VOLUME 3

Toward a Transatlantic Green New Deal:

Tackling the Climate and Economic Crises

Prepared by **the Worldwatch Institute** for the **Heinrich Böll Foundation**

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Introduction: Environment and Economy at a Critical Juncture

The grave financial and economic crisis that broke into full view in the fall of 2008 has dominated not only headlines but also government and business deliberations. Bailout efforts and stimulus packages of unprecedented scope have taken center stage, as attempts to stave off the specter of a second Great Depression unfold. In sharp contrast with the laissez-faire attitude of the past three decades, the question now is not whether government can play a useful and central role, but what the specifics of government action should be.[1]

As governments struggle to address the economic crisis, climate change presents another grave threat. The findings of the Intergovernmental Panel on Climate Change (IPCC) make it increasingly clear that urgent action is needed to dramatically reduce global carbon emissions in the coming decades. Negotiations are currently underway on a successor agreement to the 1992 Kyoto Protocol, and are expected to culminate in December at the United Nations Climate Change Conference in Copenhagen. Failure to act threatens serious and irreversible damage to the world's ecosystems, risks sea level rise and natural disasters of increasing frequency and magnitude, and is likely to have devastating impacts on food production, on economic well-being, and even on habitability in some parts of the world.

In some government and business circles at least, climate action is still too often seen as a recipe for economic damage. There is therefore a danger that some governments may decide to postpone serious action on climate until the economic crisis is resolved – even though fears of environmental action as a job killer are over-blown and climate inaction may ultimately cause large-scale job loss. According to the landmark 2006 Stern Review, failing to take action on climate change will lead to future annual economic losses of 5-20 percent of global GDP, while the annual costs of reducing greenhouse gas emissions to manageable levels would be around 1 percent of global GDP.[2]

There is growing recognition of the imperative to address the economic and environmental crises together rather than separately. This means that the solution to current economic problems lies not in pushing "shovel-ready" programs like more road building or in simply restarting the engine of consumption, but rather in laying the foundations for a fundamental green transformation.

Support is growing around the world for an integrated response to the current economic and environmental crises, increasingly referred to as the "Green New Deal." The term is a modern-day variation of the U.S. New Deal, an ambitious effort launched by President Franklin Roosevelt to lift the United States out of the Great Depression. The New Deal of that era entailed a strong government role in economic planning and a series of stimulus packages launched between 1933 and 1938 that created jobs through ambitious governmental programs, including the construction of roads, trails, dams, and schools.[3] Today's Green New Deal proposals are also premised on the importance of decisive governmental action, but incorporate policies to respond to pressing environmental challenges through a new paradigm of sustainable economic progress.

As the economic crisis began to hit in 2008, several organizations argued for policies that would promote Green New Deals. In the United Kingdom, for instance, the Green New Deal Group published a pioneering report on the topic.[4] In the United States, groups like Green for All, the Center for American Progress, and

others have actively promoted similar initiatives.[5] Encouragingly, several governments have picked up on these ideas through recently passed stimulus packages, though just one – South Korea – has pledged to spend the bulk of its funds on environmental measures.

The United Nations Environment Programme (UNEP) has become a prominent advocate for internationalizing the concept through a Global Green New Deal.[6] UNEP has also joined forces with the UN's International Labour Organization (ILO), the International Organisation of Employers (IOE), and the International Trade Union Confederation (ITUC) on the Green Jobs Initiative that promotes the creation of green and decent jobs to respond to the threat of climate change and other global environmental challenges.[7] The ILO reports that worldwide unemployment increased by about 10 million, to 190 million, during 2008. 2009 might witness a further rise to 198 million even under the best circumstances, and possibly as high as 209-230 million under less favorable scenarios.[8] Countering this trend – and specifically, creating millions of sustainable jobs – is thus an essential aspect of a Green New Deal.

Coherent transatlantic cooperation is a key requirement for striking a Global Green New Deal. North America and the countries of the European Union (EU) account for a large share of the world economy and overall world trade. The United States, Canada, and the four largest European economies (Germany, France, the United Kingdom and Italy) generated 45 percent of the world's GDP in 2008. In 2005, they accounted for 32 percent of energy consumption and 29 percent of greenhouse gas emissions. (This share would be even higher if embedded emissions in imported products were taken into account.)[9]

These regions also represent the preponderant share of environmental technology development and export. Measured as a share of world market sales of efficient technologies and products, Europe accounts for 71 percent of industrial processes, 66 percent of water-use efficiency technologies, 55 percent of electrical appliances, 53 percent of building technologies, 51 percent of propulsion technologies and emission controls, 50 percent of materials efficiency, and 42 percent of vehicle technology and design. The U.S. share of the world market is in the 8-12 percent range in most of these fields, except for emission controls, where it commands 19 percent.[10] European countries have also taken a leadership role in developing renewable sources of energy. The EU has passed a series of directives and regulations to mandate and promote energy efficiency, and has pioneered a carbon cap-and-trade system that – despite acknowledged shortcomings – offers important lessons for the United States.

With the election of Barack Obama as U.S. President, the stage is set for healing the transatlantic rift over climate policy and multilateralism that had poisoned relations during the Bush Administration. The serious challenges that lie ahead are being approached with a spirit of cooperation and in a more forthright manner, opening up opportunities for productive climate diplomacy. But this does not necessarily mean that the road to Copenhagen and beyond will be smooth. There is continued political resistance in the U.S. Congress and among some industry leaders to pursuing vigorous climate measures in times of heavy economic turbulence and the declining international competitiveness of U.S. industries. There are also indications that some EU leaders may prefer to backpedal on climate commitments in light of the economic crisis.[11]

Still, the current confluence of crisis and political change offers what may be an once-in-a-lifetime opportunity for thinking creatively and presenting bold, transformative ideas. The imagery of a Green New Deal is important in that it suggests an ambitious approach predicated on the need for strong government action and a decisive break with old policies. Updating the New Deal concept for the modern era requires not only incorporating environmental imperatives, but also ensuring that global concerns and international cooperation form a core part of the vision.

A Green Stimulus?

An array of stimulus measures (public spending programs, incentives, tax credits, as well as tax cuts) have been passed by governments around the world in recent months, injecting huge sums of money into their economies to counter the credit crunch and associated weak demand.

Conventional efforts to reinvigorate the economy entail the risk of a carbon-intensive recovery that will cement the technologies and structures that have led the world to the abyss of climate catastrophe. It is critical that a sufficiently large portion of the stimulus be green so that it can complement existing energy and climate policies, accelerate structural change toward sustainable development, and spawn large numbers of green jobs. Beyond fiscal measures, a redesign of the regulatory framework is necessary on the national and international levels to govern markets. Among the core elements of such an approach are a comprehensive cap-and-trade system for CO_2 emissions as well as a reform of tax systems that shifts taxation from human labor to the consumption of natural resources.

Table 1. Green Dimensions of Worldwide Stimulus Funds of Late 2008 / Early 2009

	Total	Green Funds		RE	CCS	Bldg	Veh	Rail	Grid	W/W
	€ Billion	€ Billion	%				€ Billion			
EU	30.0	17.6	58.7	0.5	9.7	2.2	1.5	--	3.8	--
Germany	81.0	10.7	13.2	--	--	8.0	0.5	2.2	--	--
France	26.0	5.5	21.2	0.7	--	0.6	--	1.0	3.2	--
UK	23.5	1.6	6.9	--	--	0.2	1.1	0.3	--	0.02
Italy	80.0	1.0	1.3	--	--	--	--	1.0	--	--
Spain	11.0	0.6	5.8	--	--	--	--	--	--	0.6
Other EU States	238.5	4.8	2.0	1.5	--	0.3	3.0	--	--	--
Total, Europe	490.1	41.9	8.5	2.7	9.7	11.4	6.1	4.5	7.0	0.7
United States	751.2	86.8	11.6	25.3	5.1	23.5	3.7	7.7	9.2	12.0
Total, Americas[a]	778.8	88.8	11.4	25.3	5.9	24.0	3.7	8.0	9.8	12.1
China	452.9	171.0	37.8	--	--	--	1.2	76.2	54.1	39.5
India	10.6	--	--	--	--	--	--	--	--	--
Japan	375.5	9.6	2.6	--	--	9.6	--	--	--	--
South Korea	29.4	23.7	80.5	1.4	--	4.8	1.4	5.4	--	10.7
Total, Asia Pacific[b]	891.7	206.3	23.1	1.4	--	16.3	2.6	81.7	54.1	50.2
World	**2,160.6**	**336.9**	**15.6**	**29.4**	**15.5**	**51.6**	**12.3**	**94.1**	**70.9**	**63.1**

Key: RE = Renewable Energy; CCS = Carbon Capture and Storage and other low-carbon technologies; Bldg = Building Energy Efficiency; Veh = Low-Carbon Vehicles; W/W = Water and Waste Management.
a) Also includes Canada and Chile. b) Also includes Australia and Thailand.
Sums may not add up due to rounding.
Source: See note 12.

According to an HSBC Global Research analysis of almost €2.2 trillion worth of global stimulus packages worldwide, around 16 percent – close to €340 billion – can be labeled[12] green spending as they appear to support climate policy objectives.[13] (*See Table 1.*) (An additional €261 billion worth of stimulus plans are not included in the HSBC analysis.)[14] Thus, the bulk of stimulus spending appears to be dedicated to programs that, at a minimum, fail to advance a green transformation or, at worst, actively run counter to it. For instance, some €210 billion in worldwide stimulus funds is being allocated to road building.[15]

An analysis by London-based not-for-profit E3G argues: "Unless a much higher proportion of the fiscal stimulus is directed to clean investment there will be no chance of keeping global temperatures below 2°C." Based on studies by the McKinsey Institute and the International Energy Agency, E3G argues that total low-carbon investment during the stimulus period (i.e., until 2010) would need to run to about €1,300 billon in order to move the economy onto a climate-compatible trajectory.[16] It also appears that policymakers in many countries are missing an opportunity to champion conservation of water, energy, ecosystems, species, and other natural resources, critical elements for the creation of sustainable economies.

The largest stimulus funds – both overall and among those categorized as green – are being made available in Asia. China, Japan, India and South Korea together are mobilizing close to €900 billion in stimulus funds, compared with around €780 billion in the Americas and €490 billion in Europe. Asian green funds may run to more than €200 billion, far outpacing their American and European counterparts at €89 billion and €42 billion respectively. South Korea stands out in that 80 percent of its spending is to go to green programs – a far higher proportion than is planned anywhere else.[17]

European stimulus packages provide a boost to enhancing energy efficiency, promoting carbon capture and storage, strengthening electrical grids, and developing low-carbon vehicles (the latter including money for new technologies and incentives to scrap and replace old, polluting cars). Much less is earmarked for rail systems or renewable energy (the latter is already being promoted in other ways). However, with less than 9 percent of overall European funds devoted to green programs, the stimulus is arguably not nearly green enough.[18] Furthermore, the European average hides wide divergences in the degree to which national stimulus packages include green investments.[19]

The European Commission has also independently announced some €105 billion in Cohesion Funds to be spent in 2007-2013 to create "green jobs and growth" – a substantial portion of which will go to Eastern Europe. Close to half the total – some €48 billion – is aimed at achieving climate objectives: €23 billion for railways, €6 billion for public transport, €4.8 billion for renewable energy and €4.2 billion for energy efficiency.[20]

In the United States, Congress approved $185 billion (€143 billion) in stimulus funds through the Emergency Economic Stabilization Act (EESA) in October 2008, and an additional $787 billion (€608 billion) through the American Recovery and Reinvestment Act (ARRA) in February 2009. About 12 percent of the combined funds can be considered green. ARRA supports endeavors including grid modernization, building retrofits to increase energy efficiency, rail and other public transportation, renewable energy and battery systems.[21] (*See Table 2.*) It is worthy of note, however, that the originally-proposed package was cut by $57 billion (€44 billion) worth of funds for building efficiency and rail infrastructure – both areas in which the United States has significant weaknesses.[22]

Table 2. Selected Green Provisions of the American Recovery and Reinvestment Act

$ Billion	Green Provision
11.0	Modernization of the electrical grid and creation of a smart grid
9.5	Energy efficiency retrofits ($4.5 billion for federal buildings and $5 billion for low-income housing weatherization assistance)
9.3	Investments in rail transportation, including Amtrak, high speed and intercity rail
8.4	Investments in public transportation
6.3	Energy Efficiency and Conservation Block Grants to state and local governments
6.0	Loan guarantees for renewables and for electricity transmission projects
2.5	Energy efficiency and renewable energy research
2.0	Grants for advanced batteries systems
0.5	Prepare workers for careers in energy efficiency and renewable energy fields

Source: See note 20.

A September 2008 publication by the Center for American Progress found that spending $100 billion (€77 billion) over a 2-year period on building retrofits, mass transit and rail, a smart grid, and renewable energy could yield a total of 2 million jobs – 935,000 direct jobs, 586,000 in supplier industries, and 496,000 jobs created by the day-to-day spending of those filling these new jobs. This gives a rough order-of-magnitude indication of what ARRA's green funds could accomplish.[23]

The various national stimulus plans all have their own focuses and priorities. If things go badly, they might be little more than part of a competitive frenzy of "domestic-first" measures. But at their best, they can contribute to the emergence of a cooperative crisis management, allowing national efforts to complement and reinforce each other and facilitate the creation of mechanisms and institutions for a Global Green New Deal. A variety of bodies can play an important role, including broadly-inclusive agencies like UNEP or the ILO, more narrowly-drawn "clubs" like the G-20, organizations with a highly specific mandate like the newly created International Renewable Energy Agency (IRENA), and yet-to-be-created mechanisms that facilitate the expedited sharing of best practices and promising green technologies through collaborative centers. Similar to IRENA, one might envision the creation of an agency dedicated to the promotion of energy efficiency,[24] while a new "European Community for Renewable Energies" (ERENE) as proposed by the Heinrich Böll Foundation would reach beyond the EU's January 2008 Renewable Energy Directive to combine the use of the continent's renewable resources with a transnational grid for a European internal market for green electricity.[25] A key overall objective is, in the words of the Foundation's Co-President Ralf Fücks, the need to "enhance political cooperation so that it reaches the same level as that of economic interaction."[26]

Key Economic Sectors

Four sectors – energy, transportation, buildings and basic materials such as steel, aluminum, cement, and paper – are key to modern economies. If energy is the heartbeat of human society, then transportation services (for both people and goods) are its pulse, basic materials its lifeblood, and buildings its backbone. These sectors are particularly critical in terms of their energy use and carbon emissions. Their environmental footprint radiates far beyond their confines to other sectors, determining the degree to which the overall economy is sustainable.

Energy. Hardly any modern human activity can take place without energy inputs. The nature of these inputs has, however, dramatically changed during the past century. We now once more see the beginnings of a fundamental reorientation, away from the polluting fossil fuels that destabilize the climate and toward renewable sources of energy.

Transportation. A major contributor to greenhouse gases and the cause of manifold other environmental problems. Worldwide, the transport sector was responsible for 23 percent of energy-related greenhouse gas emissions in 2004, and its emissions are among the fastest-growing of any part of the economy.[27] But transportation is also a cornerstone of modern economies and a major employer. Major change is needed to make vehicles more fuel-efficient and bring about a system that is less automobile-centered.

Buildings. Globally, buildings are responsible for 30-40 percent of primary energy use and greenhouse gas emissions.[28] But buildings also have the largest potential of any sector for reducing greenhouse gases.[29] Energy efficiency in this sector has therefore emerged as a critical area for climate change mitigation.

Basic Materials. The most energy-intensive sectors of the economy – steel, aluminum, cement, and paper – face a monumental task in reducing their environmental footprints. The steel industry is emblematic in that it consumes large volumes of coal and emits significant amounts of carbon. On average, the production of one ton of primary steel results in emissions of about two tons of CO_2. Steelmaking accounts for 5-6 percent of anthropogenic CO_2 emissions, and 27 percent of the total emissions of the world's manufacturing sector.[30]

This paper assesses opportunities for far-reaching technological change, public infrastructure development and employment generation with an eye toward these strategic sectors.

Core Elements of a Global Green New Deal

Addressing the climate crisis and an array of other environmental challenges will affect virtually every aspect of the modern economy. There are, however, a number of core areas that are of particular strategic importance and will facilitate broader progress. Greening infrastructure, especially for transportation and electricity transmission, is one high priority. Another is rapid technological change. Incremental change may help reduce carbon emissions and other environmental impacts, but is likely to be insufficient in the face of urgent and systemic problems. There is thus a need for ground-breaking change – leapfrogging to fundamentally new technologies and methods. Computerization and the digital era have made businesses more productive and permitted the emergence of far-flung, tightly-integrated global operations, but there is a need to put digital technologies far more at the service of environmental goals. A key driver of these types of changes will be a price system that reflects environmental costs instead of externalizing them.

A Green New Deal, however, cannot simply focus on new technologies or accounting systems. It also needs to directly improve the welfare of people, in part by generating "green jobs" that contribute to a more sustainable economy and offer decent employment. More broadly put, the education system plays a critical role in social and environmental progress by empowering people to unfold their talents and to acquire the skills needed in modern, knowledge-based societies. In particular, greening the economy will require large-scale research, education and professional training to provide scientific knowledge and to build a properly skilled workforce.

1. Building a Green Public Infrastructure

Several key infrastructural dimensions underpin a sustainable economy. Among them are a reinvigorated smart grid that is fully capable of integrating renewably-produced electricity; a reliable network for future fleets of plug-in vehicles; a modernized public transportation system; and a functioning system for recovering and handling scrap materials needed to boost energy-efficient secondary production of steel, aluminum and paper.

The demands placed on the electricity system are expanding rapidly and will continue to do so in the years to come. The IT revolution has already led to growing data transmission and storage needs. Electric power for data centers and computer servers to store, manage, and disseminate electronic information accounts for 1.5 percent of all U.S. electricity demand. This is expected to double to 100 billion kilowatt-hours (kWh) by 2012.[31] The impending transformation of the automobile industry toward the production of electric vehicles will further boost demand.

a. The Promise of a Smart Grid

These developments make it essential that grid transmission losses be minimized, energy efficiency improved, and grid infrastructure be adaptable to evolving needs. Yet in the United States, the existing electricity transmission and distribution system is outdated, designed piecemeal, and facing increasing overload.[32] Investments in grid renewal and transformation are critical.

A smart grid consists of state-of-the-art high-capacity transmission lines, smart meters, automated controls, digital sensors, and other technologies[33] that facilitate smarter

human choices regarding energy use, and that represent "an unstoppable paradigm shift in the way that utilities do business…"[34] in the words of a report by management consultants Booz & Company.

A smart grid can better balance supply and demand – smoothing out demand peaks and shifting loads to low-demand periods – and reduce line losses through the use of more local, distributed electricity generation. A smart grid would be better able to handle fluctuations in power generated from renewables (due to uneven wind strength or sunshine). It would also be what proponents call "self-healing": sensors and other communications would analyze faults in the system and trigger corrective actions. Finally, it would allow households and businesses to sell excess power (from home solar panels, electric vehicles, or Combined Heat and Power systems, for example) back to the grid.[35] Pilot projects indicate that energy management systems associated with smart grids can reduce electricity use by 10-15 percent, and up to 43 percent of peak loads.[36]

Full development of smart grids may take one to three decades, depending on the policies enacted in different countries and communities. But a number of them are well on their way.[37] Boulder, Colorado, will be the first city to have a smart grid in place,[38] while in California, Pacific Gas and Electric is planning to install 10 million smart meters by 2011, paid for by rate increases.[39]

In Europe, investments of up to €200 billion in transmission and distribution networks are being planned by 2020 – some €90 billion of which directly relates to smart grid technology.[40] This includes projects by companies like Iberdrola, EDP, ZigBee, Pepco, Gazprom, Siemens and eMeter; Ireland's announcement that it will invest almost two thirds of it's €12 billion budget for renewable energy and cleantech projects in smart meters and smart networks; and the Netherlands' goal of a "base level" of smart metering and replacement of all 7 million household meters by the fall of 2012.[41]

There is currently a patchwork of national directives and utility initiatives. A 2008 Booz & Company report laments that "the current technological landscape in Europe is a chaotic kaleidoscope of new equipment – smart meters with various degrees of built-in intelligence, for example, in varying states of deployment, under wildly different forms of regulation, and often following needlessly competing or proprietary standards of use." [42]

While individual initiatives are crucial to build momentum and demonstrate the benefits of a smart grid, it is critical that an overall vision and regulatory standards be established either at the national level (in the United States) or at the continental level (in Europe) so as to ensure that different parts and technologies are compatible and can be integrated with each other. In 2005, the European Technology Platform SmartGrids was set up, bringing together key stakeholders to develop a shared vision, align various projects, and draw up a strategic agenda on the national and European levels.[43]

b. Greener Transportation

Smart grids will also be part of an emerging new transportation system as electric vehicles become more commonplace. This new infrastructure entails the development of both charging stations and of the nickel metal hydride and lithium-ion batteries that are needed for electric models as well as for gasoline-electric hybrids. While companies in this emerging field include several on both sides of the Atlantic, most batteries used for hybrids today are manufactured in China, Japan, and other Asian countries.[44]

Electric vehicle charging stations will be an important part of the emerging green infrastructure. Project Better Place, a California-based company founded in 2007, is one of the pioneers in this area, and has to date secured contracts with Israel, Denmark, Australia, California, Hawaii, and Ontario (Canada) to build stations for recharging electric vehicles and exchanging batteries.[45]

The introduction of electric cars on a large scale also makes it essential that electricity production be switched from fossil fuel plants toward renewables. Without such a change,

plug-ins will simply reinforce the very energy system that is destabilizing the climate.

It is also important to remember the need for a broader green transport policy that reduces the intense dependence on motor vehicles. This means substantial and long-term investments in public transport and rail. Land-use policies that help to make communities more compact and thus more amenable to a balancing of transportation modes, including walking and biking, are also an important ingredient of a greener infrastructure.

In Europe, urban public transport and inter-city rail is already backed by a mature infrastructure and a number of countries – France, Germany, and Spain in particular – have made substantial investments in high-speed rail systems. Even so, it is still necessary to further strengthen public transport systems vis-à-vis the auto-centered system.

The United States has a much longer way to go. Passenger rail suffers from outdated equipment, and there is no high-speed rail system. The quality and extent of urban public transportation is highly uneven across the country. The ARRA stimulus program offers some money, but represents no more than a first downpayment.

Given that the automotive industry has substantial overcapacity in many countries, it may be time to think about ways to convert and reorient applicable portions of its productive capacities toward both light and heavy rail. The auto industry is no stranger to fairly fundamental changes in its orientation; during World War II, for instance, government fiat brought about an abrupt, but thoroughly planned, switch in the United States from civilian vehicles to tanks and other military equipment (and an equally speedy return to civilian production after the war).

c. Recycling Markets

Compared with producing materials like steel, aluminum, and paper from scratch, using scrap materials saves substantial amounts of energy. In the steel industry, for instance, savings run between 40 and 75 percent. Worldwide, slightly more than 40 percent of total steel production is based on recycled steel. The share has been stagnant for some years, but the absolute amounts are increasing.[46] Further expansion of the recycled share is not easy, because overall demand is rising rapidly, and the time span within which old steel becomes available for recycling can stretch to decades.

Recycling rates vary strongly across product groups and countries. In the automotive and construction industries, 80-100 percent of steel is recycled. Only 65 percent of steel cans are recycled on average, although the rate has been rising in recent years, with some countries reaching 85 percent or higher. China's steel production has been surging, but it still has very limited scrap reserves.[47]

The steel industry is ahead of the aluminum and paper industries with regard to recycling rates and functioning scrap markets, and in terms of the share of scrap-based production. Nevertheless, similar issues to those affecting the steel industry are also important in other basic materials industries.

The global recycling rate for aluminum averages 63 percent, but there are vast differences from country to country. Scandinavia and Germany have strong government regulations and high recycling rates, whereas Greece, Portugal, the United Kingdom, and Eastern Europe fare far less well. EU directives on packaging waste and vehicle end-of-life rules will likely bring improvements in future years. In North America, only 52 percent of recovered beverage cans were recycled in 2005, down from a peak of 67 percent in 1992.[48]

Strong recycling standards and functioning scrap markets are a must, and governments need to step up their rules and incentives for greater recycling.

d. Nature's Infrastructure

Ecosystems are "natural infrastructures" that provide trillions of euros' worth of clean water and air, flood protection, soil fertility, pollination, and disease control, among many other services.[49] Their value, and the scale and complexity of their activities, are far greater than those of the electric, gas and water in-

frastructures that receive so much attention in many stimulus packages.[50] By one estimate, ecosystems provide 16-54 trillion dollars (12-42 trillion euros) of services to the world's economies.[51] Given their value, investment in protecting ecosystems merits attention in any Green New Deal. Indeed, such investments are not only environmentally necessary: a free natural service such as water filtration is expensive to replace through human-built infrastructures like water treatment plants, and is virtually always superior in quality to the human-delivered alternative.

Some 60 percent of the Earth's ecosystem services studied in the 2005 Millennium Ecosystem Assessment (MEA) have been degraded in the past 50 years, primarily as a result of human activity.[52] The Economics of Ecosystems and Biodiversity (TEEB) report from the European Commission projects that, among many other impacts, business as usual activity by 2050 would lead to the loss of 11 percent of the natural areas existent in 2000 to agriculture, infrastructural expansion, and climate change, while 60 percent of coral reefs would be lost due to fishing, pollution, diseases, invasive alien species and coral bleaching. Furthermore, TEEB draws clear linkages between ecosystem health and the well-being of the poor, and sees ecosystem protection as an important way to achieve the Millennium Development Goals. In sum, in a crowded world whose ecosystems are already in many cases taxed beyond capacity, the continuation of conventional economic activity spells an accelerating deterioration of the natural systems that underpin environmental, human, and economic well-being.

Government efforts to protect ecosystem services are generally considered to be inadequate. Current global government expenditures on protected areas are estimated at $6.5 billion (€5 billion) per year – a small share of the estimated $45 billion (€35 billion) required annually to fully support conservation objectives.[53] Partly in response to political or financial inability to fund direct ecosystem protection, experiments with market-based approaches to conservation have begun. Carbon markets, wetlands banks, water banks, and conservation banks all use a combination of government regulation and market mechanisms to conserve biodiversity and natural systems. Such initiatives, along with continued government commitment to direct interventions, can be encouraged as a part of Green New Deal initiatives.

2. Leapfrogging

A Green New Deal represents a rare opportunity to put in place the most sophisticated clean technologies and management strategies across multiple economic sectors and within a short period. Many of these opportunities would have substantial climate stabilization benefits, while others would help conserve water, ecosystems and species, and materials. They also represent huge potential economic stimuli: in the energy sector alone, for example, the International Energy Agency estimates that $45 trillion (€35 trillion) in investment will be needed by 2050 to make the transition away from oil and to halve global CO_2 emissions.[54]

The leapfrogging opportunities available to policymakers and businesses today are typically found in three broad areas: the development and introduction of green technologies, advances in efficiency, and changes in management practices, especially the shift to a service economy.

a. Green Technologies

Transportation. A proposed EU Regulation setting emission performance standards for new passenger cars will set an average limit of 120 grams of CO_2 emitted per kilometer traveled for new cars (compared with current average emissions of about 160 g/km). This limit has been delayed and watered down in response to industry pressure, especially in Germany. First proposed as early as 1995, the 120-gram limit while only be phased in fully by 2015, while a 95-gram limit is envisioned for 2020.[55] The European Federation for Transport and Environment (T&E), in comparison, advocates a 2020 target of 80 grams and a 2025 limit of 60 grams.

The EU is not sufficiently ambitious and thus fails to be a forceful driver for the develop-

ment of new technologies. Growing numbers of vehicles and the increasing distances driven make for a clash with climate stabilization goals. Much stricter carbon limits, in addition to higher fuel efficiency, is an absolute must to achieve these goals.

Beyond Europe, UNEP and the International Energy Agency joined with partners in industry in March 2009 to launch a Global Fuel Economy Initiative, aiming for a reduction in fuel consumption per kilometer of 50 percent by 2050.[56] Again, this particular goal may not be enough, but it is nevertheless important that an international collaborative process has been put in place.

A fuel efficiency strategy needs to go hand-in-hand with promoting alternative propulsion systems. In 2008, slightly more than half a million gasoline-electric hybrids were produced worldwide. By 2015 it is predicted that some 2.7 million could be produced, along with 250,000 diesel hybrids and 145,000 electric vehicles. Their share of total car production might thus grow from 0.7 percent today to just under 4 percent.[57]

The next step in this evolution is plug-in hybrid electric vehicles (PHEVs). The EU has called for the production of 1 million such vehicles by 2020, while the German government alone is aiming to put 1 million electric and plug-in hybrid electric vehicles on the road by 2020 and at least 5 million by 2030.[58] In the United States, the Obama Administration has announced $2.4 billion (€1.85 billion) in funding to support the development of engines, batteries, and other components for PHEVs.[59] Making its debut in December 2008 in China, BYD Auto's F3DM is actually the first mass-produced plug-in hybrid. It is also to be introduced in Europe in 2010 and in the United States in 2011. Toyota will introduce a plug-in hybrid vehicle in late 2009, followed by VW and GM in 2010.[60]

The current auto industry crisis presents a unique opportunity to "green" this sector. The European Commission, for instance, has proposed a €5 billion "green cars initiative" to be funded by the Commission, member states, the European Investment Bank (EIB), and private industry.[61] Strong regulations and incentives are required to facilitate and push forward the introduction of new technologies. Public funds should be tied to certain conditions, such as requiring hybrids and/or PHEVs to account for a minimum percentage of future car production. Vis-à-vis car buyers, the payments offered by European governments for scrapping old vehicles could be conditional on the replacement of the old cars by a hybrid or PHEV instead of conventional vehicles.

Renewable Energy. Shifting from fossil fuels to renewables is a key dimension in the transformation of the energy system. This transformation is already well under way, given the rapid growth that a range of renewable energy sources have enjoyed over the last decade.

Global wind power capacity reached 120.8 gigawatts by the end of 2008, 36 percent more than in 2007 and 11 times more than a decade earlier.[62] In 2007, Europe accounted for 66 percent of currently installed capacity. European companies also currently dominate turbine manufacturing, with about 80 percent of worldwide sales.[63]

Global production of solar photovoltaic (PV) cells rose to a record 3,733 MW in 2007 – a 23-fold increase over 1998. Europe as a whole has a 25 percent share. Annual PV installations reached 2,392 MW in 2007, up from 278 in 2000 and 78 in 1995. Almost half the world's installations are taking place in just one country: Germany.[64]

Bio-ethanol output, mostly in the United States and Brazil, reached 64 million tons, more than three times the amount 10 years earlier. Though smaller in volume, biodiesel production is also growing, from about a half million tons in 1998 to 16 million tons in 2008 – principally in the EU.[65] But it is critical that biofuels be truly sustainable. Corn-based ethanol is not an appropriate alternative to gasoline and is expanding only due to huge subsidies in the United States. There is also growing recognition that biofuels grown in developing countries have led to problems including deforestation and the displacement of rural communities. Strict criteria are needed to prevent such practices and to focus next-

generation biofuels on cellulosic material and agricultural residues that do not cause major social and environmental problems.

Despite some tightening in bank lending during the current economic crisis, the expansion of renewables is likely to continue and accelerate in years to come, though continued government support remains critical.[66] A smart grid – discussed elsewhere in this paper – will be a key objective in this regard, to ensure that a growing and large share of renewables can be reliably fed into the electricity system.

Heating and Cooling. In representing some 40-50 percent of global energy demand, heating and cooling needs could be met by renewable energy to a far greater extent than is the case today.[67] The German Aerospace Center (*Deutsches Zentrum für Luft- und Raumfahrt – DLR*) estimates that 12 of the world's 20 largest economies could meet at least 40 percent of their heating needs with renewable energy by 2030. By 2050 this share could reach 60 percent.[68] The technologies at the heart of this potential revolution include solar water heaters, industrial and domestic biomass-fueled heating systems, heat from deep geothermal sources, and shallow geothermal heat pumps. These technologies are among the least costly options for reducing CO_2 emissions, yet they meet only 2-3 percent of global demand according to the International Energy Agency.[69]

Despite low adoption rates, the potential of renewable sources of energy for heating and cooling is proven. Ten percent of Chinese homes use solar water heaters, and their use in Israel has been routine since the 1980s. Some 60,000 ground-source heat pumps are installed in the United States annually. Cold water from Lake Ontario in Canada is used in a district cooling system with the capacity to cool more than 3 million square meters of building space.

Various policies are credited with advancing these renewable sources of heating and cooling. A tax on CO_2 in Sweden between 1980 and 2005 drove a major shift from fossil fuels to biomass for district heating. Spain requires solar systems for all new or renovated buildings, while the U.S. state of Hawaii will require solar water heaters on all new homes starting in 2010. Germany has used investment subsidies for solar thermal heat to cover high upfront costs.

b. Efficiency

Technologies that help consumers and businesses become more efficient in their use of energy, water, and materials are also relevant to the world's stimulus packages. The potential for efficiency improvements is enormous. In the energy sector, for example, a 2008 assessment by the Renewable Energy and Energy Efficiency Partnership (REEEP) notes that "the potential… is much larger than has already been implemented." All in all, by 2050, efficiency improvements could reduce world primary energy demand by some 300 exajoules, or annual reductions of 20-25 gigatons of CO_2.[70] Currently, worldwide investment in energy-efficient technologies is estimated at about €60 billion annually.

Buildings. The potential for huge efficiency gains is clear in Germany, where the Passivhaus Institute has built 6,000 houses that consume just one tenth the energy of standard German homes. Technologies used include passive solar orientation for heating and day lighting; efficient lighting and appliances; super insulation and ultra-tight air barriers on doors and windows; and heat recovery ventilators. As peak loads decline for lighting, heating, ventilating, and cooling the homes, so does the required size of fans, boiler, and other equipment, providing greater savings.[71]

The EU has spearheaded initiatives that are pivotal to setting and improving standards and driving efficiency efforts forward. An interesting model for promoting ever-higher standards of energy efficiency is the Top Runner rating system, which has worked especially well in Japan and is in use, in adapted form, in Germany as well. Such initiatives are more effective than rating efforts such as the Energy Star labeling system for appliances in the United States, which relies on consumer response to ratings to drive efficiency improvements.

Water Efficiency. While efficiency discussions often focus on energy, water efficiency is

increasingly critical in many parts of the world, including southern Europe and the western United States. Water-efficient appliances and fixtures are, of course, widely available and could be promoted through stimulus initiatives for use in homes and offices. Another option, largely untapped in industrial countries, is water harvesting: the capture of rainwater by homes and office buildings and its use onsite. A single storm dropping 2.5 cm of rain on the average U.S. rooftop would meet the equivalent of more than a third of an average American family's annual water needs. (Water from rainwater harvesting is not typically potable, but it can be used for outdoor watering and for some indoor purposes as well.) This resource is free, and can be captured with relatively inexpensive infrastructure.

In October 2008, San Francisco announced a rainwater harvesting initiative designed to promote the practice among residents of the drought-stricken city. In addition to educational efforts, the program underwrites about half the cost of residents' rain barrel purchases.[72] Such a program would be relatively easy to implement on a regional or national scale. In addition, policymakers could design incentives for builders to build water harvesting systems into new homes, allowing the direct use of rainwater in toilets, washing machines, and other non-potable applications.

Steel Industry. Technological advances over the past two to three decades have led to improved energy efficiency, greater use of byproduct gases and materials, enhanced recycling, and substantial reductions in CO_2 emissions per ton produced.[73] Among European firms, for instance, carbon emissions per ton were cut more than 50 percent between 1975 and 2000.[74] A 2007 International Energy Agency (IEA) report concluded that if the best technologies currently in use were applied worldwide, the global steel industry's annual energy consumption could be reduced by 11-14 percent. Additional measures, including closing outdated plants, could roughly double the savings.[75]

Europe and North America once employed large numbers of people in steelmaking. Many of these jobs have been lost, in part because of a massive shift in production capacities to Asia, principally China. There is growing recognition in the EU that only a high-efficiency, cutting-edge strategy offers hope of saving what remains of this industry. The European Commission is currently supporting a long-term initiative (ULCOS – Ultra-Low CO_2 Steelmaking) intended to develop breakthrough technologies with the potential to reduce CO_2 emissions by at least 50 percent.[76]

c. Services in Place of Goods

Governments can also help to support the shift to a service economy. Services tend to be less environmentally harmful than goods, and offer clear economic advantages, for example in exhibiting more moderate swings during periods of economic expansion and recession compared to durable goods, a dynamic that offers greater stability and job protection in the long run.

A well-known emerging service industry is car sharing, the subscription-based transportation service that allows people to substitute short trips in their own car with trips made in a vehicle rented by the hour. The service has been shown to reduce fossil fuel consumption, ease congestion, and reduce materials devoted to automobile manufacture. Dozens of cities now have car share programs, many of which are expanding – the membership of such programs in Japan doubled in the last year. Some are becoming increasingly green: Paris has proposed a car sharing service featuring 4,000 electric vehicles,[77] and London may introduce a similar program. The sharing concept has also been extended to bicycles, especially in major European cities, once again reducing the number of trips made in petroleum-burning vehicles.

Policymakers can pave the way for greater use of sharing services by opening political, economic, and physical space for such ventures. Funds for infrastructure construction, especially to make cycling safer, could spur public bike programs. At the local level, officials can create dedicated parking areas for shared cars and bikes.

Governments can also encourage a shift to the service concept within private firms. Take-

back laws, which require companies to accept long-term responsibility for the materials used in their products, packaging, or both, often have the effect of changing the way companies meet consumers' needs. Some turn to leasing rather than selling their products, as Xerox has done, which then leads them to redesign their products for remanufacture. Others continue to sell their product, but offer a rebate for its return, as some camera companies have done for their "disposable" cameras.

3. Turning the Digital Revolution into a Green Revolution

New information and communication tools open enormous opportunities for greening an economy. By dematerializing many services, information technology helps consumers to get what they want with reduced, often minimal, environmental impact.

Digitizing economic activity is still in its infancy. While there is vast potential for expansion, maximizing this potential requires extensive, high-quality digital infrastructures that can handle the full demand that digitized services will present. A Green New Deal can help create or complete that infrastructure – and would also stanch the accelerating job losses in the IT sector.

Information can increase efficiency in a number of ways:

- Transport services such as that offered by Carticipate.com use information technology to match people who need rides with people who have open seats in their vehicles, reducing trips overall and the pollution this represents.
- Smart energy meters help to match energy demand and supply more evenly than conventional metering by letting consumers know the price and availability of energy at various hours, reducing peak loads and slowing the need for new power plants.
- Teleconferencing capacity reduces the need for travel, a significant source of CO_2 emissions.
- Movie rental firms such as Netflix offer customers the option of downloading movies to a home computer or TV. This service eliminates DVDs, DVD packages, the DVD store, and the trip to get there, all of which yield important savings in energy and materials.
- Although new to the market, e-books may reduce the consumption of paper in the form of newspapers, magazines, and books.

The IT and telecom industries are changing the very nature of some businesses. Companies like IBM, Autodesk, Cisco and Intel see a growing role for themselves in the energy sector, whether as integrators of energy management systems or platforms, creators of "smart grids," or specialists in lowering carbon content in the supply chain. Intel engineers, until recently working on next-generation processors, now find themselves developing new nano-based solar cells. Cleantech Venture Network Executive Chairman Nicholas Parker even speculated in December 2008, "We could well be in 10 years time calling Intel an energy company, in much the same way Applied Materials is becoming better known as a solar company."

IT has an important role to play in stimulus packages. The American Recovery and Reinvestment Act designates $7.2 billion (€5.6 billion) for extending broadband service, primarily to rural areas – a largely underserved market in the U.S.[78] This investment illustrates some of the tradeoffs involved in stimulus initiatives. By one estimate, the broadband plan will create 128,000 U.S. jobs over four years, compared with 152,000 jobs on more traditional infrastructure investments, the result of telecoms equipment being largely manufactured in Asia.[79] Yet the broadband investment may be justified for a number of reasons. Asian job creation is important in itself, even for the US and European economies. Furthermore, broadband infrastructure is generally cleaner than traditional infrastructure investments (such as roads), and broadband users may stimulate rural economies by starting businesses or increasing productivity in existing businesses. Studies show that broadband can also help keep people in rural towns. For these reasons,[80] broadband investments may well be justified even if the number of direct jobs created is smaller than in alternative investment scenarios.

The EU has also approved investments in broadband as a part of its stimulus spending. While 93 percent of Europeans have high speed internet access, 30 percent of the rural population of Europe does not. The EU has set a goal of providing 100 percent of the European population with a broadband option by 2010 as part of the European Economic Recovery Plan, earmarking €1 billion for this purpose. The EU estimates that broadband internet connection is expected to create 1 million jobs and boost the EU's economy by €850 billion between 2006 and 2015.

Of course, expanded broadband implies the use of more, and more powerful, computers, which tend to be voracious users of energy and a serious source of toxic materials. Computer firms will need to continue to increase the energy efficiency of their products, and to reduce heavy metals content, if the full environmental potential of information technologies is to be realized.

4. Prices and Markets for Sustainability

A Green New Deal is an opportunity to assess how markets and prices might better be employed to promote green economies. Markets and prices are commonly regarded as powerful drivers of individual and institutional behavior and can be helpful tools in the effort to green economic activities. Governments use taxes and subsidies to influence prices directly; taxes on carbon emissions and subsidies for renewable energy production are common examples. They also use their regulatory powers to create the conditions for conservation markets to emerge – to protect wetlands or the atmosphere, for example, or to conserve species. In all three realms – taxes, subsidies, and market creation – Green New Deal initiatives have important roles to play.

Regarding **taxes**, more can be done to rationalize current tax systems, which tend to make natural resource use too cheap and labor too expensive. Using eco-tax revenues to lighten the tax burden on labor (by funding national health or social security programs through eco-taxes rather than payroll taxes) would help lower indirect labor costs and boost job creation without hurting workers' interests.[81]

Denmark, Germany, Italy, the Netherlands, Norway, Sweden, and the United Kingdom have experimented with green taxes and tax shifting since the 1990s. Before adjustment for inflation, environmental tax revenues in the EU increased more than fivefold between 1980 and 2006 to €278 billion.[83] (*See Table 3.*) The bulk of these revenues are derived from taxes on gasoline and diesel, and on motor vehicles.[84]

The effect on the ground has been notable. In Germany, for instance, an eco-tax on different forms of energy introduced in 1999 had already helped avoid the emission of more than 7 million tons of carbon dioxide in its first three

Table 3. Environmental Tax Revenue, European Union, Selected Years

Environmental Taxes	1980	1990	2000	2006
		(€ Billion)		
Revenues	/	130.4	242	277.8
		(percent)		
Revenues as Share of All Taxes and Social Contributions	5.8	6.2	6.7	6.7
Revenues as Share of Gross Domestic Product	2.2	2.5	2.8	2.7

Note: Data are for EU-15 members.
Source: See note 82.

years. Reductions in social security contributions made possible by these funds helped create 60,000 additional jobs by 2002 and possibly as many as 250,000 by 2005.[85]

Still, eco-taxes are frequently weakened by loopholes – exemptions to certain industries or energy sources, reduced tax rates to energy-intensive firms, or provisions making companies eligible for partial reimbursements. A recent study on climate change and employment in the context of the European Union laments that "the use of taxes to internalize the social costs of transport has so far run up against major forces of inertia within the Member States," and concludes that "the use of energy taxes for European environmental ends still remains very little advanced."[86] Eco-taxes instituted as part of a Green New Deal will need to be designed carefully to avoid these pitfalls.

In contrast to eco-taxes, **subsidies** for agriculture, energy, minerals, and other major economic sectors often work against sustainable economic outcomes by rooting unsustainable activity deeply in national economies – and by creating entrenched interests with a strong incentive to preserve their subsidy position. Green stimulus initiatives could remove perverse subsidies, perhaps replacing them with temporary support of renewable energy, energy efficiency infrastructure, water conservation programs, or other green initiatives (although even subsidies for defensible purposes may need to be limited, as noted below). The scope for subsidy reform is huge, as perverse subsidies are estimated to amount to hundreds of billions of euros per year globally.

The energy sector alone offers extensive opportunities for subsidy reform. Many governments institute cheap energy policies that promote over-consumption of fossil energy, or transfer risks or costs from private entities to taxpayers (as with nuclear energy). Billions of euros could be saved by ending these subsidies, freeing up funds for other green stimulus initiatives. In other cases, subsidies are poorly designed, at substantial cost to the environment: subsidies for irrigation pumping in India and Yemen, for example, are helpful to poor farmers, but have led to widespread over-pumping, depleted aquifers, and the risk of exhausted water supplies in the years ahead.

Of course, subsidies for green technologies can also be harmful to sustainability if they remain in place for long periods, because this would distort the relative prices of various economic options. Green New Deal programs would do well to require all technologies to submit to market discipline, save those with a strong justification for temporary protection (say, to counter obstacles such as high start-up costs). In the case of energy, for example, it might be better to internalize the cost of greenhouse gases into the price of goods and services than to subsidize green technologies, allowing the thousands of options for reducing emissions to compete equally.[87]

Green New Deal efforts can also encourage the adoption of **regulations that help create markets designed to advance sustainability objectives**. Created markets are now used to protect the atmosphere (using carbon markets), and regulations such as provision for feed-in tariffs help to promote decentralized generation of renewable energy. Feed-in tariffs are now the law in more than 40 nations, states and provinces. In addition, wetlands banks, water banks, and conservation banks, created out of government regulations to protect wetlands, water, and species, respectively, use market incentives to help fill gaps in ecosystem protection where direct government regulation is politically difficult to achieve or absent. Markets to protect biodiversity in the United States are now worth more than $3 billion (€2.3 billion) per year.

Carbon markets are generally prospering, even in the current recessionary environment. The research firm New Carbon Finance (NCF) reports steady growth in the volume and value of carbon trading: trading in the European, North American, Australian and project-based markets expanded by 84 percent in value in 2008 compared to 2007, and is projected to grow another 28 percent in 2009.[88]
(*See Figure 1 next page.*)

Interestingly, however, NCF's measure of voluntary carbon market activity shows that transactions fell 38 percent between their high

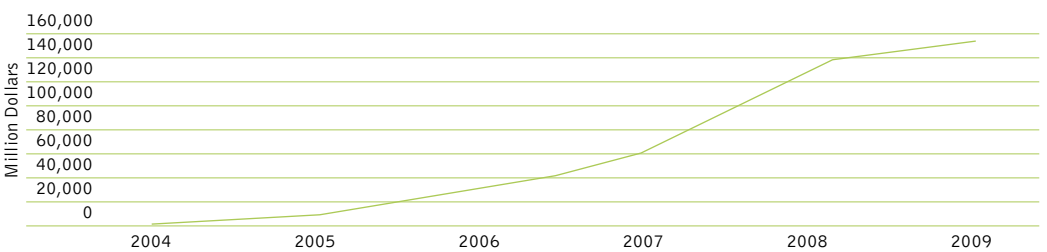
in summer 2008 and January 2009, as many budget-strapped companies abandoned their carbon reduction commitments.[89] The steady expansion of most carbon markets and the contraction of voluntary ones demonstrates the value of government-mandated carbon markets. Even the prospect of government action has an impact: NCF notes that as the Obama Administration's seriousness about action on climate has become evident to the business community, prices on the voluntary carbon market in the United States have started to rebound.[90]

Of course, carbon markets work well only to the extent that the rules governing them are properly set, as the EU's Emission Trading System (EU-ETS) experience demonstrates. Care must be taken to limit the number of exemptions, to auction permits rather than give them away, and to avoid offering too many offset possibilities. But properly designed, carbon markets can be effective instruments for meeting a societal goal while tapping the discipline and efficiencies of markets.

But markets for ecosystem protection, whether to conserve the atmosphere, waterways, or species, are not silver-bullet solutions; the economic logic of markets may not match the scientific necessities of ecosystems. A newly built wetland, for example, may not be of the same quality, or in as ideal a location, as the one it replaces, no matter what the market may say. Policymakers interested in advancing such markets will need to ensure that adequate safeguards are in place to truly protect ecosystems.

In addition, markets often fail to produce optimal social outcomes. Market outcomes that internalize full environmental costs, for example, may result in prices for goods that are harmful for those on a low income. In such cases, protective mechanisms are needed: tiered pricing, for example, that makes basic services available at low cost and bumps up prices with higher levels of consumption, or "eco-bonuses," as espoused by the Prince of Wales, that reward people for environmentally friendly lifestyles.

Figure 1. Value of Major Carbon Markets, 2004-2009



Source: See note 88.

Green New Deal, Green Employment

One of the key aims of the stimulus packages is to minimize the social pain of the current economic crisis by keeping job loss limited and creating new jobs. A green recovery has the additional objective of creating employment that is fully compatible with protecting the planet's life support systems. Far from an afterthought, linking employment and the environment is indeed crucial. Economic prosperity and employment fundamentally depend on a stable climate and healthy ecosystems. The world economy's current trajectory runs the risk that many jobs could be lost due to growing resource depletion, biodiversity loss, the impacts of increasing natural disasters, and other climate disruptions. Greening the economy, on the other hand, will be a key economic driver during this century, as humanity tackles the challenge of building a low-carbon global economy.

1. The Growth of Green Jobs

So-called "green jobs" help reduce carbon footprints and other environmental impacts. Generally speaking, environmentally friendly activities tend to generate more jobs than the activities they replace as they are often more labor-intensive than "brown" capital-intensive industries like the fossil fuel sector. Also, reduced consumption of energy and materials through higher efficiency means that the resulting savings can be invested outside the energy and mining sectors, which typically create relatively few jobs per unit of investment. (Economists refer to this as the "re-spending effect".)

A sufficiently green stimulus, along with measures to create a green public infrastructure and to bring about a process of leapfrogging to more environmentally benign technologies (discussed further below), will ensure that many millions of additional green jobs will be created in coming years, and that many existing jobs will become greener in nature. The number of such jobs is already on the rise.

a. Renewables

Jobs in the renewable energy sector are among the most visible of green jobs. These energy sources have enjoyed rapid growth during the past decade or so, translating into rising employment. In the United States in particular, a chunk of stimulus spending is being directed toward this sector, whereas Europe continues to rely on already existing measures such as feed-in laws. A pioneer in the renewable energy sector, Germany has seen significant job expansion in a very short period of time – from 160,500 jobs in 2004 to 278,000 in 2008.[91]

Wind Power. Worldwide, wind energy employment was estimated at more than 400,000 in 2008, significantly up from just the previous year.[92] Europe continues to be a leader in manufacturing and installing wind turbines, with an estimated 154,000 direct and indirect jobs in 2007, most prominently in Germany, Spain, and Denmark. It has been suggested that European wind industry employment may reach 329,000 jobs in 2020, and 377,000 in 2030.[93] U.S. wind installations surged in 2008 (replacing Germany as the country with the most capacity), and employment reached 85,000 in 2008.[94]

Solar PV. Like wind turbines, the manufacturing and installation of solar panels is growing rapidly. Germany continues to command close to half the global installation market and is also a leading producer of solar cells, directly behind China and Japan.[95] Some 57,000 people were in PV-related jobs in Germany in

2008, while Spain had about 27,000 jobs in this sector in 2007.[96] Total European PV-related employment is now approaching the 100,000 mark, and may expand to more than 700,000 in 2020 and to 1.4 million in 2030.[97] The United States, however, has fallen behind in the PV sector, with a recent analysis concluding that the U.S. had fewer than 16,000 direct and indirect PV jobs.[98]

Other Solar Technologies. While China is the global leader in terms of market size, European companies are the technological leaders in the solar thermal field. Available data suggest that Europe has more than 30,000 jobs in this industry – far more than the roughly 2,000 U.S. jobs estimated in 2006.[99] Jobs are also likely to grow fast in the emerging CSP (Concentrating Solar Power) industry. This is especially so in the United States, with its hot desert areas suited for CSP, although Spanish, German, Belgian, and British companies appear well-positioned to become important suppliers of components like collectors and mirrors.[100]

Bioenergy. Biomass is increasingly used for a variety of purposes – biofuels, biogas, and heat and power generation. European countries account for only a small share of bioethanol production, but are prominent players in biodiesel and biogas. Germany had about 96,000 direct and indirect jobs in bioenergy in 2008, while Spain has more than 10,000 direct jobs.[101] Studies suggest that several hundred thousand European jobs could be created in this sector in future years.[102] The U.S. ethanol industry had an estimated 154,000 direct and indirect jobs, with biomass adding another 152,000 and biodiesel some 6,000 jobs.[103]

Smart Grids. Renewable energy can be fed into electricity distribution systems more easily by building smart grids. The introduction of related technologies like smart meters may lead to the elimination of certain jobs (such as meter readers), but developing the technology, installing related equipment, and modernizing overall grid infrastructure will create new employment. In the United States, it has been estimated that up to 280,000 new jobs may be created, not including indirect employment.[104]

b. Energy Efficiency

Energy end-use efficiency investments create three to four times the number of jobs created by energy supply investments in coal-fired and nuclear power plants. A 2005 European Commission study concluded that efficiency investments saving 20 percent of EU energy consumption could create up to 1 million direct and indirect jobs.[105] Buildings, lighting, office equipment and household appliances offer manifold opportunities for savings. Another critical area is the excess energy generated at many industrial facilities, which can be captured through so-called Combined Heat and Power (CHP) equipment (also known as cogeneration).

Buildings. A revision of the EU Energy Performance of Buildings Directive, as currently discussed, could generate between 280,000 and 450,000 new jobs by 2020. Insulation industry umbrella group Eurima claims job gains could reach as high as 856,000.[106] Currently, the European industry manufacturing insulation materials employs almost 40,000 people, with another 300,000 involved in installations.[107] In the United States, the insulation industry employs some 60,000 people directly and in supplier industries.[108] Building retrofitting is one of the areas benefiting from ARRA stimulus funds.

Household Appliances. The European household appliances industry employs around 200,000 workers, but has shed tens of thousands of jobs in the last two decades, with production migrating to China and other countries. To remain competitive and retain jobs, Europe's household appliances industry will need to focus increasingly on efficient products. About 60 percent of European refrigerator and freezer sales meet high-efficiency Label A norms. A back-of-the-envelope calculation suggests that a similar share of the 23,000-strong workforce can be considered "green".[109] A U.S. study found that some 86,000 people in the appliance and lighting industries were involved in manufacturing efficient products, with an additional 112,000 people in supplier industries.[110]

Lighting. Efficient compact fluorescent lights are mostly produced in China. With regard to the emerging market of highly-efficient LED lamps, industry giants like GE, Osram, and Philips, as well as other European and North American companies, are involved in product design, marketing and selling, but manufacturing is mostly outsourced to Asian firms.[111] Europe has about 50,000 people working in the lighting industry – of which 8,000 are producing inefficient incandescent lamps that will be phased out of the EU market between 2009 and 2012.[112]

Combined Heat and Power (CHP). The United States has the largest CHP capacity in absolute terms. A number of European countries use CHP fairly extensively, including Denmark, Finland, the Netherlands, Germany, Poland, and Romania. A rough estimate based on U.S. conditions suggests that about 25 workers are required for operating and maintaining 10 MW of existing CHP capacity. At the present U.S. capacity of 85 GW, this would translate into 213,000 jobs. Application to the European capacity of 104 GW yields an estimate of 260,000 jobs. These results, however, should be seen as no more than rough approximations that require additional study. [113]

c. Transportation

Automobiles. Using a fairly demanding efficiency benchmark roughly comparable to about 40 miles per gallon (14km/litre), just 7.5 percent of 2004 new-car sales by European manufacturers were efficient, low-carbon vehicles. Applying that percentage to the industry's workforce, a back-of-the-envelope calculation suggests that some 150,000 out of 2 million European auto industry jobs could be considered a shade of green.[114] In the United States, only slightly more than 1 percent of cars sold meet this benchmark, suggesting that at most about 13,000 jobs can be considered to be a shade of green.[115]

Japanese firms are leading development of gasoline-electric hybrid vehicles, and the race is on among Asian, European, and American manufacturers to market plug-in hybrid electric vehicles (PHEVs). Employment will be created in producing the cars themselves, the nickel metal hydride and lithium-ion batteries needed, and the charging stations, as well as in creating an expanded smart grid that can handle a growing PHEV fleet. To some extent, this implies a shift in employment. While some workers will gain in the process, others may need assistance in retraining or finding new jobs.

Urban Public Transit and Inter-Urban Rail. An estimated 900,000 people are employed in urban public transport in the EU-25. The sector accounts for 1-2 percent of total employment, and for each direct job, on average another 2 to 2.5 indirect jobs are created.[116] The United States has seen something of a revival of urban transit, with the number of employees (including heavy rail) rising from a low of 138,000 in 1970 to almost 370,000 in 2006.[117] Railways employ about 900,000 people in the EU-25, out of 8.2 million people employed in all transport services combined.[118] Having received lower priority than road transport for many years, rail employment has generally fallen. But modernizing and expanding transit and rail networks holds considerable employment potential.

d. Recycling / Scrap-based Manufacturing

Conservation of resources is critical to a green economy, implying a need for the collection and recycling of materials; a move toward closed-loop manufacturing; much greater reliance on scrap-based secondary manufacturing in energy-intensive industries like steel, aluminum, and paper; and a redesign of products to facilitate their reuse or remanufacture. All of this implies significant employment opportunities. There are already at least 15 million jobs worldwide in recycling and related activities,[119] many of which are found in the collection of materials. Fewer are in scrap-based production of materials like steel, but such secondary production plays a critical role in helping to reduce energy use and environmental impacts.

2. Investing in Human Resources

A Green New Deal needs not only to focus on developing and deploying new technologies, but must also ensure that people have the skills and wherewithal to thrive in a green economy and thus gain a tangible stake in it. Creating a green workforce goes beyond policies to facilitate job creation in areas like renewable energy; energy, materials, and water efficiency; waste reduction and recycling; and so on. It also means renewed emphasis on education and skill-building. Globalization has already brought about an era in which "lifelong learning" seems to be a prerequisite for decent incomes and a measure of job security. The greening of employment will require new sets of skills and arrangements, and demands a set of policy initiatives:

Specialized Occupations and Trades. Green sectors of the economy such as renewable energy, building retrofits, and smart grids require engineers, technicians, and scientists, in addition to skilled and semi-skilled blue-collar workers. In countries like Germany, which has seen rapid growth of wind and solar energy, there is already a noticeable shortage of skilled workers in some areas. In order to avoid a green "skills gap," there is a need to design academic and vocational training programs.

Efficiency Contracting. There is already considerable growth in energy auditing and service contracting, in which specialized companies identify energy-saving opportunities (and are paid a portion of the actual savings achieved). Employees of such companies need specialist skills and knowledge with regard to industrial equipment and processes and the evolving field of energy and materials efficiency, as well as insights into workplace and business structures.

Greening of the Workplace. Employees intimately familiar with their own workplace are often able to pinpoint inefficient or polluting practices and suggest better procedures. In the future, these skills may increasingly become critical for career advancement, and successful businesses will likely have to find ways to facilitate and reward the internal flow of suggestions and best practices.

Performance, Not Sales. Reorienting company operations so that revenues and profits are no longer so closely tied to a strategy focused on maximizing production and sales, but depend more on durability and delivering the best performance possible, implies radically different business structures and employee skills. In retail, a sales workforce that can offer quality advice on product performance will have to be far more knowledgeable about products than one that is merely expected to maximize sales of cheaply-made, non-durable products, typically at low pay.

Retaining and Converting the Manufacturing Base. Europe and North America have long struggled with the job loss and deindustrialization that has come with growing automation, globalization, and outsourcing. Beyond the obvious challenge this poses to workers and their communities, there are also implications for building a green economy. This economy will still need to draw on many aspects of the existing manufacturing base. (For instance, the main input into wind towers is steel; glass is an important material for solar collectors and PV panels.) It is thus important that the relevant skills, knowledge, and capacities not be scattered through further disruptive deindustrialization processes. The retention of valuable expertise and the conversion of industrial capacities (for instance from auto to rail manufacturing) to the extent possible are key objectives.

These issues go beyond technical and vocational training issues, academic programming, and business-labor relations. Building a green workforce also requires that social justice concerns be addressed. Jobs need to be created not just for a limited class of highly-skilled employees, but for the workforce broadly. Luckily, a green economy can be expected to accomplish that. While designing and building wind turbines, for instance, takes specialized expertise, retrofitting buildings or installing solar panels provides broader opportunities for the workforce at large.

In a sustainable economy, employment in industries such as mining and fossil fuel-fired power plants will be limited. Tailoring skill-

building and retraining classes will be critical to ensure that workers in affected industries can participate in the green economy.

Opportunities also need to be offered for those who have been at the margins of the economy. In the United States, for instance, the American Recovery and Reinvestment Act of February 2009 offers $500 million (€386 million) in funds to prepare workers, including individuals from disadvantaged communities, for careers in the energy efficiency and renewable energy industries.[120]

Conclusion: Seizing the Moment

In the current perilous times, it has become commonplace to note that moments of crisis are also moments of opportunity. Still, it is worth reminding ourselves that the silver lining of both the Great Depression and the Second World War was the momentum they provided for an extraordinary period of innovation in governance at both national and the global levels. Both the United Nations and the "Bretton Woods" institutions – the International Monetary Fund, the World Bank, and the forerunner to today's World Trade Organization – were created in large measure in order to encourage an enduring post-World War II peace by providing for "Freedom from Fear" and "Freedom from Want." That need remains just as urgent today as it was then. The time has also come to add "Freedom from Climate Catastrophe" to the list.

As we set about the task of forging a Global Green New Deal, decisive action will be needed at multiple levels of governance. Furthermore, many different societal actors must be engaged in the process, including national governments and international institutions and members of civil society, trade unions, and the private sector.

One immediate priority is to **make national economic stimulus packages as green as possible.**

In the first place, as large as possible a share of total funds should be directly and unambiguously beneficial for the environment. It is equally important to avoid undertakings that will be actively detrimental to environmental quality, such as large-scale new road building or other projects that may look enticing because they are "shovel-ready." In addition, governments should coordinate their green stimulus package efforts in order to assess the cumulative impact and reap the greatest returns. The G-20, a group of major developed and developing countries working together to forge a collective international response to the economic crisis, is the most logical forum for this effort.[121]

It is also essential that initiatives aimed at creating and maintaining "green jobs" be encouraged and expanded. For example, labor ministries should develop skills and occupational profiles for green jobs in the renewable energy and other sectors. They should also **establish job training** programs in collaboration with unions, industry, vocational/technical schools, and universities. National governments must also provide ample funds for green jobs training, including retraining and transition assistance for those who are being displaced from energy-intensive industries such as mining and fossil fuels. Towards this end, the European Trade Union Confederation (ETUC), the European Environmental Bureau (EEB), and the Platform of European Social NGOs (Social Platform) have called on EU leaders to launch a low-carbon transition fund to support training for new green jobs and provide support for displaced workers.[122]

Governments should also seriously consider seizing the opportunity presented by the crisis to implement long overdue fiscal reforms, as described in earlier sections of this paper. For example, the time is now right to ease the strain on national treasuries imposed by stimulus spending by **reducing subsidies** for environmentally harmful economic activities. This is also an opportune political moment to implement **tax shifting** programs that reduce taxes on employment and labor (payroll taxes) and replace the revenues with environmental levies.

Increased public spending on **research and development (R&D) for energy efficiency and clean energy** is another high priority. Reviewing a series of studies, a recent report by the Potsdam Institute for Climate Impact Research and the Grantham Research Institute on Climate and the Environment argues that public R&D for energy efficiency and clean energy needs to increase at least 3- to 4-fold in order to help bring about the necessary transition to a low-carbon economy.[123] Unlike private funds, public R&D usually supports longer-term goals, promoting critical basic research that does not necessarily provide near-term payoffs. And in conditions of economic crisis, private R&D tends to be scaled back, detracting from the pace and scope of efforts needed to fully develop low-carbon technologies in a timely manner.

At present, energy R&D in IEA member states is heavily slanted toward the support of nuclear technologies. Some €3.3 billion, or 38 percent of total R&D spending on energy, was devoted to nuclear fusion and fission research in 2007. Efficiency and renewables are receiving a relatively meager 13 and 12 percent of total R&D budgets respectively. Fossil fuels, despite being a mature industry and in spite of climate change and other environmental concerns, still receive 11 percent of all funds – more than the 7 percent devoted to hydrogen and fuel cells. One category of fossil fuels-related research that has potentially positive climate impacts – carbon capture and storage – received about €110 million in support, or slightly more than 1 percent of all energy R&D.[124] In an era of climate crisis, a reprioritization is urgently needed.

But there is also a broader need for **shifts in priority**. At €8.8 billion in 2007, energy R&D is dwarfed by military R&D. The United States increased its military research budget from $40 billion (€31 billion) in 2001 to $70 billion (€54 billion) in 2008 (expressed in current dollars). By comparison, the country spent $3.6 billion (€2.6 billion) on energy in 2007 – and just $870 million (€630 million) on efficiency and renewables.[125]

Strong **transatlantic cooperation** can help to move the Global Green New Deal forward. For example, it appears increasingly likely that before long the United States will adopt a cap-and-trade system to limit its national greenhouse gas emissions, along the lines of the EU-ETS. This could pave the way for an eventual transatlantic emissions trading system, and perhaps ultimately for a global one.[126]

Securing the integrity of such a system would require several key steps, including ensuring that it is based on strong greenhouse gas reduction targets and that major emitting sectors such as aviation are included. In addition, it is important most of the permits be auctioned rather than given away for free and that the resulting revenues be used for innovative purposes. These might include funding adaptation efforts and fostering resource efficiency and renewable energy technologies in developing countries as well as promoting green technologies and buffering low-income citizens from rising electricity costs at home.

Transatlantic cooperation could also help to pave the way for stronger **energy efficiency standards**, including the possibility of harmonized fuel economy standards, as well as joint mandates to phase out particularly inefficient products such as incandescent light bulbs.

The European Union and the United States could also work together to push forward **international cooperation** on the Global Green New Deal. For example, in March 2009 UNEP called for the investment of some $750 billion (€579 billion) – 1 percent of global GDP and 25 percent of the overall proposed economic stimulus packages – in five areas that it considers integral to the Global Green New Deal: improving energy efficiency in buildings; promoting renewable energy; encouraging sustainable transport; protecting the planet's ecological infrastructure including freshwaters, forests, soils and coral reefs; and supporting sustainable agriculture.[127] UNEP also advocated that several upcoming high-level international meetings consider the Global Green New Deal, including the G-20 Summit meeting in London, the World Bank/IMF Spring Meetings in Washington in April and the G8 Summit meeting in Rome in June.[128]

If these efforts to advance the Global Green New Deal are successful, they will help to pave the way for a new global agreement on climate change to be forged in Copenhagen in Decem-

ber. If such a pact is indeed agreed upon, it will then become a centerpiece of ongoing efforts to move the Global Green New Deal ahead.

But the road to Copenhagen appears bumpy. The EU has set itself a target of reducing its CO_2 emissions by 20 percent from 1990 levels by 2020 – and by 30 percent if other rich nations commit to comparable emission cuts. However, the United States may not be able to move ahead on as ambitious a timetable as that proposed by Europe. To a large extent, this is a consequence of a lack of efforts to rein in CO_2 emissions over the past decade. During bilateral talks in March 2009, EU environmental officials were told by their U.S. counterparts that requiring cuts in greenhouse gas emissions of 20-30 percent below 1990 levels by 2020 would be asking too much of the United States, given the accumulation of an additional 14 percent since then.[129]

Substantial differences have also emerged between industrialized and developing countries over both the types of commitment that developing countries might make under the Copenhagen agreement and the extent to which the industrialized countries will be able to deliver on their previous pledges of increased **funding and technology diffusion and transfer** to help developing countries transition to low carbon economies. The Secretariat to the UN Framework Convention on Climate Change (UNFCCC) estimated in a 2007 report that additional annual global investments and financial flows of some $200-210 billion (€154-162 billion) for climate mitigation, in addition to tens of billions of dollars for adaptation efforts, will be needed by 2030.[130] These resources could come from a variety of sources, both public and private. However, the governments of industrialized countries have so far been reluctant to make financial commitments, in part due to pressures related to the global economic crisis.[131]

It is important that the Copenhagen Conference give a strong boost to international institutions and mechanisms that promote **green technology development and sharing**. For example, an International Renewable Energy Agency (IRENA) was established in Bonn in January 2009 with the mission of spearheading the widespread use of renewable energy worldwide. Seventy-five countries signed the organization's statute, and many others expressed their intention to join imminently.[132] A similar undertaking may be needed to promote energy efficiency worldwide. Indeed, perhaps both initiatives should one day be brought under the umbrella of an International Energy Agency (IEA) with a broadened membership and an updated mandate.

New political alliances will also be necessary if we are to make the Global Green New Deal a reality. One innovative effort along these lines is the Blue-Green Alliance. Initially a partnership between the U.S. environmental group the Sierra Club and the United Steelworkers union, the alliance has recently been expanded to also include the Natural Resources Defense Council (an environmental group) and three additional unions (the Communications Workers of America, the Laborers' International Union of North America, and the Service Employees International Union). The Blue-Green Alliance is working to "expand the job-creating potential of the green economy and improve the rights of workers at home and abroad."[133] Other important constituencies that need to be brought to the table include consumer groups and business organizations.

A Global Green New Deal will only work if it succeeds in addressing both pressing environmental priorities and pressing social needs in industrialized and in developing countries. Bringing about such a grand bargain will require that people everywhere focus their attention not only on improving their own welfare, but also that they empathize with the challenges all countries and people face at this time of global economic peril – particularly the most economically disadvantaged among us. Such an approach will not be easy to accomplish at a time of great societal strain. But the urgent nature of the threats we share demands that we rise to the occasion by forging an ambitious and bold collective response. As the U.S. statesman Ben Franklin said upon the signing of the Declaration of Independence in 1776, "we must all hang together or we shall most assuredly all hang separately".[134]

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