeviciute and colleagues find that the Commission's decision to increase energy efficiency and renewable energy supply by 20 per cent in 2020 would also increase greenhouse gas emissions reductions in the transport and building sectors of the EU economy, thus reducing the costs from more stringent emission reductions from the carbon-intensive sectors, such as electricity and cement. In addition, an expanded ETS might also mean more opportunities for global trade in carbon, through an expanded Clean Development Mechanism and Joint Implementation scheme. If the benefits of importing CDM credits are included in a future ETS scenario, then future EU carbon prices and compliance cost reductions appear to be significantly

[173] The sources for this box are: European Commission. "EU Energy Security and Solidarity Action Plan: 2nd Strategic Energy Review." Memo/08/703, Brussels, Belgium, 13 November 2008, available at http://ec.europa.eu/energy/strategies/2008/2008_11_ser2_en.htm. Demailly, Damien and Philippe Quirion. 2008. "Changing the Allocation Rules in the EU ETS: Impact on Competitiveness and Economic Efficiency." Fondazione Eni Enrcio Mattei (FEEM), Nota di Lavora 89.2008. FEEM, Milan, Italy. Ellerman, A. Danny and Paul L. Joskow. 2008. *The European Union's Emissions Trading System in perspective.* Prepared for the Pew Center on Global Climate Change. MIT, Cambridge, Mass. Erdmenger, Christoph, Harry Lehmann, Klaus Müschen, Jens Tambke, Segastian Mayr and Kai Kuhnhenn. 2009. *Energy Policy* 37:158-165. Fouquet, Doerte and Thomas B. Johansson. 2008. "European renewable energy policy at crossroads – Focus on electricity support mechanisms." *Energy Policy* 36:4079-4092. Renner, Sweeney and Kubit 2008, *op cit.* Stankeviciutute, Loreta, Alban Kitous and Patrick Criqui. 2008. "The fundamentals of the future international emissions trading system." *Energy Policy* 36:4272-4286.

lower. Similarly, Christoph Erdmenger and colleagues show that more stringent emissions trading combined with measures to improve energy efficiency and renewable energy supply can achieve the goal of 40 per cent reduction in 1990 levels of CO_2 emissions by 2020 for Germany, currently one of the world's major sources of greenhouse gases. The average cost of these combined measures is 50 euro per tonne of CO_2 avoided, or an additional monthly expenditure per German household of 25 euro. Encouraging such rapid renewable energy supply across Germany and the rest of Europe may also require modifying electricity pricing policy. Fouquet and Johansson show that a feed-in tariff system, where producers of renewable energy electricity receive a fixed premium in addition to the electricity market price, shows the most promise.

The employment impacts of an immediate "green recovery" investment programme to expand energy conservation and renewable energy supply in Europe are substantial. As the table below indicates, in these two areas the larger the investment and the sooner that the programmes can be implemented, the more jobs can be created quickly. The European renewable energy sector is already economically significant worldwide. European wind turbine manufactures currently account for 80 per cent for the global market share, and Europe has overtaken Japan as the world's leading producer of photovoltaic cells. It is estimated that skilled jobs account for about a third of net employment growth in the European renewable energy industry. An additional advantage of a European-wide residential building retrofitting programme is that it is likely to have substantial employment impacts across all countries in the European Union. For example, in Germany, for every $1.4 billion invested in retrofitting residential buildings, an estimated additional 25,000 jobs are created. A programme for retrofitting all houses in 10 European new member states – Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia – would cost up to US$6.4 billion per year and lead to 180,000 new jobs.

European Job Creation by "Green" Sector[a]

Sector	Scenario	Employment Effects
Renewable energy (wind, solar, biofuels)	20 % expansion of renewable by 2020	950,000 new net jobs by 2010 and 1.4 million by 2020
Renewable energy (wind, solar, biofuels)	Advanced renewable strategy	1.7 million new net jobs by 2010 and 2.5 million by 2020
Retrofitting residential buildings	Retrofit buildings to reduce CO_2 emissions 75 % by 2050	1.38 million new jobs
Retrofitting residential buildings	Retrofit buildings to reduce CO_2 emissions 75 % by 2030	2.59 million new jobs

Notes: [a] From Renner, Michael, Sean Sweeney and Jill Kubit.2008. *Green Jobs: Towards a Decent Work in a Sustainable, Low-Carbon World.* UNEP/ILO/IOE?ITUC, Geneva.

Box 8. Energy Sector Reforms and Improved Services to the Poor in Developing Economies[174]

Botswana, Ghana, Honduras and Senegal have undertaken a number of energy sector reforms that have affected the access of the poor to important fuels, including electricity, petroleum products such as kerosene and candles, charcoal and fuelwood.

All four countries have implemented some electricity sector reforms, including subsidies, stepped or baseline tariff pricing, changes in technology, price setting, loan schemes and community involvement. Senegal, Ghana and Honduras introduced stepped tariffs for low-use consumers, with the aim of increasing access by poor households. Botswana opted instead to invest in a rural electrification programme to deliveries to the poor with subsidized payments. The result was a five-fold rise in rural connections between 1996 and 2003. The reforms and concessionary pricing in Senegal, Ghana and Honduras also increased electricity access by the poor, but a slower rate. Thus households in all four countries switched from the use of wood to electricity.

The four countries also allowed private companies to take over the import, distribution and sale of petroleum products. Products such as kerosene and gas became more available to households who would otherwise rely on charcoal and fuelwood for cooking, heating and lighting. Since the 1970s Senegal has also subsidized adoption of small butane gas stoves by the rural poor as a substitute for their use of charcoal and wood as cooking fuels. Over 1999 to 2001, after 85 per cent of the households of all income groups, including the poorest, converted to gas stoves for cooking, the government reduced the subsidy by 80 per cent. Currently, 86 per cent of households in the lowest income quintile in Senegal use gas for cooking. Households in Botswana, Ghana and Honduras also increasingly switched to gas for cooking, although it is much more widely used in urban rather than rural areas.

Because Ghana still has extensive forests and woodlands, the government allocated some of these forests as fuel plantations and deregulated the private charcoal industry to encouraging the substitution of fuelwood by charcoal use for cooking and heating. As a result, from 2001 to 2004, the use of wood declined while charcoal use increased in both rural and urban areas.

Other developing economies are also adopting innovative energy sector reforms to target increased access to energy services by the poor. For example, India is promoting the provision of decentralized technologies by private energy enterprises. Nepal is encouraging the selling of biogas equipment by private companies. Indonesia has developed a public-private partnership initiative to improve access to electricity by remote rural communities.

The lessons of the energy sector reform in these developing countries indicate that, if the reforms improve the efficiency of a sector, than both the entire economy as well as the poor will benefit from improved access to energy services, lower costs, and increased quality of supply. In addition, policies targeted at benefiting the poor have also encouraged the more widespread adoption of more efficient and cleaner fuels. Thus, increasing the access of the poor to energy services and improving overall energy efficiency are not incompatible goals in developing economies.

[174] The sources for this box are: Prasad, Gisela. 2008. "Energy sector reform, energy transitions and the poor in Africa." *Energy Policy* 36:2806-2811. United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). 2008. *Energy Security and Sustainable Development in Asia and the Pacific.* ESCAP, Bangkok, Thailand.

Box 9. Grameen Shakti and Renewable Energy Use by the Poor in Bangladesh[175]

Through its innovative micro-credit scheme, Grameen Shakti in Bangladesh has been embarking on an ambitious programme to provide a range of affordable renewable energy technologies to rural households. Already, Grameen Shakti has installed over 205,000 homes across Bangladesh with photovoltaic (PV) solar systems capable of powering lights and small-scale electronic appliances (e.g., refrigerators, televisions, cell phones, computers and radios). Over 8,000 PV solar systems are being installed per month, and demand for the systems is increasing exponentially. The goal is to install 2 million PV solar systems in homes by 2011, and 7.5 million by 2015, which would reach half of the Bangladeshi population.

Across Bangladesh Grameen Shakit has also installed 6,000 biogas plants, which convert animal dung and organic litter into pollution-free biogas and slurry. The biogas can be used to cook food, for lighting and to produce electricity through home generators. The slurry is used as organic fertilizer and as food in fish farming. Over 30 large-scale plants provide electricity directly to households. Grameen Shakti has set a goal of 500,000 biogas plants established by 2015. In the long run, with the rising cost of kerosene and other conventional fuels, scarcity of wood and higher chemical fertilizers, at least 4 million biogas plants could be constructed in Bangladesh.

Grameen Shakti has also disseminated over 20,000 improved cooking stoves, and has the goal of providing one million stoves by 2010 covering 35,000 villages. The eventual market potential is for two million stoves by 2015. By replacing traditional stoves, the improved cooking stoves hope to reduce fuelwood depletion and protect women and small children from indoor pollution.

The employment and other economic opportunities of the programme are far reaching. At least 20,000 jobs have been created already with the current uptake of these three renewable energy technologies across Bangladesh. Around 1,000 women have been trained as PV solar or improved stove technicians, and many trainees have gone on to set up their own renewable energy businesses. 33 Grameen Technology Centers have been established in rural areas to carry out training and manufacturing. Through these centers, more than 45,000 rural women have learned to take care of the PV solar systems installed in their homes, and at least 10,000 school children have learned about the new renewable energy technologies. Over 1,000 local masons have been trained as part of the biogas plant construction programme, and 1,000 demonstration farm plots have been established to popularize the use of slurry as organic fertilizer. Another 1,000 improved cooking stove technicians have been trained, and around 35 manufacturing units have been set up through seed capital and technical assistance. By 2015, the goal is to create at least 100,000 direct jobs, mainly employing women, through the renewable energy technology programme and to train at least 10,000 technicians.

[175] The source for this box is: Barau, Dipal. "Bringing Green Energy, Health, Income and Green Jobs to Bangladesh." Presentation at the Preparatory Meeting, International Advisory Board to the International Climate Protection Initiative of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. Poznan, Poland, December 7, 2008.

Box 10. Fuel Efficient Vehicles and Employment[176]

Employment in the global automobile manufacturing industry, including parts and accessories production, is estimated to be around 8.4 million. Most of this employment is concentrated in the major auto producing industries, the United States, Europe, Japan and South Korea. Some large emerging market economies also have an expanding car manufacturing industry and employment, such as China (1.6 million workers), Russia (755,000), Brazil (289,000), India (270,000) and Thailand (182,000). However, the indirect employment of the global car industry, including fuel refining and distribution, sales, repairs and services, is even larger. For example, in the United States, such indirect jobs total 6.5 million, and in Japan 4 million.

It is difficult to estimate the number of direct manufacturing jobs involved in the production of vehicles with high fuel efficiency, hybrid and alternative fuel use (including electric), low emissions and other cleaner technologies. Estimates range from about a quarter million to 800,000 employees globally, or only about 3 to 10 per cent of the total global workforce. In comparison, in Japan 434,070 workers are employed in the production of hybrid and low-emission vehicles, or nearly 46 per cent of a total automobile manufacturing workforce of 952,000. If the same proportion of workers in the global manufacturing industry were employed in producing cleaner vehicles, then this activity would account for over 3.8 million jobs worldwide. As part of its Green New Deal, South Korea expects to invest nearly US$1.5 billion in fuel efficient vehicles and clean fuel, creating over 14,000 new jobs (see Chapter 2.4).

Developing economies would also benefit from this job creation. Since June 2007 Thailand has granted a range of tax incentives to auto manufactures of "eco-cars" that have a limited engine size, obtain at least 47 miles per gallon of fuel and generate 120 grams of CO_2 per kilometer driven, and meet European emission standards. The cars will be sold not only in the domestic market but also aimed at other Asian countries, Australia and Africa. Although it is too early to know the implications for net job creation in Thailand, it is anticipated that the eco-car initiative has the potential to attain a large share of the current 182,000 jobs in auto manufacturing. Similarly, studies for China show that the country could move to cleaner vehicle technology by implementing a package of investment and incentive policies that strengthen vehicle emission standards, advance fuel quality, promote hybrid and alternative fuel vehicles. By achieving such developments, a much larger proportion of the 1.6 million Chinese auto jobs would be generated through these technologies.

Given the structural change and job displacement that would occur in the automobile industry from a massive switch to fuel-efficient vehicle production, the relevant estimate is the creation of new net employment. A study for the United States shows that increases in the corporate average fuel economy (CAFE) standards for vehicles could create between 73,000 and 350,000 new net jobs as well as reduce US annual oil consumption and greenhouse gas emissions. Most of the net employment creation would occur in the traditional automobile manufacturing states that are currently affecting the worst job losses under the current crisis in the global car industry: Michigan, Ohio, California and Indiana.

[176] The sources for this box are: Bezdek, Roger H. and Robert M. Wendling. 2005. "Potential long-term impacts of changes in U.S. vehicle fuel efficiency standards." *Energy Policy* 33:407-419. Renner, Sweeney and Kubit 2008*, op cit.* Zhao, Jimin. 2006. "Whither the Car? China's Automobile Industry and Cleaner Vehicle Technologies." *Development and Change* 37(1):121-144.

Box 11. Biofuels: Economic Potential or Environmental Scourge?[177]

Concerns about the energy security, greenhouse gas emissions and increasing agricultural and export income have led to the rapid expansion of biofuel production globally. For example, over 2004 to 2007, global ethanol production has leapt from 10.8 billion gallons to 13.1 billion gallons, an increase of nearly 25 per cent. Although nearly 88 per cent of this production comes from two countries, the United States and Brazil, increasingly other countries, including many developing economies and regions, are investing in biofuel production. Currently, nearly 1.2 million jobs globally are estimated to come from such production, but this may underestimate the total employment impact of the sector since the global estimate is based on five countries: Brazil (500,000 workers), United States (312,200), China (266,000), Germany (95,400) and Spain (10,349). The future employment and economic potential of the industry looks even stronger, especially in developing economies. For example, Colombia is expected to add 170,000 jobs in its sugar ethanol industry over the next several years, Venezuela might create a million jobs through a similar ethanol programme, Nigeria's biofuels expansion from cassava and sugarcane could generate 200,000 jobs and across sub-Saharan Africa as many as 700,000 to a million new jobs could be created through increased ethanol production. Because on average biofuels require about 100 times more workers per joule of energy content produced compared to fossil fuels, it is thought that future net job creation from expanded global biofuel production could reach 10 million.

However, complaints about the environmental and economic impacts of first-generation biofuel production are also mounting. In many regions, the main biofuel feedstocks, such as sugar cane, corn (maize) and oil palm, have exacerbated problems of deforestation, water use, biodiversity loss and air and water pollution. The rapid increase in corn-based ethanol production in the United States may have contributed to problems of food and feed shortage and rising prices. Large-scale plantation monoculture of oil palm and sugar cane may be contributing to tropical forest conversion and displacement of small-scale farmers and indigenous people in the developing world. Working conditions on some plantations and processing factories may also be less than ideal, and may involve exploitation of under-age workers and even forced labor. Finally, there are concerns that the fuel efficiency of current biofuel crops, especially corn-based and rapeseed ethanol.

Further development and production of global biofuels must focus on minimizing these economic, environmental and social costs. The development of second-generation feedstocks and converting more of the energy in cellulose plant material is a promising starting point. For example, of the current feedstock, only palm oil, sugar cane and sugar beets yield sufficiently high amounts of gasoline-equivalent fuel on a per hectare (ha) basis. New feedstocks that have the potential for even higher per acre fuel yields include algae, castor oil, crop wastes, jatropha, lignin, perennial grasses, short rotation woody crops and forest-industry wastes. These new feedstocks have the potential to reduce land and water use conflicts and produce economic and employment benefits if they can become cost-effective and also produce less pressure on agricultural and forest lands, water supplies and input use. Brazil has employed the crop waste from sugarcane (bagasse) to generate heat and electricity, and is currently exploring using both bagasse and the sugar crop to boost fuel yields per acre. The US government is funding $18

[177] The sources for this box are: Goldemberg, José, Suani Teixeira Coelho and Patricia Guardabassi. 2008. "The sustainability of ethanol production from sugarcane." *Energy Policy* 36:2086-2097. Peña, Naomi. 2008. *Biofuels for Transportation: A Climate Perspective*. Prepared for the Pew Center on Global Climate Change. Renewable Fuels Association, ethanol industry statistics http://www.ethanolrfa.org/industry/statistics/. Renner, Sweeney and Kubit 2008, *op cit.*

million for research, development and demonstration of the fuel potential of many second-generation stocks. In the developing world, the increased use of jatropha and castor oil is already being developed. These and other oil seed crops may improve job creation prospects because they need to be harvested manually. In Mali, jatropoha-based biofuel will replace imported diesel and create local employment opportunities. In India, it is estimated that a jatropha farm could provide 313 person-days per ha of employment in the first year of planting and 50 person-days per ha thereafter. Brazil estimates that harvesting castor oil could provide 0.3 jobs per ha and jatropha 0.25 jobs per ha compared to 0.2 for oil palm and 0.07 for soybeans.

In addition, labor and environmental regulations on biofuel production, harvesting and processing need to adopted and enforced worldwide. International Labor Organization (ILO) recommendations on under-aged labor use and working conditions and practices need to be adopted and strictly enforced. In addition, biofuel projects, especially large-scale plantations, need to be vetted for their potential impacts on land and water use, deforestation, displacing other forms of agricultural production, and affecting the livelihoods of small farmers and indigenous populations.

2007 World Ethanol Fuel Production	
Country	**Millions of Gallons**
United States	6,498.6
Brazil	5,019.2
European Union	570.3
China	486.0
Canada	211.3
Thailand	79.2
Colombia	74.9
India	52.8
Central America	39.6
Australia	26.4
Turkey	15.8
Pakistan	9.2
Peru	7.9
Argentina	5.2
Paraguay	4.7
World Total	**13,101.7**

Notes: [a] Renewable Fuels Association, ethanol industry statistics http://www.ethanolrfa.org/industry/statistics/.

Box 12. Public and Rail Transport and Employment[178]

Public urban transit systems have significant direct employment impacts globally, accounting for 367,000 workers in the United States and 900,000 in the European Union alone. In developing countries, such as China, Egypt, Ghana, India, Indonesia Iran, Mexico, South Africa and South Korea, the expansion of compressed natural gas (CNG) buses and Bus Rapid Transport (BRT) systems is reducing urban air pollution and creating new manufacturing and operating employment. For example, in New Delhi, India the introduction of CNG buses is expected to add 18,000 new jobs.

Investment in public urban transit has also has major secondary employment effects. In Europe, public transit investments have a multiplier effect of 2 to 2.5 indirect jobs created, but in countries that invest heavily in public transport, such as Switzerland, the multiplier effect rises to 4.1. Investments in public transit can also induce employment by making transport more affordable for the poor. For example, in major cities in the United States, access to public transit has a significant factor on rates of labor participation and employment of poor inner-city residents. In Mumbai, India the availability of public transport is a critical factor in the mobility of the poor and their access to job opportunities. This is particularly true for the poor living on the fringes of the urban center, who are isolated by long commuting distances that prevent the use of non-motorized vehicles or walking.

Investments in rail systems will not only provide an alternative to road vehicles for moving passengers and freight but also create substantial employment. For example, in the United States, a 10-year federal investment programme in new high-speed rail systems and its maintenance is estimated to have the employment potential of nearly 250,000 new jobs. As part of its Green New Deal, South Korea expects to generate over 138,000 new jobs through mass transit and railroad investments (see Chapter 2.4). In Europe, the lack of investment in its existing rail systems is contributing to the decline in the workforce. Railway transport still accounts for around 900,000 jobs, but employment has fallen steadily in recent decades including a 14 per cent decline from 2000 to 2004. Employment in the manufacture of railway and tramway locomotives has also fallen significantly, to just 140,000 workers. In developing economies, railways remain an important source of transport of passengers and freight, but unless more investment is forthcoming, the employment potential is lessening. For example, in China from 1992 to 2002 employment in the railways fell from 3.4 million to 1.8 million, and in India from 1.7 to 1.5 million over the same period. The neglect of rail investments in Africa is also reducing employment as well as worsening the continent's transportation problems.

Investments that provide alternatives to car use reduce pollution and greenhouse gas emissions as well as create employment. A study in Germany found that such investments financed partially by higher gasoline taxes would double public and rail transport, increase bicycle use by 72 per cent and decrease distances traveled by car by 8 per cent - and create 208,000 additional net jobs. A similar UK study estimates a 70 to 80 per cent increase in railway and bus use as well as more bicycling and walking, while reducing reliance on car use. The resulting employment effect was a net increase in 87,000 to 122,000 new jobs.

[178] The sources for this box are: Baker et al. 2005, *op cit.* Renner, Sweeney and Kubit 2008, *op cit.* Sanchez 1999, *op cit.* World Bank 2006, *Promoting Global Environmental Priorities in the Urban Transport Sector*, *op cit.*

Box 13. Market Reforms and Fiscal Policies for Sustainable Transportation[179]

The overwhelming evidence is that transport market distortions, including the "underpricing" of motorized travel, current urban and land use planning practices that encourage automobile use, and distortions in public investment in favor of road transport over other modes of travel, are systematically biasing the development of transportation networks worldwide to favor road transportation and excessive motor vehicle use. Removal of these distortions would contribute to less economic waste, reduce pollution and congestion, foster greater transport choice and facilitate sustainable transport strategies that would boost economic recovery and employment (see Boxes 10 to 12). The key areas in which transport market and planning reforms could be implemented by all national governments are indicated in the following table.

Potential Reforms of Transportation Market and Planning Distortions[a]

	Description	Potential reforms
Consumer options and information	Markets often offer limited alternatives to motorized vehicle transport	Recognize the value of alternative modes of transport and more accessible development in planning decisions
Underpricing	Many vehicle costs are fixed or external; fixed costs lead to more vehicle use, and external costs are not borne by motorists.	Where feasible, convert fixed costs to variable charges and charge motorists directly for the costs they impose.
Transport planning	Transportation planning and investment practices favor road transport expansion even when other solutions are more cost effective.	Incorporate full costs of road transport and use, including external costs, and apply least-cost planning so alternative modes and management strategies are funded if they are cost effective.
Land use policies	Current land use planning policies encourage lower density auto-oriented development	Apply smart growth policy reforms that support more multi-modal, accessible land use development.

Notes: [a]Based on Litman 2006, *op cit.*

To tackle the persistent problem of "underpricing" of road transport relative to alternative modes of travel, as well as to encourage the development of more fuel-efficient vehicles, a number of fiscal policies and market-based instruments could be adopted. Some countries have already employed such instruments as part of their efforts to tackle some of the key external costs imposed by motorized vehicle use and to encourage more fuel-efficient transport. The following table lists various fiscal policies and gives examples of "best practice" uses of these instruments by specific countries.

[179] The sources for this box are An, Feng, Deborah Gordon, Hui He, Drew Kodjak and Daniel Rutherford. 2007. *Passenger Vehicle Greenhouse Gas and Fuel Economy Standards: A Global Update.* International Council on Clean Transportation, Washington DC. Fischer, Carolyn. 2008. "Comparing flexibility mechanisms for fuel economy standards." *Energy Policy* 36:3116-3124. Gordon, Deborah. 2005. "Fiscal Policies for Sustainable Transportation: International Best Practices." In *Studies on International Fiscal Polices for Sustainable Transportation.* The Energy Foundation, San Francisco, pp. 1-80. Huang, Yongh. 2005. "Leveraging the Chinese Tax System to Promote Clean Vehicles." In *Studies on International Fiscal Policies for Sustainable Transportation.* The Energy Foundation, San Francisco, pp. 90-97. Kahn, Matthew E. and Joel Schwartz. 2008. "Urban air pollution progress despite sprawl: the 'greening' of the vehicle fleet." *Journal of Urban Economics* 63:775-787. Litman 2006, *op cit.* Minato, Jari. 2005. "Clean Vehicle Promotion Policies in Japan." In *Studies on International Fiscal Polcies for Sustainable Transportation.* The Energy Foundation, San Francisco, pp. 81-89. Sterner, Thomas. 2007. "Fuel taxes: an important instrument for climate policy." *Energy Policy* 35:3194-3202. Zhang 2008, *op cit.*

International Best Practices in Fiscal Polices for Sustainable Transportation	
Fuel tax	Gasoline/diesel tax (Poland); carbon tax (Sweden)
Vehicle tax	Annual vehicle attribute taxes and fees (European Union); Tax and fee reductions or exemptions for new clean, fuel-efficient cars (Denmark, Germany, Japan); Annual fees for CO_2 and smog externalities (Denmark; United Kingdom).
New vehicle incentives	Clean car rebates (Japan, United States); Gas guzzler tax (United States); "feebate": variable purchase tax with fuel consumption (Austria).
Road fees	Road pricing/high occupancy toll lanes (California, US); Congestion pricing (London, UK); Full externality based road pricing (Singapore).
User fees	Parking fees (California, US); In-lieu fees for parking (Canada, Germany, Iceland, South Africa); Parking demand management (United States).
Vehicle insurance	Fines for lack of mandatory insurance (United Kingdom, United States); Insurance-specific auto tax (France); Pay-as-you-drive and pay-as-you pump insurance (United Kingdom, United States).
Fleet vehicle incentives	Cost-effective, clean and fuel-efficient public fleets (Canada); Incentives for clean, fuel-efficient company cars (United Kingdom).

Notes: [a] Adapted from Gordon, Deborah. 2005. "Fiscal Policies for Sustainable Transportation: International Best Practices." In *Studies on International Fiscal Polices for Sustainable Transportation.* The Energy Foundation, San Francisco, pp. 1-80.

Fiscal policies can have lasting impacts on fuel consumption, pollution and the development of fuel-efficient vehicles. For example, a study by Thomas Sterner shows that, if all economies in the Organization for Economic Cooperation and Development adopted fuel taxes equivalent to those adopted by countries with the highest rates, then total vehicle fuel consumption in the OECD would be 36 per cent less and carbon emissions reduced by half. Governments can also promote fuel efficiency in motorized vehicles through greenhouse gas and fuel economy standards. The European Union has a target standard of 130 grams of CO_2 per kilometer driven for certain types of new vehicles, and Japan will phase in by 2015 the toughest standards of 125 grams of CO_2 per km driven for all new passenger vehicles. A mix of fiscal policies and fuel economy standards may be the most effective means of introducing cleaner and more fuel efficient cars. In addition, regulations could be more cost effective by introducing tradable fuel economy credits or "feebate" schemes that would award rebates if standards are exceeded but charge fees if they under-comply. For example, a mix of regulatory standards, fiscal policies and technological change has allowed California over the last 15 years to achieve a remarkable "greening" of its vehicle fleet and rapid improvements in air quality, despite the continuing fast-paced growth of its urban areas. Such policies are proving attractive to large emerging market economies. China is gradually increasing its fuel economy standards and adopting more fiscal policy measures, especially vehicle and fuel taxes, to introduce more fuel efficient vehicles. India, too, has started phasing in such policies.

Box 14. Low and Middle Income Economies and Patterns of Resource Use

Many low and middle-income economies fall into a persistent pattern of resource use that shows a chronic problem of resource dependency, the concentration of large segment of the population in fragile environments, and rural poverty. The following table reveals this pattern by taking 71 developing economies that have at least 20 per cent of their total populations living in marginal areas (following the definition in Box 2) and grouping them by the degree of resource

dependency of the economy, as measured by the share of primary commodities in total exports. The figure in parentheses by each country also indicates the share of the rural population living below the national rural poverty line.

Fifty-five of these developing economies have a primary product export share of 50 per cent or more, and could therefore be considered highly resource dependent. All of these economies also show high incidence of rural poverty, i.e. at least 20 per cent or more of their rural population is poor. The 16 countries that have a large share of their populations on rural lands but are less resource dependent (primary product export share ≤ 50 %) still have a high incidence of rural poverty. Only two, Jordan and Tunisia, have rural poverty rates less than 20 per cent.

The concentration of populations in fragile environments and resource dependency seem to be correlated. All but 4 of the 55 highly resource dependent economies have at least 30 per cent of their populations located in marginal rural areas. 10 of these economies have at least 50 per cent of their populations concentrated in fragile environments. In contrast, none of the 16 less resource dependent economies has 50 per cent or more of their populations located on marginal lands.

	Share of Population on Fragile Land ≥ 50 %	**Share of Population on Fragile Land 30-50 %**	**Share of Population on Fragile Land 20-30 %**
Primary Product Export Share ≥ 90 %	Burkina Faso (52.4) Chad (67.0) Congo Dem. Rep. (NA) Laos (41.0) Mali (75.9) Niger (66.0) Papua New Guinea (41.3) Somalia (NA) Sudan (NA) Yemen (45.0)	Algeria (30.3) Angola (NA) Benin (33.0) Botswana (NA) Cameroon (49.9) Comoros (NA) Eq. Guinea (NA) Ethiopia (45.0) Gambia (63.0) Guyana (NA) Iran (NA) Mauritania (61.2) Nigeria (36.4) Rwanda (65.7) Uganda (41.7)	Ecuador (69.0) Congo, Rep. (NA) Liberia (NA) Zambia (78.0)
Primary Product Export Share 50-90 %	Egypt (23.3) Zimbabwe (48.0)	Central Af. Rep. (NA) Chad (67.0) Guatemala (74.5) Guinea (NA) Kenya (53.0) Morocco (27.2) Senegal (40.4) Sierra Leone (79.0) Syria (NA) Tanzania (38.7)	Bolivia (83.5) Burundi (64.6) Côte d'Ivoire (NA) El Salvador (49.8) Ghana (39.2) Guinea-Bissau (NA) Honduras (70.4) Indonesia (34.4) Madagascar (76.7) Mozambique (55.3) Myanmar (NA) Panama (64.9) Peru (72.1) Togo (NA)

Primary Product Export Share < 50 %		Costa Rica (28.3) Haiti (66.0) Lesotho (53.9) Nepal (34.6) Pakistan (35.9) South Africa (NA) Tunisia (13.9)	China (46.0) Dominican Rep. (55.7) India (30.2) Jamaica (25.1) Jordan (18.7) Malaysia (NA) Mexico (27.9) Sri Lanka (79.0) Vietnam (35.6)

Notes: Primary commodity export share is the average export share 1990/99 for low and middle-income countries, from Barbier 2005, *op cit*. Share of population on fragile land is from World Bank 2003. *World Development Report, op cit*. Figure in parenthesis is the percentage of the rural population living below the national rural poverty line, from World Bank. 2008 *Word Development Indicators, op. cit.*

Box 15. Improving the Sustainability of Primary Production: Malaysia[180]

Present-day Malaysia exports processed plantation crops (including tropical timber products) and bases industrial development on export-oriented, labor-intensive manufacturing. As indicated in Box 14, although 20-30 per cent of Malaysia's population is still concentrated on fragile land, its share of primary product to total exports has fallen to a third. The decline in Malaysia's resource dependency is particularly remarkable given that primary product export share was 94 per cent in 1965 and still 80 per cent as recently as 1980-81.

Malaysia's long-run economic growth performance has been strong, reflecting continued reinvestment of the economic returns from primary production for export in physical and human capital. Long-run average annual growth in Malaysia has averaged 4.0 per cent. Long-term investment in gross fixed capital formation as a share of gross domestic product (GDP) has averaged 28 per cent, which is greater than the world average for high income economies. Moreover, long-run net investment in Malaysia, adjusted for depletion of minerals and timber, was positive in all years but one, and net domestic product rose by 2.9 per cent per year. Gross primary and secondary school enrolment rates in Malaysia have been considerably higher than in other low and middle-income countries, and in the case of primary school enrolment, the rates match that of higher income economies. This successful reinvestment of primary production revenues has been the key to the diversification of the Malaysian economy, including the rapid decline in its resource dependency, rising rural wages and the absolute as well as relative fall in the agricultural labor force. Other economy-wide benefits also occurred, such as the increase in the number of urban and rural households with access to piped, treated water.

As in the case of other low and middle-income economies, Malaysia's development has been accompanied by significant agricultural land expansion, especially at the expense of tropical forests. Much of the land conversion has been used to expand production of perennial plantation crops, such as oil palm and rubber. Malaysia is also a major world exporter of tropical timber

[180]The sources for this box are: Auty 2007, *op cit.*Barbier, Edward B. 1998. "The Economics of the Tropical Timber Trade and Sustainable Forest Management," in F.B. Goldsmith (ed.), *Tropical Rain Forest: A Wider Perspective*, Chapman and Hall, London, pp. 199-254. Barbier 2005, *op cit.* Coxhead, Ian and Sisira Jayasuriya. 2003. *The Open Economy and the Environment: Development, Trade and Resources in Asia*. Edward Elgar, Northampton, MA. Gylfason 2001, *op cit.* Kaufmann, Daniel, Aart Kraay and Massimo Mastruzzi. 2003. "Governance Matters III: Governance Indicators for 1996-2002". World Bank Policy Research Department Working Paper. Vincent, Jeffrey R., Razali M. Ali and Associates. 1997. *Environment and Development in a Resource-Rich Economy: Malaysia under the New Economic Policy.* Harvard Institute for International Development, Harvard University Press. World Bank 2008 *World Development Indicators, op cit.*

products, and is the leading world exporter of wood-based panels. Thus considerable investments have occurred in agro-industrial and forest-based industries, with extensive forward and backward linkages to domestic plantation crops and tropical forestry.

With regard to governance, Malaysia ranks comparably with high-income economies in terms of political stability, accountability, government effectiveness, regulatory framework, rule of law and control of corruption. Malaysia has held successful democratic elections and managed relatively smooth transitions in political power. The long-term political stability of Malaysia is particularly remarkable, given that the population is ethnically diverse, containing a Malay majority with a sizable Chinese and Indian minority. Overall, Malaysia appears to have the "good governance" necessary for long-run management of its natural resource wealth and the reinvestment of resource rents to achieve a more diversified and prosperous economy.

Several policies appear to have been especially critical to the successful strategy of reinvesting the returns from developing primary production activities in Malaysia. First, from the 1970s onwards, the revenues from the mineral and timber industries amounted to about one third of gross domestic investment, and the most effective policies were aimed at generating and reinvesting these key revenues. These policies included petroleum-sharing contracts, which both attracted investment from international oil companies to provide essential capital and technology while at the same time ensuring that substantial oil revenues were retained within Malaysia. The establishment of the Permanent Forest Estate in Peninsular Malaysia also enhanced the development of long-term timber management for forest-based industries as well as maintaining a sustained flow of timber revenues. Although substantial tropical deforestation did occur, forest and land use policies were implemented to ensure that deforestation led to the expansion of tree-crop plantations for export. Malaysia became a leading innovator and global producer in this industry, thanks in large part to the country's investment in agricultural research. This contrasts with the situation in many other tropical countries, where the end result of deforestation has been unproductive, degraded land. Finally, the substantial reinvestment of primary production revenues from minerals, timber and plantation crop exports was vital to the industrial development of export-oriented, labor-intensive manufacturing, which has in turn led to the diversification of the present-day Malaysian economy. Thus, these polices ensured that the Malaysian economy as a whole succeeded in using investible funds from resource use and primary production to build up stocks of physical and human capital that more than offset the depletion of mineral, timber and other natural resources.

More recently, the successful diversification of the Malaysian economy has created its own "virtuous circle" with regard to reducing land degradation and deforestation, halting depletion of fisheries and other renewable resources and combating rural poverty. For example, the reduced deforestation and rural poverty in Peninsular Malaysia owe much to the region's rapid economic growth and diversification. Better employment opportunities in labor-intensive manufacturing has spilled over into higher real wages in agriculture and a declining workforce as labor has moved out of rural areas. The result has been less land clearing and less pressure on fragile environments, including coastal and marine ecosystems. Increased rural-urban migration and the absolute decline in the agricultural labor force have been accompanied by rising rural wages and better employment prospects for the rural poor. Finally, the declining pressure on rural resources and land has also enabled Malaysia to implement resource management policies in agriculture and fisheries. For example, the government has implemented land rehabilitation programmes for smallholder rice and rubber, which has overcome problems of land fragmentation and improved the economic viability of these smallholdings. In marine fisheries, several policies have been

instigated to reduce overfishing in commercial and traditional coastal fisheries through controlling fishing effort and increasing returns.

However, not all resource management strategies have been successful in Malaysia. In agriculture, some government programmes wasted substantial subsidies on attempting to rehabilitate smallholder land that was not economically viable, while at the same time policy-induced rigidities in land markets actually increased the amount of productive land that was idled. Although policies to control overfishing in coastal areas were implemented, deep-sea fishing remained largely open access. In addition, too often resource management strategies in Malaysia have been driven by an emphasis on maximizing physical production rather than on maximizing net economic benefits. This has been exacerbated by direct involvement of public enterprises in key sectors, such as forestry, petroleum and fishing. Over-exploitation of Malaysia's remaining tropical timber reserves in Sabah and Sarawak to feed the forest-based industries in Peninsular Malaysia is a worrisome problem, which has been fueled by long-term policies of log export restrictions and protection of wood panels and furniture industries that has led to over-capacity and inefficiencies in timber processing. Recently, there have been concerns about the expansion of oil palm plantations and their impacts on excessive deforestation.

Box 16. Improving the Sustainability of Primary Production: Thailand[181]

In many ways, Thailand's success resembles that of Malaysia. Since the 1970s Thailand has been a net food exporter that bases industrial development on export-oriented, labor-intensive manufacturing. As a consequence, resource dependency in the Thai economy has declined steadily; primary product export share was 95 per cent in 1965, 68 per cent in 1980-81 and 30 per cent currently. Although 80 per cent of the population still lives in rural areas, the share of the rural population living in poverty is only 18 per cent. Diversification of the Thai economy and the decline in its resource dependency has been accompanied by rising rural wages and the absolute as well as relative fall in the agricultural labor force.

The successful diversification strategy of Thailand is reflected in its long-run growth and investment patterns. Annual growth in GDP per capita has averaged 4.7 per cent over several decades, and the share of gross fixed capital formation in GDP has averaged 28 per cent. Both of these trends exceed world averages or that of high-income economies. In addition, primary and secondary school enrolment rates are above those of low and middle-income economies and comparable with world rates. Thailand's development has been accompanied by significant agricultural land expansion at the expense of tropical forests, mainly through new land for perennial plantation crops. However, Thailand's remarkable success with resource-based development has occurred without the benefit of substantial mineral and timber reserves capable of generating significant economic returns. Instead, this development has been accomplished

[181] The sources for this box are: Barbier 2005, *op cit.* Barbier, Edward B. and Suthawan Sathirathai, eds. 2004. *Shrimp Farming and Mangrove Loss in Thailand*. London: Edward Elgar. Coxhead and Jayasuriya 2003, *op cit*. Feeny, David. 2002. "The Co-evolution of Property Rights Regimes for Man, Land, and Forests in Thailand, 1790 1990." In. *Land Property and the Environment, ed,* John F. Richards. San Francisco: Institute for Contemporary Studies Press, pp. 179-221. Gylfason 2001, *op cit.* Kaosa-ard, M. and Pednekar, S. S. 1998. *Background Report for the Thai Marine Rehabilitation Plan 1997-2001*. Report submitted to the Joint Research Centre of the Commission of the European Communities and the Department of Fisheries, Ministry of Agriculture and Cooperatives, Thailand, Thailand Development Research Institute, Bangkok. Kaufmann et al. 2003, *op cit.* Pingali, Prabhu L. 2001. "Environmental Consequences of Agricultural Commercialization in Asia." *Environment and Development Economics* 6(4):483-502. World Bank 2008 *World Development Indicators, op cit.*

through considerable investments in agro-industrial industries, with extensive forward and backward linkages to domestic plantation crops, food crops and fisheries. Good governance appears to be crucial to the success of this long-term development strategy in Thailand.

In Thailand's economy, traded food production and plantation crops dominate both upland and lowland farming, and so the pressures on upland forests are solely determined by inter-regional labor migration. Any increase in labor demand in the lowlands will result in reduced deforestation as the total area of upland agriculture declines. Thus the emphasis on agro-industrialization, with forward and backward linkages, and on reinvestment of rents in labor-intensive manufacturing has generated a "virtuous cycle" of reducing land degradation and deforestation, better management of fisheries and other renewable resources and improving rural livelihoods. However, the key to this process was a profound structural change in the Thai economy, reflected in rising prices for non-trade, mainly non-agricultural goods, growth of non-agricultural investment and rising labor productivity outside of the farm sector. The result has been increased employment opportunities outside of agriculture, rising rural wages, declining relative agricultural prices and thus a reduction in farm profits and investment. The overall outcome was a relative decline in the agricultural sector relative to the rest of the Thai economy, accompanied by a fall in total planted area, which in turn reduced pressures for land conversion and deforestation. Meanwhile, the agricultural sector has been forced to become more efficient, commercially oriented and internationally competitive. As a result, substantial inter-regional migration has occurred from highland to lowland areas to take advantage of rising rural wages accompanying the commercialization of agriculture on favorable and productive lands, even as total rural employment opportunities and planted area across Thailand have declined. In addition, the economy-wide trade reforms implemented in Thailand provided further stimulus to labor-intensive manufacturing industries, greater employment opportunities outside of rural areas, and significantly reduced pressures on frontier agricultural soils, forests and watersheds.

In other sectors, such as fisheries, Thailand has also promoted export-oriented industries, particularly shrimp. Since 1979, Thailand has been the world's major shrimp producer, and one third of all shrimp marketed internationally is from Thailand. Although shrimp are also caught in coastal fisheries, the vast majority of Thailand's shrimp production now comes from aquaculture. The total value of export earnings for shrimp is around $1-2 billion annually, and the government has been keen to expand these exports. Thailand has also sought to manage its coastal fisheries through zoning. Since 1972, the 3 km off-shore coastal zone in Southern Thailand has been reserved for small-scale, traditional marine fisheries. The Gulf of Thailand is divided into four such major zones, and the Andaman Sea (Indian Ocean) comprises a separate fifth zone.

However, there have been problems with some resource management strategies pursued in Thailand. First, ill-defined property rights for forest areas have contributed to excessive upland deforestation and the rapid conversion of mangroves to shrimp farms in Thailand. Historically, this has been a common problem for all forested areas in Thailand. Although the state though the Royal Forestry Department ostensibly owns and controls forest areas, in practice they are *de facto* open access areas onto which anyone can encroach. Estimates of the amount of mangrove conversion due to shrimp farming vary, but studies suggest that up to 50-65 per cent of Thailand's mangroves have been lost to shrimp farm conversion since 1975. In provinces close to Bangkok, mangrove areas have been devastated by shrimp farm developments. This has led to substantial losses to local communities dependent on mangrove-based activities and the habitat support provided by the mangroves for coastal fisheries, as well as leaving coastal

populations vulnerable to frequent tropical storm events. Second, the build-up of manufacturing and agro-industries coupled with the increasing commercialization of agriculture may lead to better land and water management but is worsening other environmental problems, such as pollution and congestion in cities (particularly Bangkok), industrial and toxic waste, over-use of pesticides and non-point pollution in agriculture. Finally, the increasing commercialization of agriculture is likely to continue the trends towards consolidation of land holdings, adoption of labor-saving innovations and reductions in cropping intensities, which will add to labor substitution and declining employment opportunities in agriculture. Although this may have removed less productive, marginal upland areas from food production, rural employment opportunities in lowland areas are likely to slow down and provide less work for the rural poor from upland areas. In Thailand, there does not appear to be a set of policies targeted at the upland areas to i) manage the transition from movement of rice and subsistence-crop production to a variety of commercial-oriented agricultural enterprises, such as maize, horticulture, tree crops, dairy and livestock-raising, ii) promote these enterprises in those upland areas with the most suitable agro-ecological conditions, i.e. areas that are less susceptible to erosion and have favorable micro-climates, iii) provide research and development support to develop adequate post-harvest and marketing facilities, targeted to smallholder production, and to facilitate the integration of these upland enterprises with the economy's agro-industrial development strategy and iv) encourage the commercialization of upland agriculture as an alternative source of employment for the rural poor in these areas.

Box 17. Improving the Sustainability of Primary Production: Botswana[182]

Botswana has remained heavily dependent on mineral export earnings, principally diamonds. Not only are nearly all of its exports from primary products but also minerals, especially diamonds, account for one-third of GDP and half of government revenue. Because of its high resource dependency, since the 1970s Botswana has experienced periodic and substantial commodity export booms and windfalls. Yet since 1965 the country has had one of the highest rates of long-term growth in the world, and very high rates of government expenditures on education to GDP. Botswana's long-run share of investment in GDP is equivalent to that of Malaysia and Thailand, and Botswana also has comparably high rates of primary and secondary school enrolment. Thus, unusually for most mineral-dependent economies, Botswana has achieved substantial economic success through reinvesting its resource wealth in physical and human capital.

Botswana's success in managing cycles of commodity booms and busts is attributed largely to its adoption of appropriate and stable economic policies, including managing the exchange rate to avoid excessive appreciation during boom periods, using windfalls to build up international reserves and government balances that provide a cushion when booms end, avoiding large-scale increases in government expenditure and instead targeting investments to public education and infrastructure, and finally, pursuing an economic diversification strategy that has led to modest increases in labor-intensive manufactures and services. However, such long-term policies for

[182] The sources for this box are: Barbier 2005, *op cit.* Gylfason 2001, *op cit.* Iimi, Atsushi. 2007. "Escaping from the Resource Curse: Evidence from Botswana and the Rest of the World." *IMF Staff Papers* 54:663-699. Kaufmann et al. 2003, *op cit.* Lange, Glenn-Marie and Matthew Wright 2004. "Sustainable development and mineral economies: the example of Botswana." *Enviornment and Development Economics* 9(4):485-505. Sarraf, Maria and Moortaza Jiwanji. 2001. "Beating the Resource Curse: The Case of Botswana." *Environmental Economics Series.* The World Bank Environment Department. The World Bank, Washington DC. World Bank 2008 *World Development Indicators, op cit.*

stable management of the economy are only possible if legal and political institutions function well. Botswana has had considerable political stability and lack of civil conflict that are on par with high-income economies. In addition, the government has an international reputation for "honest public administration", and overall Botswana is generally rated the least corrupt country in Africa.

The cornerstone of the Government of Botswana's long-run development policy has been the recovery and reinvestment of resource rents. Over several decades, the government has collected on average 75 per cent of mining rents through taxes and royalties. These mineral revenues have been reinvested in public capital, and public sector investment has accounted for 30-50 per cent of total gross fixed capital formation in the economy. Although much of this public expenditure has been on infrastructure, such as roads, expansion of water connections, electricity and communications, there has been an increasing emphasis on investment in education and health, which in recent years has averaged 24 per cent of the capital development budget.

Since the mid-1990s, the main planning tool for guiding this public investment in Botswana has been the Sustainable Budget Index (SBI). This index is simply the ratio of non-investment spending to recurrent revenues. An SBI value of 1.0 or less has been interpreted to mean that public consumption is sustainable because it is financed entirely out of revenues other than from minerals, and that all the revenue from minerals is used for public investment. An SBI value greater than 1.0 means that consumption relies in part on the mineral revenues, which is unsustainable in the long term. However, one downside of relying on the SBI as an economic planning tool is that it encourages the over-reliance of the economy on public sector investments. Over the long term, this over-reliance has resulted in continued growth in public sector investment for a variety of expenditures, including for defense or for other non-productive investments, such as agricultural subsidies and assistance programmes, and some pure transfer payments. Public expenditures have also risen due to the efforts of the government to combat the HIV/AIDS epidemic in Botswana, including its recent commitment to provide affordable medicine to the entire population.

One of the key investment strategies of the government has been to increase foreign exchange reserves and financial assets. The main rationale has been to save windfall gains from mineral revenues for use when export earnings decline, both during short-term busts and in the long run once mineral reserves are depleted. Overall, this strategy has been successful. In recent years, income from foreign financial assets has become the next largest source of government revenue after mineral taxes and royalties.

The government has also been able to foster modest diversification of the economy, particularly in labor-intensive manufactures and services. This was achieved both directly through public investment in the manufacturing sector and indirectly through adopting stabilization policies that prevented appreciation of the domestic currency, even during periods of commodity booms. Although the share of manufacturing value added in GDP remains only 5 per cent, the sector is expanding. Employment in manufacturing and services has also grown, and accounts for 25 and 32 per cent of formal employment respectively.

Less successful have been the government programmes to promote agricultural growth. Although on average 7 per cent of the government's development budget has gone to agriculture, and public sector expenditure in support of agriculture averages more than 40 per cent of agricultural GDP, over the past decades the sector's contribution to overall GDP has declined to less than 4 per cent. The main reason for the decline has been prolonged periods of drought

combined with continuing over-pressure on rural resources, including depletion of village water reserves, water pollution problems, over-grazing, rangeland degradation and depletion of wood supplies.

To sustain and build on its economic success, there are some additional structural imbalances that Botswana needs to tackle in the near future. First, the economy is overly reliant on public sector investment to the extent that the relative share of private sector capital in the economy has declined significantly. Second, although growth in manufacturing and services shows signs that the economy is diversifying, these sectors produce mainly non-tradable goods. Overall, the economy is still dominated by mining, especially for export earnings, and the declining relative share of private capital in the economy suggests that full economic diversification is likely to be unrealized for some time. Finally, the government programmes for investing in agriculture have been largely a failure. Yet agricultural development is still critical for the economy. Agriculture accounts for over 70 per cent of the labor force, and will remain a significant source of income for the rural poor. As indicated in Box 14, over half of the population still lives in rural areas, and 30-50 per cent of the population is on fragile land. Moreover, around 47 per cent of the population still lives in poverty.

Box 18. Ecosystems and the Economic Livelihoods of the Poor[183]

The importance of the coastal ecosystems, coral reefs, forested watershed and floodplains to the economic livelihood of the poor is well documented.

For example, estimates from Thailand suggest that the net present value (in 1996 US$) over 1996-2004 arising from the net income to local communities from collected forest products from coastal mangroves range from $484 to $584 per hectare (ha). The net present value of mangroves as breeding and nursery habitat in support of off-shore artisanal fisheries ranged from $708 to $987 per ha, and the storm protection service was $8,966 to $10,821 per ha. Such benefits are considerable when compared to the average incomes of coastal households; a survey conducted in July 2000 of four mangrove-dependent communities in two different coastal provinces of Thailand indicates that the average household income per village ranged from $2,606 to $6,623 per annum. The overall incidence of poverty (corresponding to an annual income of $180 or lower) in all but three villages exceeded the average incidence rate of 8 per cent found across all rural areas of Thailand. Excluding the income from collecting mangrove forest products would have raised the incidence of poverty to 55.3 per cent and 48.1 per cent in two of the villages, and to 20.7 per cent and 13.64 per cent in the other two communities. The Thailand example is not unusual; poor households across the developing world typically obtain many benefits from mangroves, and also value their continued existence beyond what the ecosystems yield in economic goods and services.

Coral reefs are another critical habitat throughout the developing world that both support near-shore fisheries harvested by poor coastal communities and provide valuable shoreline protection. For example, estimates were made of the losses, in net present value per square kilometer (km^2), in terms of support for near-shore artisanal fisheries and coastal protection from the destruction of coral reefs in Indonesia. The main threats to coral reefs are from poison fishing, blast fishing, coral mining, sedimentation from logging onshore and overfishing. Together, these threats account for present value losses in coastal fisheries of around $0.41 million per km^2 of coral reef

[183] The source for the case studies cited in this box is: Barbier 2008, *op. cit.*For additional case studies see Sukhdev 2008, *op. cit.*

destroyed, and present value losses in coastal protection $0.011 to $0.453 million per km^2 of coral reef destroyed. Evidence from Kenya indicates that coral reefs may also be critical to larval dispersal to fishing areas, which could affect the effectiveness of marine reserves and closed fishing grounds in inducing stock recovery and thus eventual re-opening to fishing. Coral reefs also have important cultural and non-use value to neighboring coastal communities; many cultural and religious traditions have evolved in tropical coastal zones that honor the dependence of local communities on adjacent reefs and reflect the value of preserving this way of life into the future.

Forested watersheds in developing regions also provide a number of hydrological services that can impact the livelihoods of the poor, such as water filtration/purification; seasonal flow regulation; erosion and sediment control; and habitat preservation. These services will become increasingly important as more and more river basins in developing areas experience rising water use relative to freshwater supplies. In addition, the forests of upper watersheds provide a number of direct uses to poor communities living there, including timber, collected non-timber products and community forestry. Yet, overwhelmingly, the benefits of maintaining and improving land uses in upper watersheds appear to be additional hydrological services downstream. In the central highlands of Bolivia, for example, a project to improve watershed protection and reduce soil erosion on farmers' fields in the uplands yielded a net present value of nearly US$34.9 million, with the majority of the benefits due to flood prevention and the increased water availability due to aquifer recharge in the lower watershed. Similarly, improvements to the upper watersheds in Karnataka, India through afforestation and construction of tanks, artificial ponds, check dams and other reclamation structures led to significant benefits to downstream farmers through improving groundwater recharge and availability, thus reducing the cost of irrigation and the need for developing new wells or extending existing wells. Increased water flow associated with afforestation of watersheds in Eastern Indonesia generates economic values for downstream farmers equivalent to 1 to 10 per cent ($US3.5–$35) of annual agricultural profits. However, land uses other than forests in some tropical watersheds may also yield beneficial hydrological flows; for example, forest conversion to livestock pasture in the upper watersheds of Río Chiquito, Costa Rica actually increased water flow downstream, generating net present values in the range of US$250 to US$1,000 per hectare of pasture.

In many developing regions, important downstream ecosystems in river basins are the seasonally inundated savanna or forested floodplains. During seasonal flood events, water often leaves the main river channel and inundates these floodplains. As the floods abate and recede, crops are planted in the naturally irrigated soils, fish are caught more easily in the retreating waters, and the increased alluvial deposits increase the biological productivity of forests, wildlife and other harvested resources. Around half of Africa's total wetland area consists of floodplains, and including huge large-scale ecosystems of several thousand square kilometers such as the Inner Niger Delta in Mali, the Okavango Delta in Botswana, the Sudd of the Upper Nile in Sudan and the Kafue Flats in Zambia. Millions of people across the continent dependent directly on the floodplains for their economic livelihoods through production activities such as flood-recession agriculture, fishing, grazing and wood and non-wood harvesting of riparian forest resources, and millions more in surrounding arid land depend on the groundwater recharge service of floodplains for drinking water and irrigation. Similar benefits are found in other extremely poor countries, such as Bangladesh, where 80 per cent of the country consists of floodplains created by the confluence of the Ganges, Brahmaputra,Meghna, and other rivers.

For example, upstream dam developments threaten the economic livelihoods of millions of poor agricultural households dependent on the Hadejia-Jama'are floodplain in Northeast Nigeria. Full implementation of all the upstream dams and large-scale irrigation schemes is estimated to produce overall net losses in terms of agricultural, fuelwood and fish production to these households of around US$20.2-20.9 million in net present value terms. In addition, the reduction in mean peak flood extent is predicted to cause a one-meter fall in groundwater levels in the shallow aquifers that are recharged by the standing water in the floodplain wetlands, leading to additional annual losses of around $1.2 million in tubewell irrigated dry season agriculture and $4.76 million in domestic water consumption for rural households. In Bangladesh, fishing and flood-recession agriculture are important joint products to poor rural households utilizing natural floodplains. Floodplain fish production benefits mainly the landless households. As a consequence, a natural floodplain means more land devoted to fishing rather than agriculture but actually yields higher overall net economic returns, especially compared to traditional management scenarios of upstream dam developments to limit flooding, increase agricultural area and expand crop production downstream.

Box 19. Bailing out the World's Poorest[184]

The World Bank recommends that, during an economy-wide crisis, it is essential for a developing economy to design and implement a comprehensive safety net programme targeted at the poor. Targeting the programme, by use of "poverty maps" to direct funds to where the poor are located or by ensuring that the main recipients are the women in poor families, can reduce the costs significantly. A safety net that provides effective insurance to protect the poor from a crisis usually builds in design features that encourage participation in the programme only by those who need help, and just temporarily until economic conditions improve again. The features that work best are a combination of transfers to households, usually in the form of cash or food, and a relief work programme. Cash or food transfers can be targeted to specific groups who are unable to work or who would otherwise forego important expenditures during a crisis, such as educating children. Relief work assists the working poor who are either temporarily unemployed or underemployed as the result of the crisis.

An ideal safety net programme would have the following features:

- It should have a guaranteed low wage for relief work, set at a rate which discourages the non-poor from participating and encourages the poor to leave the scheme for better paid work once the crisis is over.
- The work should be proposed by community groups in poor areas, to make certain that the relief effort is responsive to local needs and produces outputs valued by the poor.
- The budget must be sufficiently large to employ anyone who wants to work at the guaranteed wage; if work has to be rationed, then its effectiveness as insurance for the poor is diminished.
- A rapid expansion of demand for relief work should be taken as a signal to implement cash or food transfers, targeted to specific groups who either cannot work or to households that would otherwise forego educational or health expenditures.

[184] The sources for this box are Development Research Group 2008, *op cit.* Ravallion 2008, *op cit.*

Well designed relief work programmes have been an important part of economic recovery programmes since Roosevelt's New Deal. More recently, during the East Asian financial crisis of 1997-8, both Indonesia and South Korea introduced large relief work initiatives. Mexico implemented such programmes in the 1995 "Peso crisis", Peru during its recession of 1998-2001 and Argentina in its 2002-3 financial crisis. Conditional Cash Transfer (CCT) programmes have been increasingly used in developing economies during crises to ensure that poor people do not forego educational or health expenditures. A typical scheme requires the children of the recipient family to demonstrate adequate school attendance or the family to provide evidence of maintaining basic health care. Such CCT programmes have been used successfully in Bangladesh, Brazil, Indonesia and Mexico.

There are also economy-wide benefits of a comprehensive safety net programme. If a crisis does create the opportunity for implementing an effective safety net for the poor, then it should become a permanent and automatic policy, expanding in times of crises but still functioning under normal economic conditions to alleviate persistent poverty problems in some areas. Some of the features of the programme, such as incentives to encourage the children of poor families to stay in school or using relief work to build assets of value to poor communities, could be maintained to enhance longer term poverty reduction in the economy. The safety-net programme should also provide an additional and immediate stimulus to aggregate demand in the economy. The extra income targeted to the poor is likely to translate rapidly into increased consumption in the local and wider economy.

Box 20. Water Scarcity and its Impacts[185]

The most common measure of aggregate freshwater availability is the total renewable water resources of a country or region, which consists of adding up average annual surface runoff and groundwater recharge from precipitation, plus surface inflows from other countries or regions. Hydrologists usually measure the degree of water stress or scarcity by comparing total renewable water supply to the total water withdrawals per year in a country or region. Withdrawal refers to water removed or extracted from a freshwater source and used for human purposes (i.e. industrial, agricultural or domestic water use). The ratio of water withdrawals to total freshwater resources per year is often referred to as *relative water demand* or the *water criticality ratio*. Hydrologists typically consider criticality ratios for a country or a region between 0.2 and 0.4 (or 20 per cent to 40 per cent) to indicate medium to high water stress, whereas values greater than 0.4 reflect conditions of severe water limitation.

Already, developing countries account for 71 per cent of global water withdrawal. Water demand in these countries is expected to grow by 27 per cent by 2025. Although criticality ratios are projected to remain low across all developing countries, there are important regional exceptions. By 2025 Asia is expected to show signs of medium to high stress. West Asia/North Africa is currently facing severe water limitation, and this problem is expected to reach critical levels by 2025. As shown in the table below, the problem of water stress and scarcity is likely to

[185] The sources for this box are: Barbier, Edward B. 2004. "Water and Economic Growth." *Economic Record* 80:1-16. Cosgrove, William J. and Frank R. Rijsberman. 2000. *World Water Vision: Making Water Everybody's Business.* World Water Council and Earthscan Publications, London. Rosegrant, Mark W. and Ximing Cai. 2002. "Water for Food Production" In Ruth S. Meinzen-Dick and Mark W. Rosegrant, eds. *2020 Vision Focus 9: Overcoming Water Scarcity and Quality Constraints.* International Food Policy Research Institute, Washington, DC.
Vörösmarty, Charles J., Pamela Green, Joseph Salisbury and Richard B. Lammers. 2000. "Global Water Resources: Vulnerability from Climate Change and Population Growth." *Science* 289 (14 July):284-288.

be worse for key developing countries and regions. The two most populous countries of the world, China and India, account for around 35 per cent of global water withdrawal. Both countries are already displaying medium to high water stress, which is expected to worsen by 2025. However, the problem is worse still for specific river basin regions within each country. Some of these river basins have or will have in coming years criticality ratios exceeding 100 per cent, suggesting chronic problems of extreme water scarcity. Other countries facing worsening water stress and scarcity include Pakistan, the Philippines, South Korea, Mexico, Egypt and virtually all other countries in West Asia/North Africa.

The fact that water scarcity and stress is occurring in specific river basins and regions and not necessarily across entire economies may be one reason that is difficult to determine whether current patterns of water use relative to supply is hampering economic development. A study of water use and economic growth across 163 countries found little evidence of a current widespread problem of global water scarcity in terms of physical water limits constraining economic development worldwide. The exceptions are the handful of countries in the West Asia/North Africa region that exhibit moderate or extreme water scarcity. Nevertheless, as the table below indicates, increased water utilization in critical river basins may become sufficiently severe to hamper economy-wide growth in more countries in the near future.

Developing Countries and Regions with Critical Water Ratios

	Total Water Withdrawal (km^3)			**Total Withdrawal as a Percentage of Renewable Water Supply (%)**		
Region/Country	**1995**	**2010**	**2025**	**1995**	**2010**	**2025**
Huaihe	77.9	93.7	108.3	83	100	115
Haihe	59.2	62.1	62.9	140	147	149
Huanghe	64.0	71.1	79.5	89	99	111
Changjian	212.6	238.5	259.1	23	26	29
Songliao	51.5	59.2	67.6	26	30	34
Inland	89.5	98.9	111.2	299	330	371
Southwest	8.3	9.7	12.3	1	1	2
ZhuJiang	77.1	84.9	96.9	19	21	24
Southeast	38.8	41.4	47.7	27	29	33
China total	**678.8**	**4,356**	**845.5**	**26**	**29**	**33**
Sahyadri Gats	14.9	18.7	20.8	14	17	19
Eastern Gats	10.5	13.7	11.6	67	87	74
Cauvery	11.8	12.8	13.1	82	89	91
Godavari	30.2	33.3	38.8	27	30	35
Krishna	46.2	51.4	57.5	51	57	63
Indian-Coastal-Drain	34.8	46.9	43.6	108	145	135
Chotanagpur	7.2	10.9	14.3	17	26	34
Brahmari	25.5	27.2	31.0	24	22	26
Luni River Basin	41.9	43.1	50.8	148	140	166
Mahi-Tapti-Narmada	31.4	34.3	36.3	36	39	42
Brahmaputra	5.5	7.2	9.2	1	1	1
Indus	159.1	178.7	198.6	72	81	90
Ganges	255.3	271.9	289.3	50	54	57
India total	**674.4**	**750.0**	**814.8**	**30**	**33**	**35**
Pakistan	**267.3**	**291.2**	**309.3**	**90**	**98**	**105**
Philippines	**47.0**	**58.2**	**70.0**	**24**	**29**	**35**

South Korea	**25.8**	**34.9**	**35.9**	**56**	**75**	**78**
Mexico	**78.6**	**86.2**	**94.2**	**24**	**26**	**29**
Egypt	**54.3**	**60.4**	**65.6**	**89**	**99**	**108**
Other West Asia/North Africa[a/]	**143.2**	**156.0**	**171.5**	**116**	**125**	**139**

Notes: a/ Excluding Turkey.
Source: Adapted from Rosegrant *et al.* 2002, *op cit.* Table B.3.

Box 21. Transboundary Water Availability[186]

Many countries share their sources of water, as river basins, large lakes, aquifers and other freshwater bodies often cross national boundaries. Such transboundary water sources are important for global supply; for example, two out of five people in the world live in international water basins shared by more than one country. The Amazon River has 9 countries sharing it, and the Nile 11 countries. Sometimes transboundary water resources are equally distributed across countries, making it reasonably easy for the countries to agree on sharing arrangements. Alternatively, the external sources of water may not be the most important source of supply for countries. But as the table below indicates, 39 countries currently receive most of their water from outside their borders. All but two of the countries are developing economies.

Region	Countries receiving 50-75 % of their water from external sources	Countries receiving > 75 % of their water from external sources
Middle East	Iraq, Israel, Syria	Bahrain, Egypt, Kuwait
East Asia and the Pacific	Cambodia, Vietnam	
Latin America and the Caribbean	Argentina, Bolivia, Paraguay, Uruguay	
South Asia		Bangladesh, Pakistan
Sub-Saharan Africa	Benin, Chad, Congo, Eritrea, Gambia, Mozambique, Namibia, Somalia, Sudan	Botswana, Mauritania, Niger
Eastern Europe and Central Asia	Azerbaijan, Croatia, Latvia, Slovakia, Ukraine, Uzbekistan	Hungary, Moldova, Montenegro, Romania, Serbia, Turkmenistan
High-Income OECD	Luxembourg	Netherlands

Box 22. The Economic Benefits of Improved Drinking Water and Sanitation[187]

An increasing number of studies in developing economies illustrate the economic benefits to poor households in having access to clean water and sanitation services. Most of the benefits occur because households gain not only from access to these vital services but also because of the reduction in the implied costs of the coping or averting strategies that the household must employ when they do not have access.

[186] The source for this box is: UNDP 2006, *op cit.*
[187] The sources for this box are: Casey, James F., James R. Kahn and Alexandre Rivas. 2006. "Willingness to Pay for Improved Water Service in Manaus, Amazonas, Brazil." *Ecological Economics* 58:365-372. Hutton, Guy and Laurence Haller. 2004. "Evaluation of the Costs and Benefits of Water and Sanitation Improvements at the Global Level." Water, Sanitation and Health Protection of the Human Environment, World Health Organization, Geneva. Pattanayak, Subhrendu K., Jui-Chen Yang, Dale Whittington and K.C. Bal Kumar. 2005. "Coping with unreliable public water supplies: Averting expenditures by households in Kathmandu, Nepal." *Water Resources Research* 41:W02012-W02023.

For example, a study in Manaus, Brazil estimated that households are willing to pay more than US$6.12 per month for improved water treatment services. Yet this amount is well below what the households are currently paying for "unclean" water. A study in Kathmandu, Nepal found that households cope with unsafe water by spending time on collecting water from public sources, storing water and treating it before consumption. Some households also spend money on bottled water, as well as water from public tanker trunks and private vendors. In addition, households invest in storage tanks, water filters, tube wells and chemicals, plus the costs of maintaining these facilities. These "coping costs" average as much as US$3 per household per month, or about 1 per cent of current incomes. Not only are these coping costs almost twice as much as monthly water utility bills but also are significantly lower than the estimated WTP of the average household for improved water services.

These results are typical across many developing economies and regions. A global assessment for the World Health Organization (WHO) of the costs and benefits to households of clean water and sanitation interventions amounted to US$5 and US$11 economic benefit per US$1 invested for most developing country sub-regions and for most interventions. The return on a US$1 investment was in the range of US$5 to US$28 for interventions that met the MDG of halving by 2015 the proportion of the target population without clean water or sanitation, that increased access to improved water and sanitation for everyone or that proved disinfection at point-of-use over and above increasing access to improved water supply and sanitation. The main contributions to the high benefits of these interventions were the income gains from the reduced number of days spent ill, the money savings from less health service use and expenditures on medicines, and the increase time spent on income and productive activities of the household.

Box 23. Cost-Benefit Analysis of the Ganga Action Plan, India[188]

The Ganga Action Plan (GAP) was launched in February 1985 to raise the water quality levels of the Ganges River in India. The final investment cost of implementing the GAP from 1985/86 to 1996/96 was US$318 million (in 1995/96 prices), with an operating cost over the same period of US$10 million. In addition, water-polluting industries were required to invest in abatement, which amounted to an annual cost of effluent treatment of US$10.5 million. Due to the Plan, water quality in terms of dissolved oxygen improved, biochemical oxygen demand and concentrates of phosphates and nitrates were observed, although some places along the Ganges were affected only marginally. The result, however, was that the clean-up of the river produced multiple benefits to many different stakeholders.

The main benefits from cleaning the Ganges accrued to residents, tourists and pilgrims (at bathing ghats) who visit the river for bathing, including for religious purposes. However, there were other important benefits, arising from wanting to bequeath the biodiversity the river supports to future generations, from reassurance that the Ganges River is kept clean and its aquatic life protected, and from the desire to protect people living along the river from water borne diseases. These benefits of the GAP were estimated through surveys of households. In

[188] The sources for this box are: Markandya, Anil and M.N. Murty. 2000. *Cleaning Up the Ganges: The Cost Benefit Analysis of Ganga Action Plan.* Oxford University Press, New Delhi. Markandya, Anil and M.N. Murty. 2004. "Cost-Benefit Analysis of Cleaning the Ganges: Some Emerging Environment and Development Issues." *Environment and Development Economics* 9:61-81.

addition, improving water quality in the Ganges led to various health benefits to nearby residents using the water, which were estimated by the increased income due to the reduced number of working days lost from illness by river water users. As sewage sludge and waste water from towns and cities along the Ganges are as organic fertilizer and irrigation by small farmers, the increased number of sewage treatment plants built by the GAP allowed farmers to irrigate more hectares and to substitute treated sewage for conventional fertilizers. By estimating the fertilizer cost savings and the increased yields from irrigation, the additional agricultural benefits arising from the GAP could be calculated. Finally, there were substantial social benefits from employing unskilled labor in the GAP projects, due to increased income from employment and from redistribution of income to the unskilled laborers who belong to the lowest income group in the Indian economy.

The following table summarizes the present value estimates of the various benefits and costs of the GAP, along with a sensitivity analysis of the likely income distribution effects. As the CBA indicates, the net present value of the Ganga Action Plan is significantly positive. In addition, because many of the benefits accrue to poor income groups, such as farmers, river water users and unskilled labor, the income distribution effects of the GAP are substantial. When these are taken into account, the net present value and the benefit-cost ratio of cleaning up the Ganges River rise considerably.

Cost-benefit analysis of GAP and income effects, US$ million (1995-96 prices)

		Income distribution effects[b]	
	Present value[a]	**ε = 1.75**	**ε = 1.75**
Benefits from:			
Recreation and amenities	0.83	0.08	0.06
Non-use	195.20	12.49	8.39
Health effects	23.49	72.42	81.64
Agricultural productivity	16.33	48.58	56.76
Employment of unskilled labor	54.53	162.17	189.49
Costs to:			
Industry	42.74	4.10	2.91
Government	129.81	129.81	129.81
Net present value	117.83	161.83	203.62
Benefit-cost ratio	1.68	2.21	2.53

Notes: [a]Estimated over 1985/86 to 1996/97 at 10 per cent discount rate.

[b]The value of ε is the weight attached to the costs and benefits of each stakeholder group relative to the costs and benefits of a group with income equal to the national per capita income.

Box 24. Market-Based Instruments and Market Reforms in Water Sectors[189]

The growing international experience with market-based instruments, market reforms and similar measures in various water sectors suggests that familiarity with these policies is growing. The table below summarizes the measures that have been applied in different water sectors.

Despite their growing prevalence, the use of market-based instruments and market reforms is still relatively limited. One problem, as a study of global water markets found, is that certain conditions must exist for water markets and trading to be effective:

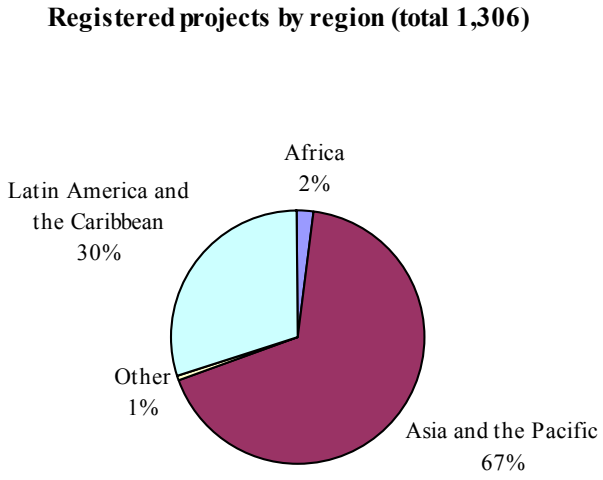
- Water rights or water us rights are well-established, quantified and separate from the land.
- Water rights are registered, and people are well-informed about water trading.
- Organizational or management mechanisms are in place to assure that the traded water reaches the owner or owners.
- The infrastructure for conveying water is flexible enough for water to be rerouted to the new owner.
- Mechanisms are in place to provide 'reasonable' protection against damages caused by a water sale for parties not directly involved in the sale.
- Mechanisms are in place to resolve conflicts over water rights and changes in water use.

Sector or application	Market-based instrument or market reform
Clean water supply	Private sector involvement; private-public partnership; tariffs and taxes; water trading and markets.
Stream-flow modification; excessive surface water withdrawal; excessive groundwater withdrawal; protection of freshwater ecosystems and watersheds	Licensing supply sources and withdrawals; realistic water pricing; reducing or eliminating energy and agricultural subsidies and subsidized credit facilities; water and wetland banking; payment for ecosystem services.
Sanitation and sewage treatment	Private sector involvement; private-public partnership; tariffs and taxes; bond issuance.
Water quality management (nutrient, pesticide, suspended sediments)	Regulations, penalties and taxes for industrial pollution and agricultural run-off; tradable permits; payment for ecosystem services; subsidies for soil conservation and organic farming.
Hazardous chemical management	Regulations and penalties

[189] Easter and Archibald 2002, *op cit.*

Box 25. The Clean Development Mechanism[190]

The Clean Development Mechanism (CDM) is a provision of the Kyoto Protocol, which was designed originally as a bilateral mechanism through which entities in high income economies could gain certified emission reductions (CERs) by investing in clean energy technologies in developing economies. A CER is equal to one metric tonne of CO_2 equivalent. In practice, the CDM has become an international institution through which low and middle income countries can earn income from reducing greenhouse gas (GHG) emissions through earning CER credits. In addition, by effectively setting an international price on carbon, the CDM has facilitated the commercial viability of low-carbon technology transfer, in terms of both equipment and know-how, has reduced some barriers to information and capital flows necessary for investing in clean energy technologies in recipient countries, and finally, has improved the quality of technology transfers to developing economies by providing assistance in project design and collaboration in management.



[190] The sources for this box are: Carmody and Ritchie 2007, *op cit.* CDM Statistics, available at http://cdm.unfccc.int/Statistics/index.html. Collier, Paul, Gordon Conway and Tony Venables. 2008. "Climate change and Africa." *Oxford Review of Economic Policy* 24(2):337-353. Lloyd, Bob and Srikanth Subbarao. 2009. "Development challenges under the Clean Development Mechanism (CDM)-Can renewable energy intitiatives be put in place before peak oil?" *Energy Policy* 37:237-245. Hepburn, Cameron and Nicholas Stern. 2008. "A new global deal on climate change." *Oxford Review of Economic Policy* 24(2):259-279. Leguet, Benoit and Ghada Elebed. 2008. "A Reformed CDM to Increase Supply: Room for action." In Karen Holme Olsen and Jørgen Fenhann, eds. *A Reformed CDM – including new Mechanisms for Sustainable Development.* Capacity Development for CDM (CD4CDM) Project, UNEP Rise Centre, Denmark, pp. 59-72.Schneider, Malte, Andreas Holzer and Volker H. Hoffmann. 2008. "Understanding the CDM's contribution to technology transfer." *Energy Policy* 36:2930-2938. Wheeler, David. 2008. "Global Warming: An Opportunity for Greatness." Ch. 2 in Nancy S. Birdsall, ed. *The White House and the World. A Global Development Agenda for the Next US President.* Center for Global Development, Washington DC.

As of January 2009 there were 1,306 registered projects. Over two thirds were in the Asia and Pacific Region, 30 per cent were in Latin America and the Caribbean and only 2 per cent in Africa. The expected annual average CERs of these projects currently total nearly 244 million, which suggest an equivalent amount of reduction in tonnes of GHG emissions. More than 4,200 projects are currently in the CDM pipeline, and if approved, they are expected to yield 2.9 billion CERs until the end of 2012. Thus, in a very short time, the CDM has mobilized billions of public and private investment to reduce GHG emissions in developing economies.

However, 85 per cent of the CERs from current registered projects are paid to five large emerging market economies: China (132 million CERs), India (32.7 million), Brazil (19.8 million), the Republic of Korea (14.6 million) and Mexico (8 million). 85 per cent of CDM projects are also concentrated in nine countries: India (380 projects), China (356), Brazil (148), Mexico (110), Malaysia (35), Chile (27), Indonesia (21), the Philippines (20) and the Republic of Korea (20). Another 8 developing countries have between 10 and 15 projects. The remaining 36 economies have seven or less CDM projects, with the vast majority having only one or two projects currently.

Although the investments in CDM projects and accumulation of CER credits in large emerging market economies are welcome, particularly as these economies are increasingly important sources of current and future global GHG emissions (see Box 3), the virtual absence of CDM projects in many low-income economies and in Africa is of concern. One problem is that poorer countries lack the investment climate or the basic technological capacity to attract the foreign capital flows and technology transfers required for most projects. In addition, the type of small-scale clean energy projects required by many low-income economies, such as micro hydropower, biomass and solar systems aimed at providing decentralized energy services to poor communities, are not the type of large-volume/low-cost sources of GHG emission reductions that will earn substantial CER credits under the CDM . For example, an analysis of the CDM projects currently in the pipeline by Leguet and Elabed finds that most of the expected CERs issued to 2012 will come from a handful of large-scale initiatives: incineration of hydrofluorocarbons, nitrous oxide and perfluorocarbons (40 per cent of all CERs); grid-connected renewable electricity generation, fuel switching and reducing transmission losses (45 per cent); and capturing fugitive methane emissions, such as pipelines, coal methane and landfill gas (10 per cent). There are a growing number of small-scale wind, solar, hydro and biomass CDM projects, but these are overwhelmingly concentrated in large emerging market economies, such as China, India, Brazil and Malaysia.

Perhaps a greater problem is the investment uncertainty surrounding the CDM beyond 2012. While the general expectation is that a global carbon market will exist in some form after 2012, the lack of international consensus to date on a post-Kyoto climate change agreement means that there is considerable uncertainty over any future carbon market or the CDM. An Asian Development Bank report concludes that such uncertainty forces investors either to discount CERs deliverable after 2012 or not to price them at all. As 2012 approaches, CDM income is increasingly viewed as contingent income. Financial analysis of project cash flows are therefore made without reference to revenues from CERs, and thus the requirement for project entities to prove that the project is "additional" and would not have proceeded without CDM revenues becomes difficult to fulfill. As long as this uncertainty over the post-2012 carbon market and CDM persists, there could be a large decline in the future expected number of projects approved and the CERs earned.

Appendices

Appendix 1: PIIE-WRI Analysis of a Green Recovery Programme for the United States[191]

The Peterson Institute for International Economics and the World Resources Institute provide a modeling framework for assessing the economic and environmental impacts of a green recovery programme for the United States.

The programme represents a set of policy options, combining specific investments, pricing policies, regulations and other measures that could be considered part of a comprehensive US recovery effort. Many of these policies are currently included in the US$827 billion stimulus package proposed by the Obama Administration; others are not.

The twelve specific policies considered in the PIIE-WRI analysis are:

- **Household Weatherization**: Install insulation, new windows, and better light bulbs in residential dwellings.
- **Federal Building Efficiency**: Retrofit federal buildings to reduce overall energy demand.
- **Green Schools**: Provide funding to ensure that new school construction and renovations are highly energy efficient.
- **Production Tax Credit**: Promote the deployment of grid-connected renewable energy through extension of the production tax credit (PTC).
- **Investment Tax Credit**: Bolster incentives for installing distributed renewable generation options in businesses and households through an increase in the investment tax credit (ITC).
- **CCS Demonstration Projects**: Fund carbon capture and storage (CCS) demonstration projects around the country.
- **"Cash for Clunkers"**: Provide a tax credit toward the purchase of a new or used high-efficiency vehicle when an older and less–fuel efficient vehicle is retired.
- **Hybrid Tax Credit**: Provide a tax credit toward the purchase of a new hybrid vehicle.
- **Mass Transit Investment**: Fund "shovel ready" mass transit projects.
- **Battery R&D**: Fund strategic investment in the research, development, and deployment of advanced battery systems aimed at reducing lithium battery cost and weight.
- **Smart metering**: Provide matching funds to upgrade electricity metering, enabling users to better control energy costs and allowing utilities to more effectively manage demand.
- **Transmission**: Construct high-voltage transmission lines to allow for greater renewable energy penetration.

[191] This appendix is based on Houser, Trevor, Shashank Mohan and Robert Heilmayr. 2009. *A Green Global Recovery? Assessing US Economic Stimulus and the Prospects for International Coordination.* Policy Brief Number PB09-3. Peterson Institute for International Economics and World Resources Institute, Washington, DC, February. I would like to thank the authors, Manish Bapna, Ed Tureen, the Peterson Institute and World Resources Institute for allowing me to use the results of this study and copyrighted material in this appendix and report.

To assess the energy and environmental impact of the green recovery programme, the authors of the study employed the Energy Information Administration's (EIA) National Energy Modeling System (NEMS), which is used to create the Department of Energy's official Annual Energy Outlook (AEO). Estimates of the employment impact of each programme were made using the input-output tables from the Department of Commerce's Bureau of Economic Analysis (BEA). This allowed assessment of the direct employment effects (jobs created in the sector receiving stimulus spending), indirect employment effects (jobs created in industries supplying the sector), and induced employment effects (jobs created when new direct and indirect hires spend their wages). The authors were also able to evaluate the employment impact of energy cost savings to households, firms, and the federal government, as well as the corresponding reduction in revenue to the energy industry, resulting from each scenario.

The PIIE-WRI study was able to estimate and compare how the twelve policies vary in terms of job creation, energy savings, emissions cuts, and energy import reductions per billion dollars of government spending. For programmes where government dollars are matched by private dollars (such as tax credits, demonstration projects, or some infrastructure investment), the analysis also estimates the ratio of public to private spending.

The overall findings of the analysis were that the decreased cost and consumption of energy from the entire programme have the potential to save the US economy an average of US$450 million per year for every US$1 billion invested. In addition, every $1 billion in government spending would lead to approximately 30,000 job-years and reduce annual US greenhouse gas (GHG) emissions by 592,600 tons between 2012 and 2020.[192] Employment effects are measured in job-years, or the number of full-time equivalent jobs lasting one year. The employment gains represent a 20 percent increase in jobs creation over more traditional infrastructure spending.

The relatively high employment effects of the green recovery package relative to conventional infrastructure investments are related to two factors. First, the green programmes are expected to stimulate additional private sector investment, thus multiplying direct, indirect and induced job creation. Second, the PIIE-WRI study finds that the net employment effects of reducing energy costs to the economy as a whole are significant. Energy efficiency improvements and green tax credits have employment effects that continue well beyond the initial investment period (see Figure 1). In contrast, the jobs created by conventional tax cuts and road infrastructure investments end once the money is spent.

Figures 1 to 3 compare the economic and environmental impacts of the various policies analyzed in the PIIE-WRI study.

Figure 1 shows the total employment effects in terms of job-years created through US$1 billion in government investment, and depicts the relative size of public to private investment. In addition, the figure indicates the net change in employment resulting from energy savings and the change in energy mix in the economy following the initial investment. The effects of the green recovery policies are compared to conventional spending on road building and tax cuts. Almost all the green measures have a more lasting employment effect compared to the latter conventional policies.

In Figure 2 the horizontal axis depicts reduction in average annual energy expenditures between 2012 and 2020 for the US economy, measured in 2007 US$ million. In Figure 3, the horizontal

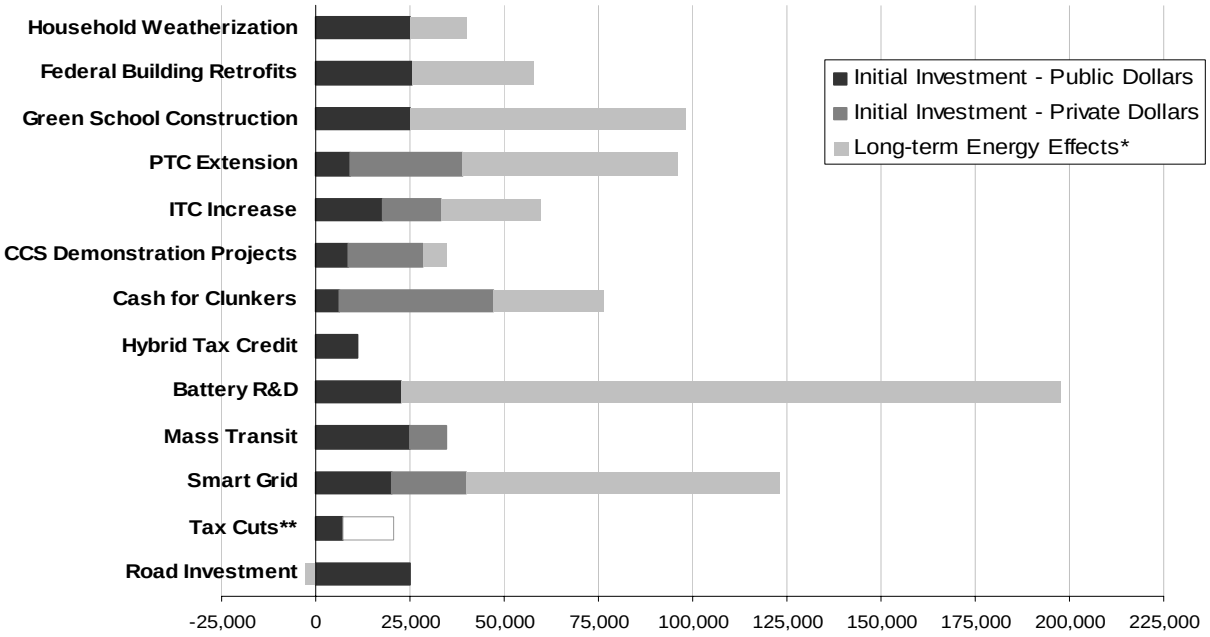
[192] The employment and GHG emission impacts exclude the effects of the transmission policy. See Houser et al. 2009, *op cit.* for further details.

axis shows the reduction in net imports of oil (in thousand barrels per year). In both figures, the vertical axis indicates the reduction in average annual GHG emissions (in thousand tonnes) over the same period. The size of the bubble shows the number of direct, indirect and induced jobs created in the year that the investments are made.

The timing for implementing these different green policies is likely to vary considerably. The building efficiency programmes (e.g., household weatherization, retrofitting federal building and greening schools) could be implemented swiftly, and provide immediate stimulus to the construction industry. Smart meter deployment and "shovel ready" mass transit investments could also be initiated fairly rapidly. The Cash for Clunkers and hybrid tax credit programmes could also be adopted quickly, but it may take longer for consumers to respond to these incentives. The remaining programmes are likely to require a longer lead time before implementation.

Figure 1: Total Employment Effects

Job-years created through $1 billion in government investment



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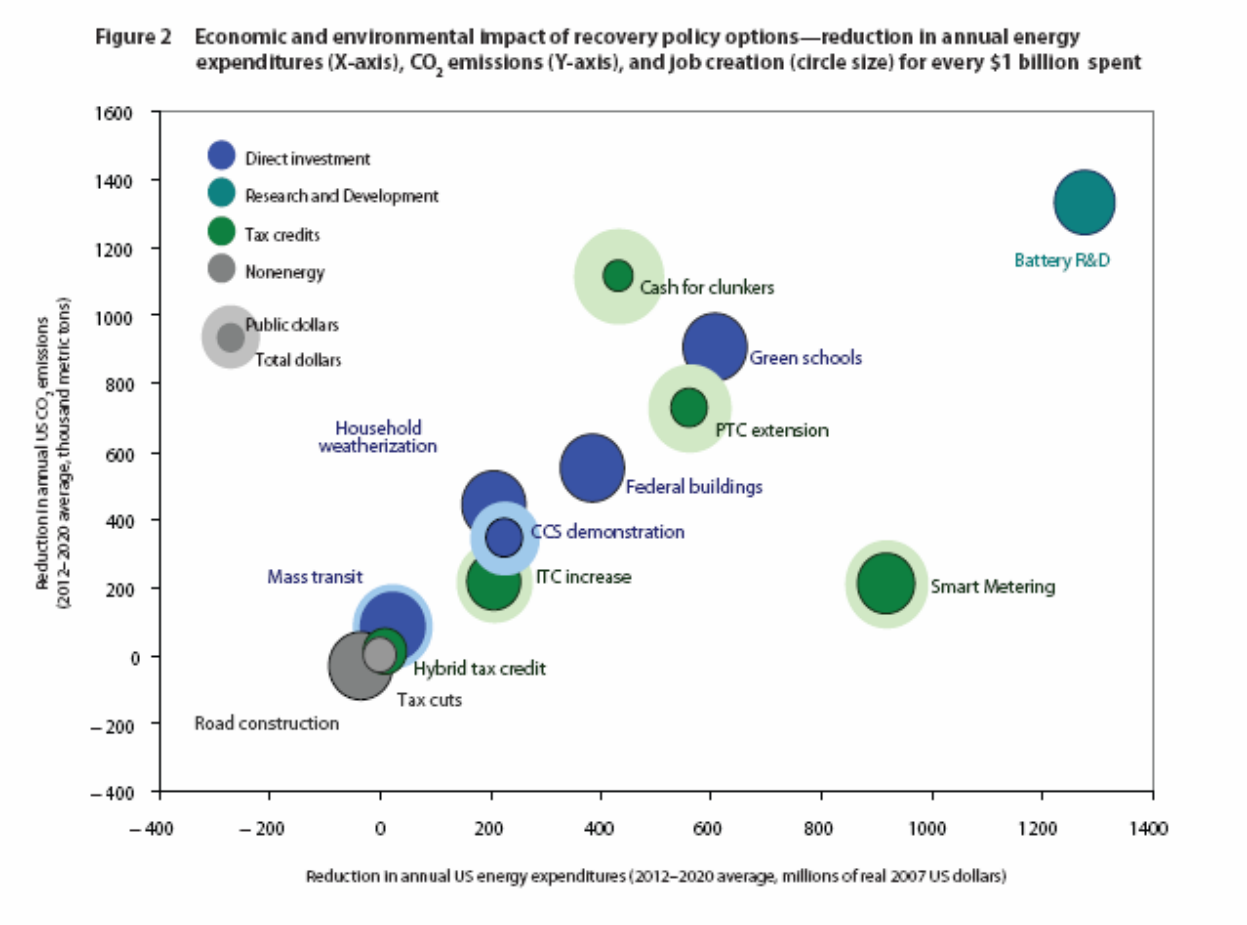
Notes: * Long-term energy effects measures the net change in employment (measured in job-years) resulting from energy savings and change in energy mix for the decade following the initial investment.
** For tax cuts, the lighter field indicates the employment effects of the share of the initial tax cut or rebate saved until future years.

Source: Houser, Trevor, Shashank Mohan and Robert Heilmayr. 2009. *A Green Global Recovery? Assessing US Economic Stimulus and the Prospects for International Coordination.* Policy Brief Number PB09-3. Peterson Institute for International Economics and World Resources Institute, Washington, DC, February.



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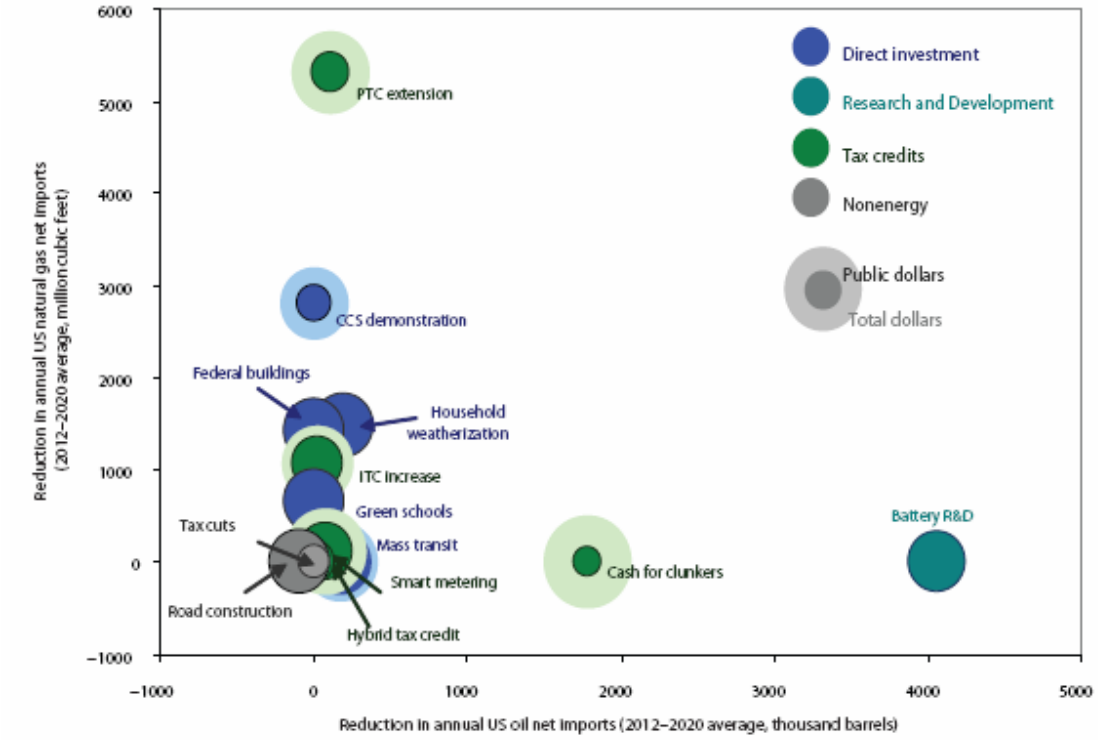
Source: Houser et al. 2009, *op cit.*

Figure 3 Economic and energy security impact of recovery policy options—reduction in annual oil imports (X-axis), natural gas imports (Y-axis), and job creation (circle size) for every $1 billion spent



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Source: Houser et al. 2009, *op cit.*

Appendix 2: Millennium Institute T21 Model Scenarios for China[193]

The Millennium Institute (MI) has developed the Threshold 21 (T21) national model to support comprehensive integrated planning and to test policy, monitoring, and evaluating results. This appendix describes policy simulation results for the impacts of energy efficiency and clean technology investments for the cement and iron and steel sectors of China. The T21 model of China is based on system dynamics and incorporates the economic, social, and environmental pillars into a holistic framework that encompasses their reliance on energy interdependence. Details of the model and the policy scenarios for the China simulations are available from MI.

The details of the cement and iron and steel sectors are based on direct research in China and consultation with experts there.[194] They include the different types of technology being used, their demands for energy and other inputs, creation of jobs and GDP, GHG emissions of each technology, and production and use of the outputs. Both sectors have experienced rapid growth over the past couple of decades, with larger plants being built with new technologies which are more efficient and profitable. In cement, newer and more efficient rotary kilns are being put in place, and older and smaller vertical (much less efficient) are being retired where possible. In iron and steel, the efficiency gains are primarily from applying better technologies in the larger new and existing plants and trying to retire more of the older smaller ones. As more recyclable steel becomes available, from the growing base of steel, additional gains in reducing GHG emissions can be achieved by shifting to electric arc furnaces. However, the amount of recyclable steel available depends of the scraping of old steel products, not technological changes. Both sectors are highly dependent on energy, much of which is from coal (directly or indirectly). There is potential to shift to more recycled inputs, but major shifts will require significant new technological innovations. The analysis also considers the uses of these products. 50 per cent of cement production goes into residential housing, 10 per cent into commercial building, and 20 per cent into infrastructure. 45 per cent of steel production goes into building, 10 per cent into infrastructure and part of the rest into motorized vehicles and housing appliances.

At this stage, the analysis with the model focuses on how best to reduce GHG emissions from cement and iron and steel production. Scenarios run with the T21 model include policies on the supply side to:

- Increase investments in new plants using cleaner technologies.
- Improvements in the energy efficiency of existing plants.
- Reduce the GHG emission content of inputs by using less clinker for cement or more recycled steel.

Scenarios on the on the demand side include:

- Reduce the growth rate in the size of residences (the primary consumer of both products).
- Reduce the amount of cement and steel used in construction through design improvements.

[193] This appendix was written with the assistance of Andrea Bassi, Weishuang Qu and John Shilling of the Millennium Institute. Andrea Bassi and Weishuang Qu ran the T21 model policy simulations, and John Shilling provided the write up of the scenario results that are included in this appendix. I am grateful to them for their input. For more information on the Millennium Institute and the T21 integrated planning model, see http://www.millenniuminstitute.net/.

[194] Dr. Kejun Jiang and Prof. Yuansheng Cui

- Increase the quality and lifespan of buildings.
- Reduce the cement and steel use per unit of public expenditures on infrastructure.

The effects of these programmes are similar in both industries due to the similarity in their overall structures and the common source of much of the demand.

Increased investment at feasible levels has only a modest effect due to the huge size of the existing capital stock in these industries. Additional investments of a few US$ billion would make only a small difference in the efficiency of total capacity, but they could set examples for other plants to copy to speed up the rate by which the new technologies are introduced, which would result in greater efficiency improvements. This supports efforts to increase efficiency in existing plants and speed up the closing of the older, smaller, and less efficient plants. However, there is often strong local support for these plants as they contribute to local economies and employment. These activities would need to be accompanied by programmes to create new jobs in other sectors.

The impacts of improving efficiency on CO_2 emissions in existing plants is shown in Graph 1, where the improvements in efficiency are increased from the trend of 1.5 per cent per year to 2.5 per cent per year in cement and from 2 per cent per year to 3 per cent per year in iron and steel.[195] There are improvements in energy efficiency, and GHG emissions decline by 130 million tonnes per year in cement and 200 million tonnes per year in iron and steel by 2030 compared to the base case. However, the demand for these products for construction grows as more people need housing, as rising incomes lead to demands for larger residential units, as more offices and factories need to be built, and as more infrastructure is built. Thus improvements in efficiency of over 50 per cent between 2008 and 2030 will reduce the growth of GHG emissions, but they will continue to grow in cement from 1.12 billion tons in 2008 to 1.67 in 2030. In steel, emissions will rise from 980 million tonnes in 2008 to a peak of 1.1 billion tonnes in 2015, and then decline to 980 million tonnes in 2030 due to the faster growth in efficiency and lower share of steel in construction. There are limits to how much reduction in GHG emission growth can occur on the supply side based on existing technology and known improvements being developed. The improvements in efficiency will only modestly reduce employment in these sectors as the newer technologies require less labor, but there may be gains in sectors producing the new technologies for these sectors.

In view of the limits on the supply side, the MI decided to look at the potential gains that could occur if there were also changes in the demand side. The scenarios looked at changing demand in residential construction, since that is where the much of production of both sectors goes. Reviewing recent developments, the average size of residential housing has doubled to about 30 square meters per capita since 1990. The base cases assume that this growth in size continues and rises to 60 square meters per capita in 2030. By assuming policies are instituted which restrict growth so it only rises to 40 square meters per capita in 2030, the GHG emissions growth rate essentially stopped, and the level of emissions in the cement and iron and steel sectors declines for a while and then rises back to the 2008 level after 2020 and remains constant, as shown in Graph 1. Graph 2 shows how the production is reduced. By combining the restrictions on growth in housing size and the further improvements in efficiency, the overall rate of GHG emissions in these two sectors is actually reduced from 2.09 billion tonnes in 2008 to 1.87 billion tonnes in 2030, even with more residences and somewhat larger housing size. The model also

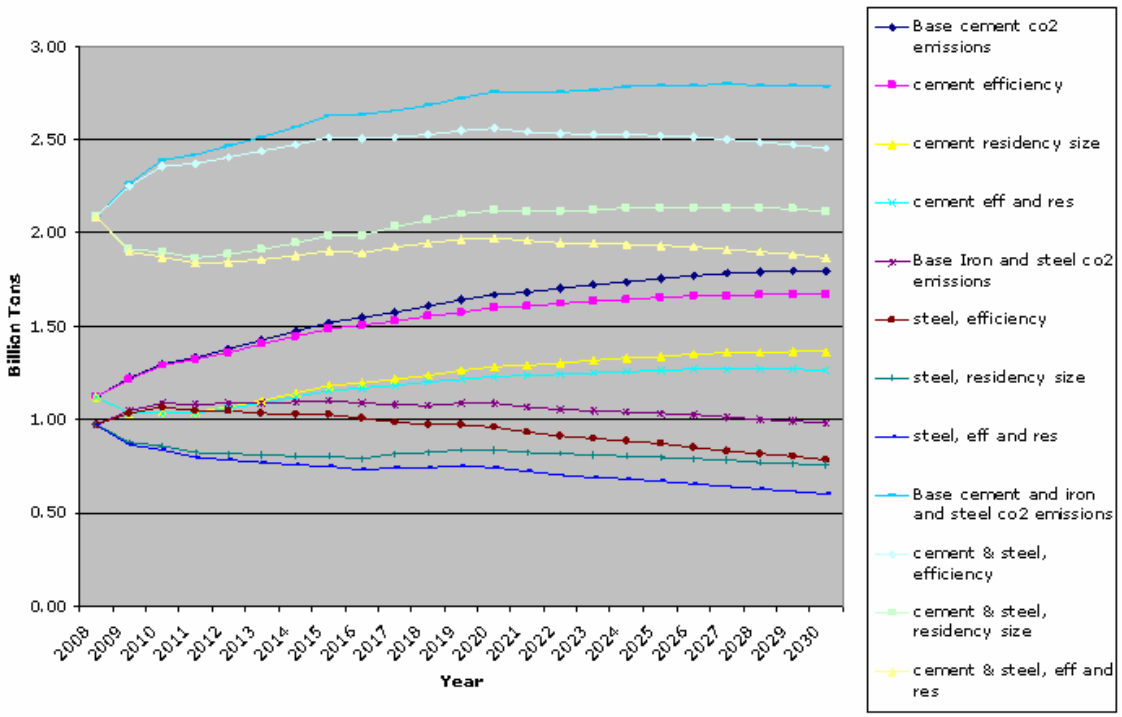
[195] Had the trend improvements in efficiency not been maintained, the emissions would have increased significantly faster.

examines further possible reductions in demand be increasing the quality and life span of houses and reducing expenditure on infrastructure, which will reduce direct demand for these products and may reduce the demand for cars, which uses steel as well. This shift in demand reflects in a sense the model for development the Chinese chose to follow. The Japanese have smaller and more energy efficient homes, while the USA has larger, less energy efficient ones. If China chooses to adapt the Japanese model, then it can slow the growth in demand for cement and steel in its housing, and reduce GHG emissions. But if it adopts the USA model, emissions will go up sharply.

Looking at these sectors alone, these policies will reduce demand for their products, which will lead to somewhat lower output and employment levels for these sectors than in the base case. However, since these are capital-intensive industries, the effects on employment are relatively small. The potentially similar negative effects in the construction sectors are likely to be less, especially if higher quality buildings are required, as that will require relatively more labor per square meter built. But as residential sizes are smaller, they will be less expensive, so consumers will have more money available to buy other goods. The result is likely to be an increase demand for other products, which will increase overall GDP growth, per capita incomes, and employment. There may also be some effects on transportation and car demand if infrastructure changes in ways what encourage more mass transit.

The results for China's cement and iron and steel sectors also demonstrate the extent to which investment in improved technology can reduce the growth of GHG emissions. The scenarios also reveal the scale factor of growing demand as the overall economy and population expand. The outcomes imply an overall increase in GHG emissions through 2030 as the demand for these products for construction grows rapidly. It becomes clear that changes in demand as well as production processes are needed to actually reduce GHG emissions, at least until new technologies are developed to generate the energy required in these sectors while producing significantly less emissions.

Graph 1: Cement, Iron and Steel, and Total CO2 Emissions



Graph 2: Cement and Iron and Steel Production