
Climate Finance

Regulatory and Funding Strategies for Climate Change and Global Development

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Part IV



National Policies

*Implications for the Future Global
Climate Finance Regime*



Climate Legislation in the United States

Potential Framework and Prospects for International Carbon Finance

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Key Points

- There is an increasing prospect of a comprehensive US cap-and-trade program to control GHG emissions. A US carbon market would have crucial implications for carbon finance, particularly in developing countries.
- US climate legislation passed by the House of Representatives in June 2009 would impose a cap-and-trade system to ratchet down GHG emissions from a broad range of sources. Once fully underway in 2016, the cap would cover nearly 85% of US GHG emissions. The cap would reduce emissions from covered sectors by 17% below 2005 levels by the year 2020, and by 83% below 2005 levels (80% below 1990 levels) by the year 2050. These targets, applied to a program of such broad scope, would represent the most ambitious effort to date taken by any country to reduce GHG emissions.
- The proposed legislation provides several points of entry for other countries to gain access to the US carbon market. This would help anchor a new bilateral approach to expanding carbon markets that can be a useful complement to the international agreement being negotiated under the auspices of the United Nations Framework Convention on Climate Change.

- In particular, US GHG allowances would be fully fungible with credits from other emission trading systems with absolute caps on emissions, and similarly stringent monitoring and verification protocols. Moreover, 1 to 1.5 billion tons of emissions from covered US sources could be offset by verified emissions reductions elsewhere in the world, in the form of credits for reduced emissions from tropical deforestation, credits for sector-wide emissions reductions in developing countries, and project-based offset credits such as Certified Emissions Reductions under the Clean Development Mechanism.
- Initially, two-thirds of allowances would be allocated for free, another one-sixth given to state governments to fund energy efficiency, clean tech research, and adaptation. Over the life of the program, 4% of the value of the allowances (an estimated USD 50 billion in present value) would be put aside to fund reductions in tropical deforestation, with another 5% (USD 70 billion) for international adaptation and international clean technology transfer.

On June 26, 2009, the US House of Representatives passed a sweeping bill that would reduce US greenhouse gas (GHG) emissions by 17% below 2005 levels by 2020, and 83% below 2005 levels by 2050. If the momentum from the House bill can be carried on through the Senate, the United States may at last be taking on meaningful domestic action, on the eve of the international negotiations in Copenhagen in December 2009. This chapter sketches the key features of the House bill, focusing on the provisions that would allow linkages between the US carbon market and emissions reduction efforts in other countries.

Overview of the House Bill

The American Clean Energy and Security Act (ACES), sponsored by Henry Waxman (Democrat of California) and Ed Markey (Democrat of Massachusetts), is a comprehensive energy and climate bill. At its heart is a cap-and-trade program that would put a declining limit on allowable GHG emissions from most of the US economy, including all CO₂ emissions from fossil energy use as well as process emissions (of CO₂ and other GHGs) from large industrial facilities. (A separate cap would limit the import and consumption of hydrofluorocarbons.) Sources covered

by the cap would be required to submit one allowance for each ton of GHG emissions in each year; the allowances would be fully tradable and bankable. Covered sources could also meet their compliance obligations by purchasing credits for verified emissions reductions from the US forestry and agricultural sectors, as well as from international sources (as discussed later in the chapter).

The cap would take effect in 2012, covering the electric power sector and transportation fuel producers, together accounting for roughly two-thirds of US emissions in 2005. Fuels producers would be responsible for the carbon content of their fuels—that is, the eventual tailpipe emissions from combustion. The cap would be extended to cover major industrial sources in 2014, increasing coverage to just over 75% of 2005 baseline emissions; it would be fully phased in by 2016, when the inclusion of natural gas would increase coverage to nearly 85% of baseline emissions. The cap would decline over time; in 2012, it would limit emissions by covered sources to 97% of their 2005 levels, declining to 83% in 2020, 58% in 2030, and 17% in 2050.

In the initial years, roughly two-thirds of allowances would be allocated gratis to regulated emitters or energy consumers; one-sixth would be allocated to State governments and other non-emitters to fund energy efficiency, clean energy research, adaptation, reductions in tropical deforestation, and other public purposes; the remaining one-sixth would be auctioned by the federal government, with most of the proceeds going to fund tax credits for low-income households. By 2035, the free allocation would be almost entirely phased out. Over the span of the program, the bill would set aside 4% of cumulative allowances (worth an estimated USD 50 billion in present value) to fund reductions in tropical deforestation, along with another 5% of allowances (USD 70 billion) to finance international adaptation and international clean technology transfer.

In addition to the cap-and-trade provisions, ACES contains a range of complementary measures designed to spur energy efficiency and renewable energy, including a combined renewable energy/energy efficiency standard for the electric power sector; strengthened energy efficiency standards for buildings and appliances; performance standards on new coal-fired power plants; and performance standards for industrial sources of emissions below the minimum threshold needed to qualify under the cap-and-trade program. Taken together, the entire bill—including the cap-and-trade provisions, the complementary measures, and supplemental

reductions from tropical deforestation achieved through allowances set aside for that purpose—is designed to reduce net US GHG emissions by 20% below 2005 levels by the year 2020, falling to 83% below 2005 levels by 2050.

While the US has lagged behind other developed countries in its commitment to reduce GHG emissions—most noticeably by choosing not to sign the Kyoto Protocol—the proposed legislation represents a sea change. If enacted, it would become the most ambitious GHG emissions reduction program anywhere in the world.

Although the required reductions appear less stringent than those already adopted by the EU, when compared to the 1990 baseline commonly used in international negotiations, that baseline obscures the fundamental changes in the structure of Europe's economies that have occurred since 1990. These include the economic collapse in countries of the former Soviet Union and the ensuing decrease in emissions throughout Eastern Europe, the reunification of Germany (and the subsequent shuttering of highly polluting, inefficient East German factories), and the deregulation of the electric power sector in the United Kingdom (with its attendant dramatic fall in Britain's reliance on coal-fired electricity generation). When compared to the proper counterfactual—emissions in the absence of climate policy—the targets embodied in the proposed US legislation turn out to be at least as stringent as the current EU target.

In addition, the US legislation caps GHG emissions through the middle of the century, specifying a cap for every year through 2050. (In contrast, the current commitment protocol under the Kyoto Protocol lasts only through 2012.) Such a long time horizon is crucially important to provide the clear signals needed to shape investment decisions.

International Linkages under the Proposed Legislation

Of particular relevance, from the perspective of international carbon finance, are the provisions in ACES that would establish links between the US carbon market and emissions reduction or abatement activities in other countries. These various links can be thought of as distinct points of entry into the US carbon market. First, the bill provides for unlimited linkage (full fungibility of allowances) with emission trading systems in other countries, as long as those countries impose mandatory absolute

tonnage limits on total GHG emissions at the national or sectoral level, and establish provisions for monitoring, enforcement, and offset quality that are at least as stringent as those under the US program. (Thus allowances issued under the European Union's Emissions Trading Scheme could almost certainly be tendered for compliance with the US system.) The determination of which countries would be eligible for this linkage provision is assigned to the Environmental Protection Agency (EPA), in consultation with the Secretary of State.

Second, ACES would allow covered entities to offset up to 1 billion tons of emissions annually, using credits for verified emissions reductions in developing countries (with the limit applied on a pro-rated basis for individual emitters); as many as 1.5 billion tons could be offset with international credits if the supply of domestic offset credits were limited. Beginning in 2017, international credits are subject to a 20% discount, meaning that emitters must submit 5 credits to offset 4 tons of emissions. These international credits fall into three categories:

1. *International forest credits.* The bill authorizes the EPA Administrator, in consultation with the Secretary of State and the Administrator of the US Agency for International Development (USAID), to enter into agreements or arrangements with countries on reducing emissions from deforestation. To be eligible for crediting, forest nations will have to demonstrate, beginning 5 years from the start of the program (extendable 8 more years in the case of small-emitting and least developed countries), reductions in total emissions from deforestation nationwide, or in their large-emitting states or provinces, from a baseline that results in zero net deforestation within 20 years. Programs in forest nations must be undertaken in compliance with rigorous monitoring and accounting standards, and in consultation with local communities, indigenous peoples, and other stakeholders. In addition, the bill sets aside 5% of the total US allowance pool to assist tropical forest nations in preparing to participate in this program, to preserve existing forest stocks, and to achieve supplemental reductions of 720 million metric tons in 2020, and cumulative reductions of 6 billion metric tons by 2025.
2. *Sectoral credits.* The bill directs the EPA, in consultation with the Secretary of State, to identify sectors and countries that are suitable for crediting on a sectoral basis—meaning that credits are awarded

only if the sector as a whole reduces emissions below a specified baseline. Sectoral crediting would apply to developing countries with high GHG emissions and comparatively high levels of income, for sectors that would be capped if they were in the United States. To gain access to the US market through this sectoral crediting program, listed nations would have to establish a domestically enforceable sectoral baseline of absolute emissions, set at levels below business as usual and consistent with a goal of limiting global warming to 2°C relative to preindustrial levels (equivalently, limiting atmospheric GHG concentrations to 450 ppm CO₂e).

The clear and explicit insistence on meaningful absolute baselines measured in tons—as opposed to no-lose sectoral intensity targets measured in tons per unit of output—is a crucial feature of the legislation. Compared with intensity-based measures, absolute baselines provide more certainty over the resulting emissions, are less susceptible to subsequent manipulation (under intensity targets, allowable emissions depend on measures such as sectoral output, which is itself often imprecisely measured), and prepare developing countries eventually to establish a domestic cap-and-trade system of their own and become full participants in global carbon markets.

3. *Credits issued by an international body.* The bill authorizes the EPA, in consultation with the Secretary of State, to issue offset credits in exchange for international offset credits issued by a body established pursuant to the UN Framework Convention on Climate Change (UNFCCC)—as long as the EPA Administrator determined that the international body's procedures provided equal or greater assurance of the integrity of offsets relative to the US domestic offset program. For example, Certified Emissions Reductions issued under the Clean Development Mechanism (CDM) could be sold into the US market and used for compliance (subject to the 5:4 ratio on international offset credits), at least for project types for which the CDM methodologies for additionality and verification of emissions reductions were found adequate.

Starting in 2016, EPA may not issue project credits for projects in countries and sectors on the sectoral crediting list. This provision is important to create the right incentives for developing countries to move away from project-based offsets—where concerns about additionality and measurement are endemic—and towards sectoral caps.

A Two-Track Approach to Expanding Carbon Markets

One of the most significant aspects of the US legislation is its role as a harbinger of a new model for expanding carbon markets. The bill passed by the House of Representatives, with its multiple points of entry into the US carbon market, represents a parallel track to building international participation in reducing GHG emissions—one that can operate alongside (and as a complement to) the international negotiations under the auspices of the UNFCCC. The UNFCCC provides the multilateral forum for overarching tasks such as setting global targets for emissions reductions and constructing international financing arrangements for clean technology and adaptation. ACES, on the other hand, would establish a bilateral process by which the US could grant access to its carbon market to specific countries—in the form of credits for tropical deforestation, or for sector-wide emissions reductions, or for project-based offsets.

Some critics will surely argue that allowing individual countries to set the rules for access to their carbon markets will undermine efforts to build a single global market. A parallel US system for approving offset credits would likely require a separate set of criteria for additionality as well as for monitoring, reporting, and verification protocols, potentially adding a further hurdle to the development of emissions reductions projects in developing countries. The benefits of a parallel track, however, would outweigh any drawbacks. First, the ability of developed countries to set the terms of access to their markets will be crucial from a political perspective. In the US Congress, for example, one of the most important issues in the debate about climate legislation is whether and when major developing economies like China and India will accept binding limits on their emissions. By setting a high bar for emission reduction credits from other countries, Congress can create the incentive structure that will encourage other countries to act—and therefore help to assuage domestic concerns about taking action in the absence of commitments from other countries.

Second, a parallel approach offers an additional mechanism to encourage (and reward) emissions reductions in major emitting developing countries, in the event that international negotiations are deadlocked or delayed.

Finally, a parallel approach has the potential to create a virtuous cycle in carbon markets. A country that imposes relatively stringent criteria will limit the supply of credits available in its market, effectively driving up their price—creating a stronger incentive for developing countries to

meet the more stringent criteria. In effect, this is a carbon-market version of the so-called “California effect”—the positive dynamic that occurs when one (sufficiently large) jurisdiction imposes a higher standard on products and thereby raises the bar for an entire industry.

The US stands on the cusp of a landmark achievement. Climate legislation along the lines of what has already passed the House of Representatives would vault the US to a position of leadership in the international arena, after over a dozen years of lagging behind. As importantly, US action on climate has the potential to induce leading developing economies to reduce their emissions in order to sell credits into a US cap-and-trade system—keeping costs low for American consumers and businesses while securing meaningful emissions reductions around the world and preparing the groundwork for a truly global carbon market.

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NOTES

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Chapter 24



The EU ETS

Experience to Date and Lessons for the Future

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Key Points

- The EU has learned valuable lessons about the effective structure and governance of carbon markets through its experience with Phases I and II of the EU ETS. The scheme has moved the EU towards expected full compliance with its Kyoto commitments. Plans for post-2012 provide for higher levels of auctioning, wider coverage of gases and industry, and a more centralized and harmonized scheme overall.
- There has been some difficulty—especially recently—in creating a sufficiently high price on carbon to incentivize a significant shift towards a low-carbon economy, but a combination of a lower cap for Phase III that decreases annually after 2020 (promising long-term certainty) and other policy measures (such as subsidies and renewable energy standards) should promote such a shift.
- In its 20:20:20 package for Copenhagen, the EU has committed to 20% cuts below 1990 levels regardless of the outcome of international negotiations. If a satisfactory agreement on multilateral limitations commitments can be reached, the figure rises to 30%, paving the way towards an OECD-wide carbon market by 2015 and a wider global carbon market after that, with the CDM continuing to play a role but in a reformed, refocused, and more limited way.

- Even though the EU ETS provides the main source of demand for CERs, the CDM has fallen short in stimulating sufficient broad-based mitigation activity in developing countries. A stepping stone between the current state of affairs and assumption by major developing countries of a full cap-and-trade system is required. The EU has proposed adoption of sectoral crediting mechanisms to deliver both the necessary changes in actions and the requisite funding. The EU's de facto control over significant private-sector financial flows to the developing world through the offset crediting features of the EU ETS will likely enable it to secure adoption of this approach.

Experience to Date

Operating from 2005 to 2007, Phase I had a cap of 2.4 billion allowances per year. This first period was highly effective in making boardrooms aware of carbon risks and opportunities and stimulating the search for abatement opportunities. Further, the infrastructure of a functional, liquid market was successfully created. Phase I did, however, encounter problems. Allocations were not based on verified emissions. Also, companies were able to achieve steep initial reductions by exploiting cheap abatement opportunities previously overlooked. The result was a deep drop in allowance prices. The European Union (EU) responded by placing a firewall between Phases I and II by not allowing banking, thereby protecting Phase II from a flood of cheap allowances.

Currently the EU Emissions Trading System (EU ETS) is in Phase II (2008–12). The cap, significantly reduced from Phase I, is 2.08 billion allowances per year, 6.5% below verified emissions for 2005. The data received by the Commission indicate that there has been a sufficient drop in total EU emissions to make full compliance with Kyoto commitments appear likely. The use of certified emissions reductions (CER) and emission reduction units (ERU) offset credits from the Clean Development Mechanism (CDM) and Joint Implementation (JI) projects, authorized through the Linking Directive, has helped to lower compliance costs within the EU and generated significant levels of private investment in mitigation projects in a limited number of developing countries. The EU has placed a variety of both qualitative and quantitative limits on recognition of offset credits in order to protect the environmental integrity of the ETS from unsound credits or hot air credits, demonstrating the feasibility of both

kinds of regulation. Because the EU provides most of the demand for CERs, the EU regulations demonstrate the potential for recipient cap-and-trade systems to profoundly affect the norms and practices for generating offset credits. The functional extension of the EU ETS to the countries of the European Economic Area, the linkage of the EU ETS to the Kyoto offset credit mechanisms, and the related switching of central registries from the EU-based Community Independent Transaction Log to the UN-based International Transaction Log are promising indications of the prospects for future linking of carbon markets.

One major lesson from both phases is that the initial allowance distribution process, based on grandfathered free allocation, is cumbersome, and a National Allocation Plan (NAP) system, under which allowance allocation was delegated to member states, fails to ensure the environmental integrity of the resulting cap. There were very different allocation methods in different member states' NAPs, leading to different treatment of similar types of industry. Auctioning of allowances by member states has been extremely limited (around 4%). These problems have spurred corrective measures in the design of the post-2012 ETS.

Reform

The EU ETS has been established as the core of EU climate policy and will continue in that role, although it currently covers only 41% of EU greenhouse gas (GHG) emissions; significant emitting sectors—including transport, aviation, and agriculture—are not subject to the ETS, being regulated by other policies and measures, but are being considered for inclusion at a later date. Legislation has already been put in place for the 2020 objectives, which include a goal to reduce economy-wide GHG emissions by 20% below 1990 levels regardless of what other jurisdictions do. The target will be raised to a 30% reduction if a new global framework can be agreed upon, although the difficult issue of how the burden of additional reductions will be allocated among the member states has yet to be agreed upon.

At the core of Phase III is a single EU-wide cap rather than independent caps for member states, thus abandoning the NAP system in favor of a centrally administered approach. Phase III requires emissions from sectors covered by the ETS to be reduced 21% below 2005 emissions. Domestic offsets are also being considered, along with coverage of additional

gases and more industrial sectors, to bring nearly 50% of EU GHG emissions within the ETS. Also important is that the new legislation sets a policy of continuous reductions of 1.74% per annum beyond the end of Phase III in an effort to provide a degree of long-term regulatory certainty that has been lacking. Phase III requires a fully harmonized allocation process in which auctioning is the default allocation method: by 2013 more than 50% auctioning is anticipated, rising to 70% by 2020 and 100% by 2027. Member states must also use 50% of auction revenue for “climate purposes.” A novel feature will be the ability to auction allowances early or auction more new entrant allowances to existing entities if the price spikes significantly in a short space of time.

Another significant feature of Phase III is that it provides a guaranteed level of demand for CDM and JI credits post-2012, although greater scrutiny of offset quality is to be expected, and quantitative limits will ensure that the Kyoto requirement of supplementarity will be preserved.

The difficulty in creating a sufficiently high price to incentivize domestic industry to develop and adopt more expensive forms of technology-intensive abatement such as carbon capture and storage (CCS) has been noted. Not all of this is necessarily due to the cap-setting and allocation decisions: it may also be due to the current economic climate and to lack of predictability on long-term policy, although it is difficult to distill the driving factors. It is hoped that consensus on international mitigation commitments can be reached in Copenhagen so as to trigger the 30% cut in EU emissions, which will drive the price path further up and promote long-term regulatory certainty. Other policy instruments, such as the renewable energy mandates and direct subsidies from the economic stimulus package, have also been adopted to stimulate a shift to low-carbon investment, and steps are underway to double R&D funding for low-emissions technology by 2012 and quadruple it by 2020.

International Offset Use

The EU ETS has, to date, been the main source of demand for CDM and JI credits. The EU has welcomed the CDM's contributions in engaging developing countries in carbon markets and stimulating investors and entrepreneurs to actively explore opportunities for reductions. The CDM has also proven an important cost-containment mechanism for Annex I

Parties and regulated firms. There are, however, important weaknesses in the CDM. As a project-based mechanism, it involves cumbersome procedures and large transaction costs, and it significantly limits the scale of mitigating activities. There have also been difficulties in ensuring the environmental integrity of CERs because of problems in defining baselines and applying additionality criteria and questions about the reliability of monitoring, recording, and verification (MRV) arrangements. Because the CDM provides and the EU ETS uses offset credits for reductions on a 1:1 basis, even environmentally sound projects do not reduce overall global emissions but simply relocate them from developing to developed countries, while unsound projects may actually lead to emissions increases. The participation of only a limited number of developing countries is also problematic. There is thus a major need for change if the CDM is to play a key role at the necessary scale in a global carbon market.

The EU has continually stressed the need for reform of the CDM to ensure that only projects that deliver real and additional reductions are credited and to extend the mechanism's reach beyond the low-hanging fruits of the very cheapest abatement opportunities. The EU does not advocate a total halt of the CDM by 2013, believing that a reformed CDM can and should play an important role not only in least developed countries (LDCs) but also in some sectors in key developing countries not suited for application of sectoral crediting mechanisms. It does, however, envisage that it will impose additional regulatory restrictions on recognition of CERs for the EU ETS, although details will depend on Copenhagen.

The EU's Vision for the Future

Progress has been made on developing the EU's long-term climate goals: the 20:20:20 by 2020 unilateral pledge, the 2020 objective of 30% below 1990 levels for the developed countries as a group, a stated undertaking to work with developing countries to reduce their business-as-usual (BAU) emissions by 15–30%, the 2050 global and developed country objectives, and, crucially, the overall objective of limiting warming to 2°C, which informs all of the others.

The EU Copenhagen Communication also includes a vision for the future of climate markets. It calls for linking the domestic cap-and-trade systems that will be adopted in the coming years to create a global carbon

market, with a linked EU and US cap-and-trade system as the nucleus. The EU wants to see a robust Organisation for Economic Co-operation and Development (OECD)-wide carbon market by 2015, while exploring options for extending this network to other economically advanced countries by 2020. The European Commission's membership in the International Carbon Action Partnership (ICAP), a forum to share experiences and knowledge with the goal of linking climate markets, is a first step in this direction.

To help achieve the EU's goal of adoption by all developing countries of low-carbon development strategies by 2011, an international registry has been proposed in which all mitigation and adaptation measures taken by developing countries are recorded and can be transparently assessed. Developing country plans should have technical expertise to back them, which developed nations should help provide.

In addition to an improved CDM, there is a pressing need for a new mechanism to act as a stepping stone between project-based crediting and cap-and-trade in developing countries. The EU advocates the use of a sectoral offset crediting mechanism with baselines set below BAU, with the ultimate objective of phasing it out over time as participating developing countries adopt cap-and-trade systems that are linked to the global cap-and-trade allowance market. The sectoral mechanism envisaged would initially focus on the electric power sector and on sectors, such as aluminum and cement, that are subject to intense international competition. The EU has stated a preference for multilateral rather than unilateral criteria for such crediting mechanisms, which, it is hoped, will generate a substantial portion of the developing country mitigation investments required to achieve the 2°C goal. Other EU suggestions to raise the necessary funds from the developed world for developing country mitigation include payments into a central fund based on a formula that takes into account responsibility and ability to pay, and global allowance auctions.

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Chapter 25



Greenhouse Gas Emissions and Mitigation Measures in China

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Key Points

- Although China's GHG emissions account for 20% of the world's total, its per capita levels are still relatively low.
- China has already begun taking significant actions to mitigate future emissions growth, including adopting a goal of reducing emissions by 20% per unit of GDP by 2010.
- China views the transition to a low-carbon economy as an opportunity to develop valuable intellectual property rights and brands with global reach.

While China is currently responsible for 20% of global greenhouse gas (GHG) emissions, its per capita emissions levels are relatively low. As a result of its share of global emissions, industrialized nations have been pressuring China to adopt binding emissions caps. However, China has so far refused. Many may interpret China's reluctance to commit to a binding cap as a reluctance to confront the challenges of global warming. This is not the case. In fact, China is already heavily investing in major emissions reductions across a wide variety of sectors, in spite of the challenges these measures present to China's efforts to raise living standards for its population.

Furthermore, many in China have come to see the growing market for sustainable technology as an opportunity to diversify, further its economic growth, and reduce its foreign trade dependence (71% in 2007). Recently, Chinese companies have seen many successes in wind and solar energy, electric vehicles, and ultra-supercritical thermal power manufacturing. In light of these successes, many in the Chinese government believe that a global transition to more sustainable technologies will present an ideal opportunity for China to improve its research and development capacity, gain intellectual property rights for globally competitive technologies, and develop strong Chinese brands with global reach.

Basic Facts about China's GHGs Emission

The rapid economic growth and urbanization of China present both huge challenges and opportunities. In 2007, China's total emissions reached 760 million tons CO₂e, accounting for 20% of the world's total emissions. For the first time, China surpassed the United States as the largest emitter of greenhouse gases. However, its per capita emissions rate is only 4.3 tons CO₂, lower than the rate of all industrialized nations and far lower than the US's rate of 19.9 tons CO₂.

For a number of reasons, China's emissions are likely to increase, and will only be mitigated with the rapid deployment of carbon-neutral technology. First, China is undergoing a particularly energy-intensive period to meet the requirements of infrastructure constructions and improvements in its citizens' living conditions. Consequently, industrial emissions account for 70% of its total, as opposed to 18% in the US. However, this percentage is likely to decrease in the future.

Second, China essentially functions as the world's factory. Fully 20% of China's emissions originate in manufacturing and transport of goods for export. Such export emissions are likely to constitute a substantial portion of China's overall emissions for the foreseeable future.

Third, if China maintains 7.8% annual gross domestic product (GDP) growth, its business-as-usual (BAU) emissions will grow 3.1% annually. Under these assumptions, China's emissions growth will increase 113% from 2005 levels by 2030.

In light of these facts, transitioning to low-carbon technologies will benefit both China's energy security and global climate change mitigation efforts.

China's Domestic Mitigation Actions

In 2006, China launched its first national energy efficiency target: to reduce energy consumption across the economy by 20% per unit of GDP by 2010. This is part of China's eleventh five-year plan, and the target has been allocated to various sub-national governments.

In addition to the economy-wide target, China has designed and rolled out many more specific implementation programs over the years, including:

- *Industrial sector:* The Medium and Long Term Energy Conservation Plan contains medium- and long-term energy efficiency objectives for a dozen major industrial products, including steel, copper, and cement. It also includes targets for major energy-consuming equipment, such as coal-fired industrial boilers, medium- and small-sized motors, and specific industrial processes. This project will cost the public and private sectors more than USD 55 billion. It will save about 300 million tons coal equivalent and account for roughly 40% of the total reductions necessary to reach the national energy efficiency goal. The Top-1,000 Energy-Consuming Enterprises program is a central part of this effort. Under this program, energy efficiency targets were assigned for 1,000 major Chinese enterprises which collectively account for 47% of China's total industrial emissions. Key features of this plan include energy auditing and management institutions developed with the assistance of the government. The total anticipated savings are 100 million tons coal equivalent.
- *Power sector:* The power sector is responsible for 50% of the China's total emissions. Emissions will be limited by both increasing the capacity of renewable energy and improving the energy efficiency of the conventional power sector. Measures intended to increase efficiency of the traditional power sector include the replacement of small units with large ones to increase single-unit capacity; the development of cogeneration and related technologies; the promotion of large grid interconnection and efficient grid operation technology; and the replacement of small oil-fired generating units with units powered by natural gas. Additionally, 5% of the total power generation capacity was prematurely retired in 2006—mostly carbon-intensive plants. The national Ultra High Voltage Grid and Strong Smart Grid plans have also been rolled out recently to improve the

electricity transmission efficiency. From 2006 to 2007, the coal combustion efficiency increased 7% in thermal power sector due to these measures. China's Medium and Long Term Development Plan of Renewable Energy contains several specific targets intended to increase the importance of renewable energy: by 2010, the consumption of renewable energy will account for 10% of total consumption; by 2020, this proportion will increase to 15%.

- *Building sector:* Major policy goals include national design standards mandating 50% energy conservation for all newly constructed buildings, as well as more stringent standards mandating 65% energy conservation for new buildings in 4 municipalities and some other major cities, such as Beijing, Tianjin, Chengdu, and Chongqing. These measures should result in a 240 million ton carbon dioxide equivalent (CO₂e) reduction, which will account for 21% of China's entire energy conservation plan.
- *Transportation sector:* China also intends to increase the availability of public transportation and use of energy efficient vehicle technology. In the next three years, China plans to invest USD 500 billion on new railway construction. The Adjustment and Revitalization Plan of Automobile Industry, released by the State Council in March 2009, proposes that China increase the share of new energy vehicles and compact vehicles to about 5% of new auto sales from 2009 to 2011.

According to Chinese Development and Reform Committee's statistics, a successful reduction of national emissions by 20% per unit of GDP will result in a 750 million ton CO₂e reduction and conserve 300 million tons of coal equivalent. These reductions would be larger than the cumulative reductions made by Annex I countries under the Kyoto Protocol during the first commitment period.

The Perspective

China hopes that by rapidly scaling up the implementation of new technologies, it will rapidly reduce costs through economies of scale and development of new technology. Technology is the engine, policy the wheel, and finance the fuel. The hope is that by providing the right policy incentives, finance will flow to technology innovation and deployment. China

has actively encouraged this process, even during the economic downturn. Although global demand for low-carbon technology declined, the Chinese government decided to grow the domestic market for low-carbon manufacturing to compensate for the shortfall in global demand.

One example of this strategy has been the implementation of ultra-supercritical power plants to replace older, less efficient power plants. From 2004 on, new plants that exceed 600 MW being brought online must use supercritical and ultra-supercritical thermal power technology.

Due to the scale of new power plant construction, the cost of those new technologies has dropped significantly. As a result, ultra-supercritical devices are able to compete with older, less efficient subcritical technology.

China has attempted to adopt a similar approach to the renewable energy market, including wind energy, solar energy, and electric vehicles. According to the industry association, the per unit cost of wind energy installation in China is now 30% lower than it was 3 years ago.

Conclusion

China understands the significant challenges that global warming presents and has initiated serious measures across wide sectors of its economy to address the problem. Although it has not committed to a binding cap, its GHG reductions could potentially, within a matter of only five years, match the reductions made by Annex I nations under the Kyoto Protocol. China further sees the spread of low-carbon technologies as an opportunity to diversify and strengthen its economy through the development of valuable intellectual property rights and brands.

FURTHER READING

On Chinese domestic mitigation actions and its monitoring, reporting, and verification (MRV) potentials, see *Mitigation Actions in China: Measurement, Reporting and Verification*, Working Paper of World Resource Institute, on behalf of Third Generation Environmentalism, available at http://pdf.wri.org/working_papers/china_mrv.pdf.

For more on Chinese domestic action with figures, see Julian Wong and Andrew Light, *China Begins Its Transition to a Clean-Energy Economy—China's Climate Progress by the Numbers* (Center for American Progress, 2009), available at http://www.americanprogress.org/issues/2009/06/china_energy_numbers.html.

For another summary of recent national mitigation policies, see Pew Center on Global Climate Change, *Climate Change Mitigation Measures in the People's Republic of China* (2007), available at <http://www.pewclimate.org/docUploads/International%20Brief%20-%20China.pdf>.



Cities and GHG Emissions Reductions

An Opportunity We Cannot Afford to Miss

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Key Points

- Lower-carbon cities can substantially contribute towards mitigation efforts. Existing variations in energy use across cities have roots in local and national policies as well as patterns of behavior and cultural norms, all of which can be altered to reduce carbon intensity.
- Reducing carbon intensity of cities may not only require many conventional urban policies on financing and building codes to be re-examined, but also other macro policies such as tax breaks for homeownership and fiscal transfers to local government may need a fresh look. In particular, without changes in individual behavior, low-carbon cities are unlikely.
- Due to the rapid pace of urbanization and the immense lock-in effects once urban capital stock is built, policymakers may need to act even if the outcomes are uncertain. The wait for more clarity may be interminable and the consequences irredeemable.

Urban areas consumed about two-thirds of the world's energy in 2006. This is expected to increase to three-fourths by 2030. However, even in cities at similar levels of development, per capita urban energy use, and thus GHG emissions per capita, varies considerably. In light of this variation, would it be possible for governments to enact policies to promote

less carbon-intensive cities? If so, what role could such policies play in a new climate change agreement?

An Underappreciated Opportunity

The average urban American consumes more than twice as much energy as the average urban European. Cities like Hong Kong, Tokyo, Singapore, and Amsterdam require less than a seventh of the energy of Houston, Phoenix, Detroit, and Denver to meet their transportation needs. Even within the United States, per capita energy consumption varies by a factor of three across cities. Many developing countries, especially India and China, are rapidly urbanizing, and similar discrepancies are beginning to emerge in these countries. For instance in China, energy use varies by a factor of seven from Chongqing to Hohhot, depending on income, climate, and energy intensity of industries. Given this variation, energy paths chosen by cities in emerging economies will have a huge impact on global GHG emission levels. In fact, lower-carbon cities could contribute over a third of the carbon mitigation in countries like India by 2050. This is an opportunity too big to miss.

Unfortunately, changes in city forms, behavior, and building types do not appear to be part of the mainstream climate change discussion. McKinsey's GHG cost curve, discussed extensively in this book, assumes very limited savings from behavior changes. The UNFCCC, in their "Investment and Financial Flows to Address Climate Change" in 2007, avers that "nearly all additional transport investment needed under the mitigation scenario is for the purchase of motor vehicles and production of transport fuels, [and] there will be no significant change to large transport infrastructure investments between the reference and mitigation scenarios." It also assumes that "most emission reductions in the buildings sector result from increased efficiency of appliances, space and water heating and cooling systems, and lighting."

What Opportunities Exist to Influence Energy Consumption in Cities?

Can policy actually make cities more compact, increase use of public transport, and affect building form? In order to encourage the development of

more energy efficient cities, we first need to identify factors that may help explain variations in energy use across cities. While there is still debate, there seem to be some broad commonalities among cities with low energy use. Compactness of course helps, as residents travel less and use more public transportation. But building types, and the interaction of building type with behavior, seem to matter as well. In a survey in Taiwan, Hwang et al. (2009) found that 57% of respondents used the air-conditioner at work when they felt warm, but only 16% did so at home, while 58% used the fan or opened a window. While who paid the bill must have been relevant, it was also true that “only a quarter of workplaces . . . visited [were] equipped with fan or [had] . . . operable windows.”

Nivola (1999) asked why European cities were more compact than American ones and offered the following answers: (a) less inner-city crime and (b) more investment in mass transit instead of highways, but also (c) agricultural support that raised land prices, (d) tax breaks for homeownership, (e) higher fuel and car taxes, (f) higher gas and electricity prices that make large homes and appliances expensive, and (g) higher share of transfers to local government. Thus, in addition to local policies, macro policies too appear to affect urban form, albeit in a complex and often poorly understood manner.

Even if these policies change, cities are limited in their response by the lock-in effect. This refers to the often-substantial impact of existing urban capital and systems on the cost of change. For example, Atlanta, where only 4.5% of the trips are by public transport, would need to increase its 74 km of track by 46 times and add 2,800 stations to get the same level of metro accessibility as similarly sized Barcelona, where 30% of trips use public transport, even though it has only 99 km of track and 136 stations. The lock-in effect has two major implications. First, proposals to change existing urban environments will be expensive. Second, the later one acts, the more new urban development will be locked into forms that are not compact and energy efficient.

Specific Policy Options

These complexities and lock-in effects make changing urban form and behavior a wicked problem, one that is almost incapable of resolution. A re-examination of some common urban policies below from a climate change perspective illustrates this difficulty of crafting solutions.

Property Taxes

Does the use of property taxes as the mainstay of local financing induce sprawl by discouraging densification since that leads to increase in taxable value or even by giving small groups the ability to choose their taxation levels by incorporating a new town? If so, an inter-governmental fiscal system that limits local taxes and relies more on statutory transfers to local governments and user fees may encourage more large, compact cities and fewer small towns.

Tax Benefits for Homeownership

Similarly, tax benefits for homeownership promote development of locations with low land values and hence home prices, usually at the fringes of the existing city. Disjunctions between home and work locations increase travel demand as homeownership deters relocation closer to work. Transport demand could fall if more people rent rather than own their homes. Increasing the supply of rental housing and making homeownership less aspirational could be critical to a low-carbon city.

LEED-Certified Modern Buildings

Moving from sprawl to aesthetics, is a modern building just glass, steel, and central air-conditioning? LEED-certified modern buildings are now visible in India and China, but do they reduce actual energy consumption? Newsham et al. (2009) find that, while, as a group, LEED buildings consumed less energy per unit area, up to a third of them used more energy than their conventional counterparts and higher levels of certification did not imply better energy efficiency.

Climate-Responsive Architecture and Behavioral Change

There are other approaches to modern building that challenge the conventional aesthetic imagination. Jiang Yi (2009) posits two philosophies of building design and use, viz.: 人定胜天 (Rén dìng shèng tiān), i.e., the triumph of man over nature, vis-à-vis 天人合一 (Tiān rén hé yī), i.e., the oneness of man and nature. Climate-responsive architecture, which leverages climatic resources to reduce use of energy for heating, cooling, and

lighting of buildings, and part-time, part-space air-conditioning (even if by relatively inefficient equipment) fosters user tolerance for a wide range of indoor temperatures and may use much less energy than centrally air-conditioned spaces with more energy efficient equipment.

Culture and patterns of behavior are clearly important. The characterization of Europeans as people who wear sweaters indoors in winter and Americans as those who do the same in summer may be apocryphal, but it does point to behavior and culture as being critical elements. These differences may have roots in deeper cultural orientations. Is it possible that China and India, with distinct cultural sensibilities, will think and thus build differently than Western nations? Can their construction workforce, at the bottom of their labor totem pole, acquire the ability to erect such buildings?

Implementing Change: Governance and Ethical Concerns

Finally, who will make decisions about what policies to implement and how to finance them? Different layers of governance—international, national, and local—will all need to be involved in different capacities to influence urban energy consumption. For example, global agreements are needed to make international financial flows possible; action by national governments is required to change the tax structure, and only local governments are likely to be able to ensure building codes appropriate to their local environment.

These issues of multi-level governance are further complicated by matters of detail. If Annex I countries do decide to finance more efficient city building in developing countries, how should these transfers be structured? Approaches centered on crediting, which tend to rely on a form of BAU baseline or efficiency target, are unsuited for these kinds of systemic changes. Conditioning on GHG reduction would deny the uncertain and complex linkages between action and outcome. Instead, a specialized fund can support a set of measurable, reportable, and verifiable (MRV) climate-friendly actions in cities through the provision of long-term low-interest loans or interest-free, non-repayable financial transfers.

But even if this were acceptable, can parties agree on the kind of investments to support? Should public transport be rail or road based? Do gas pipelines qualify—because they encourage fuel switching in transport and facilitate load-center gas plants? What about water recycling to

reduce energy use in transporting water? Does public rental housing, as in Hong Kong, and the additional cost for low-carbon cement qualify? Finally, should one country's taxpayer pay for cutting property taxes in another?

This paper also raises a broader concern: should international actors try to influence societal behavior in individual countries? Cultural relativism advocates caution in efforts to induce behavioral changes. However, without changes in behavior, low-carbon cities are unlikely. A second question is whether efforts to change behavior are preposterous. A good response to this is the anti-smoking campaign. This is, however, not a first-choice strategy for the OECD countries, as illustrated by their focus on energy efficiency and technological fixes to decarbonize their cities. Still, this does not change the fact that, regardless of how efficient Atlanta's cars become, its residents are likely to emit more carbon than Barcelona's.

Any attempt to reduce urban emissions is fraught with uncertainty. The choice before us is either to try to remake our cities, in spite of the uncertainty, or wait and hope that the uncertainty lessens. The risk is that the wait may be interminable and, worse, the consequences irredeemable.

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A Prototype for Strategy Change in Oil-Exporting MENA States? *The Masdar Initiative in Abu Dhabi*

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Key Points

- Masdar, supported by the Government of Abu Dhabi, is attempting to create viable renewable and clean energy solutions, to commercialize these solutions, and at the same time to create a culture of sustainable development in the MENA region.
- Masdar City, the world's first zero-carbon city, is one of the flagship projects, along with a 100 WM solar plant, an industrial hydrogen power plant, and a nationwide Carbon Capture and Storage (CCS) system.

The debate around climate change and energy security is by now well known. A key issue facing our world today is how to tackle these challenges in a way that can sustain human progress and economic development, while at the same time safeguarding our environment and the future of our planet. It is clear there is no single answer to these challenges. Rather, the solution lies in the diversification of technologies, including clean fossil fuel energy, as we transition towards a low-carbon future. It is with this in mind that Abu Dhabi launched the Masdar initiative in 2006, taking the lead in developing a new model for government and business to work together in turning the world's climate and energy challenges into opportunities for sustainable growth and economic development.

A wide-ranging, multifaceted initiative, Masdar integrates the full renewable and clean technology life-cycle—from research to commercial deployment—with the aim of creating viable alternative energy solutions in a nascent and often fragmented industry. Benefiting from the full support of the Government of Abu Dhabi, Masdar provides a platform for the development of renewable energy and low-carbon technologies at a global level while creating a new clean energy growth-generating sector in the Emirate. The initiative is driven by five key components: education and research, project development, technology funding, value chain industry, and sustainable living.

With much of the world's carbon emissions increasingly coming from power generation, Masdar's investment and project deployment strategy in Abu Dhabi is focused on deriving a considerable share of future power supply from clean energy sources. This will be achieved by leveraging two of the Emirate's great natural advantages: year-round sunshine to produce solar power, and the development of fossil-fuel-based clean power generation projects on the back of a long-established hydrocarbon sector.

Masdar has already launched a 100 MW concentrated solar power plant in Abu Dhabi which will be operational by early 2012. This will be followed by a series of similar projects combined with next-generation photovoltaic power plants in order to reach a target of 1.5 GW of solar electricity by 2020, out of a projected installed capacity of 20 GW.

However, with Abu Dhabi's rapid increase of electricity demand over the next decade, the reliance on fossil fuels will likely remain high. Masdar is working on making our dependence on fossil fuels more sustainable, by advancing and rolling out multiple clean power technologies including pre-combustion and post-combustion carbon capture solutions.

The development of a national CCS network by 2020 forms the backbone of this effort. This program consists of a series of CCS projects aimed at taking a significant cut from Abu Dhabi's carbon footprint by 2020. The Phase I project started in summer 2008 and will be completed in 2014. Once fully operational, the project will capture around 5 million tons of CO₂ per year—equivalent to removing over a million cars from the roads of the United Arab Emirates—from conventional gas-fired power plants and heavy industry, using chemical absorption technology. The CO₂ will be transported in a pipeline network for injection in Abu Dhabi onshore oil reservoirs.

Masdar has also launched the world's first industrial-scale hydrogen-based power plant. The 400 MW plant will separate natural gas into hy-

drogen and CO₂ through auto-thermal reforming. The hydrogen is then burnt to produce emissions-free electricity, while the CO₂ is captured and sent into the CCS pipeline network.

Another flagship project, and a very tangible manifestation of Masdar's vision, is Masdar City, the world's first zero-carbon, zero-waste, and zero-car community under construction at the outskirts of Abu Dhabi. The city—which upon completion will be home to 90,000 people—will be fully powered by renewable energy and will showcase advanced technology in energy efficiency and green building. It will consume around 200 MW of power, compared with 800 MW normally required by a conventional city of the same size.

Masdar City is a prototype demonstration of how clean technologies and energy efficiency solutions can be integrated to provide a healthy emission-free environment with a high quality of life. Many elements of Masdar City will serve as best-practice examples for the blueprints of new and existing cities. Masdar City will provide us with great opportunities and a new way of life: sustainable industries, green jobs, and new, clean sources of energy. It will also provide the world with a successful model of sustainable living.

We believe that all of these initiatives and projects will have a substantial and growing impact on Abu Dhabi over the coming decade in reducing emissions and developing human capital. Although Masdar is still young, it is already serving as a catalyst for change in the region and is rapidly developing into a global leader in the renewable and low-carbon space. At the same time, Masdar is laying the groundwork for a growing awareness of sustainable development in the Middle East.

