

# CLIMATE CHANGE 101

## International Action



Climate change is a global challenge and requires a global solution. Greenhouse gas emissions have the same impact on the atmosphere whether they originate in Washington, London or Beijing. To avoid dangerous climate change, emissions ultimately must be reduced worldwide. An effective global strategy requires leadership by the United States, and commitments and action by all the world's major economies.

### GLOBAL EMISSIONS

Greenhouse gas (GHG) emissions, largely carbon dioxide (CO<sub>2</sub>) from the combustion of fossil fuels, have risen dramatically since the start of the Industrial Revolution. Globally, energy-related CO<sub>2</sub> emissions have risen 145-fold since 1850—from 200 million tons to 29 billion tons a year—and are projected to rise another 36 percent by 2030 (see Figure 1).<sup>1</sup>

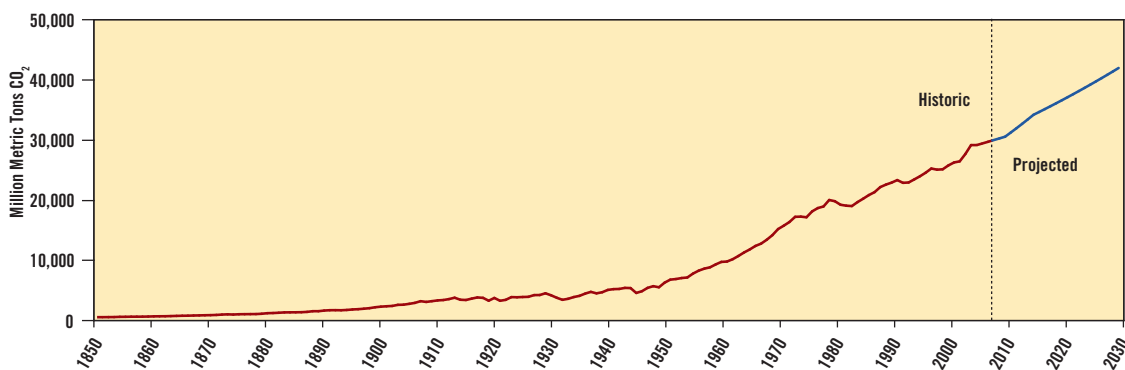
Most of the world's emissions come from a relatively small number of countries. The 20 largest emitters, with 70 percent of the world's population and 95 percent of the global gross domestic product (GDP), account for approximately 85 percent of global GHG emissions. The top six emitters—China,

the United States, the European Union (EU),<sup>2</sup> India, Russia, and Japan—accounted for more than 60 percent of global emissions in 2008. (If emissions from land use change and forestry are also taken into account, Indonesia and Brazil, with high rates of deforestation, rank among the top 5 emitters.<sup>3</sup>)

In absolute terms, China surpassed the United States in 2006 as the largest annual emitter and is currently responsible for 21 percent of global GHG emissions. The United States, with 5 percent of the world's population, is responsible for 17 percent of GHG emissions (see Figure 2).

Figure 1

**Global Carbon Dioxide Emissions 1850–2030**



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Figure 2

**GHG Emissions for Major Economies**

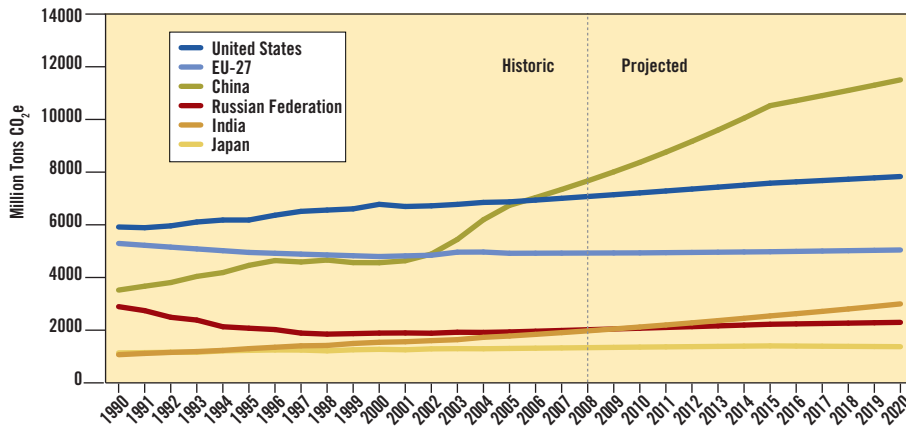


Figure 3

**Per Capita GHG Emissions 2008**

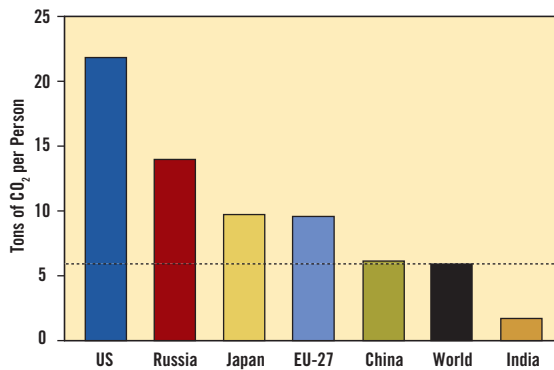
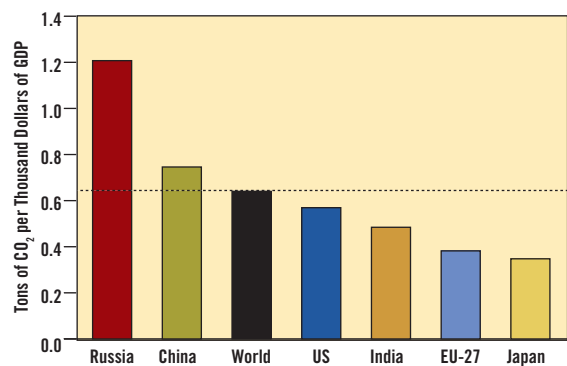


Figure 4

**GHG Intensity 2008**



On an intensity basis (emissions per GDP), U.S. emissions are significantly higher than the EU's and Japan's (see Figure 3). On a per capita basis, U.S. emissions are roughly more than twice as high as those of the EU and Japan and three and a half times the world average (see Figure 4). Looking ahead, U.S. GHG emissions are projected to remain largely flat through 2020. By comparison, emissions are projected to decline from current levels (2008) by about 4 percent in the EU and 7 percent in Japan by 2020.

Emissions are rising fastest in developing countries. China's and India's emissions are projected to grow compared to current levels by about 45 percent and 47 percent, respectively,

by 2020. Annual emissions from all developing countries surpassed those of developed countries in 2004.

As overall emissions from developing countries rise, their per capita emissions will remain much lower than those of developed countries. China's per capita emissions are expected to be a third more than the world average in 2020, but will still be about 40 percent of those of the United States. India's per capita emissions will be about one-tenth those of the United States.

Looking at emissions on a cumulative basis, the United States accounts for 30 percent of energy-related CO<sub>2</sub> emissions since 1850, while China accounts for 9 percent.<sup>4</sup> Cumulative emissions are an important measure because of the long-lasting nature of greenhouse gases in the atmosphere.

## THE INTERNATIONAL CLIMATE EFFORT

Governments launched the international climate change effort at the “Earth Summit” in 1992 with the signing of the United Nations Framework Convention on Climate Change (UNFCCC). Signed by President George H.W. Bush and ratified by the U.S. Senate, the UNFCCC now has 194 parties.

The UNFCCC set as its ultimate objective stabilizing atmospheric GHG concentrations “at a level that would prevent dangerous anthropogenic [human] interference with the climate system.” Recognizing the wide range in countries’ historical contributions to climate change and in their capacities to address it, governments agreed they had “common but differentiated responsibilities.” In keeping with that principle, developed countries agreed to “take the lead” and to assist developing countries in combating climate change. Developed countries also agreed to a non-binding “aim” of reducing their emissions to 1990 levels by 2000.

In 1995, recognizing that this voluntary target was insufficient and in most cases would not be met, governments adopted the Berlin Mandate, calling for the negotiation of binding targets for developed countries. These negotiations led in 1997 to the Kyoto Protocol. Under the Protocol, developed countries agreed to an average emission reduction of 5.2 percent below 1990 levels by 2008–2012 (the first commitment period). Individual targets range from –8 percent for EU countries to +10 percent for Iceland; the target the United States negotiated for itself was –7 percent.

Key provisions of the Protocol, urged largely by U.S. negotiators, provide countries with flexibility to meet their targets cost-effectively. These include three market-based mechanisms: international emissions trading (trading of emission allowances<sup>5</sup> among countries with targets); and Joint Implementation and

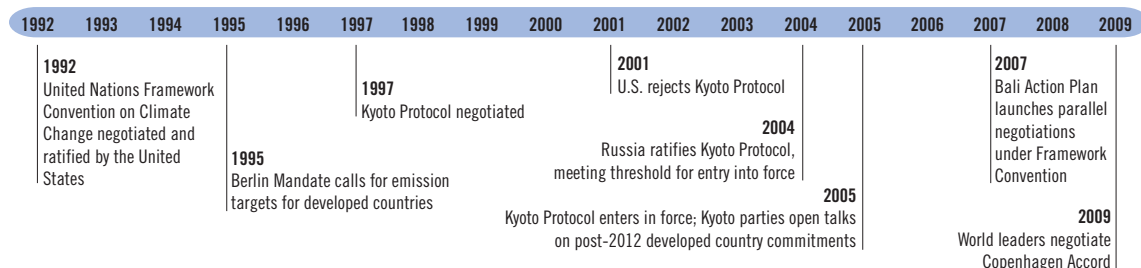
the Clean Development Mechanism (JI and CDM, which credit emission reductions from projects in developed and developing countries, respectively). Other flexibility provisions include: setting emission targets as five-year averages, rather than single-year limits; counting a “basket” of six greenhouse gases, not just carbon dioxide; and providing credit for carbon sequestration (i.e., storage) in forests and farmland.

Following the United States’ renunciation of Kyoto in early 2001, other governments completed negotiations on the Protocol’s detailed implementation rules and proceeded to ratify it. Russia’s ratification in 2004 provided the necessary quorum (at least 55 countries representing 55 percent of 1990 developed country emissions), triggering the Protocol’s entry into force in February 2005. Kyoto has now been ratified by 193 countries. The 37 industrialized countries with binding targets account for 60 percent of developed country emissions and about a quarter of global emissions.

Meeting in Montreal in 2005, parties to the Kyoto Protocol opened negotiations on post-2012 commitments for developed countries. In Bali in 2007, governments launched a parallel negotiating process under the Framework Convention, which includes the United States, with the aim of an “agreed outcome” in Copenhagen in 2009. The Bali Action Plan envisions “measurable, reportable, and verifiable” mitigation “actions or commitments” by developed countries; mitigation “actions” by developing countries; and technology, financing, and capacity-building support for developing countries.

While many parties hoped for a binding agreement in Copenhagen, the summit instead produced the Copenhagen Accord, a political agreement negotiated by a group of world leaders, including President Obama. Among its provisions, the Accord: set a long-term goal of limiting global warming to

## Timeline International Action on Climate Change



## Climate Action Around the World

Many countries have policies and programs that help reduce or avoid GHG emissions. Some are undertaken specifically to address climate change; others are driven principally by economic, energy, or development objectives, but at the same time contribute to climate efforts. In the United States, state and local governments are taking the lead. California has enacted a mandatory target to reduce statewide emissions from all sources to 1990 levels by 2020 (a 28-percent reduction compared to “business as usual” projections). Ten northeastern states have established the Regional Greenhouse Gas Initiative, a cap-and-trade program to reduce emissions from power plants. Thirty-one states and the District of Columbia require that a significant percentage of their electric power come from renewable or alternative energy sources. At the federal level, the United States has taken a number of actions, including new GHG vehicle standards and a Renewable Fuel Standard. Bills have been proposed in Congress to establish mandatory economy-wide GHG limits, but have not been enacted. (For more information on U.S. action, see three other reports in the *Climate Change 101* series: *Local Action*, *State Action*, *Federal Action*, and *Business Solutions*.) Here is a sampling of policies and programs in other major GHG-emitting countries:

### European Union

- *Kyoto Target*—Reduce EU-15 emissions 8 percent below 1990 level by 2008–2012. Individual targets for 12 new member states range from -8 to +6 percent.
- *Copenhagen Accord Pledge*—Unilateral commitment to reduce EU emissions 20 percent below 1990 levels by 2020; 30 percent below 1990 levels if other developed countries agree to comparable reductions and advanced developing countries contribute according to their capabilities and responsibilities. As part of its Climate and Energy package, the EU has established a law to enforce its unilateral 20 percent target.<sup>6</sup>
- *Emissions Trading System*—Mandatory CO<sub>2</sub> emission limits for 12,000 installations in six major industrial sectors, with emissions trading. Links to the Kyoto Protocol’s emission crediting mechanisms.

- *Renewable Energy Target*—Mandatory target of 20 percent of EU energy mix from renewable sources by 2020, including a minimum of 10 percent biofuels in overall fuel consumption.
- *Energy Efficiency Goal*—A non binding goal of energy efficiency improvement of 20 percent from projected 2020 levels.
- *Auto Fuel economy*—Mandatory standards to reduce average CO<sub>2</sub> emissions of new passenger cars from 160g/km (258g/mile) to 120g/km (193g/mile) by 2015.

### China

- *Copenhagen Accord Pledge*—Domestically binding commitment to reduce emissions intensity by 40-45 percent by 2020 compared to 2005 levels, increase share of non-fossil fuels in primary energy consumption to 15 percent by 2020, and increase forest coverage by 40 million hectares and forest stock volume by 1.3 billion cubic meters by 2020 compared to 2005 levels.
- *National Climate Change Program*—Comprehensive program adopted in 2007 outlining existing and planned policies and programs addressing climate change mitigation and adaptation. The government is also currently developing new energy and climate goals for its 12th Five Year Plan, to begin in 2011, which may include initial steps toward establishing a carbon market.
- *Energy Intensity Goals*—National goals of reducing energy intensity by 20 percent by 2010. Achieved through a combination of energy-saving initiatives including: Top 1000 Energy-Consuming Enterprises program; building more efficient coal-fired power plants and shutting down inefficient facilities; appliance standards and consumer subsidies; taxes on petroleum; and mandating provincial and local government action on energy-efficient buildings and public transportation. This will result in 1.5 billion tons of emission savings.<sup>7</sup>

## Climate Action Around the World *(continued)*

- *Renewable Energy Initiatives*—National targets for renewables to provide 15 percent of primary energy by 2020, including specific targets for wind, solar, biomass, and hydropower capacity.
- *Fuel Economy Standards*—Proposed standards for 2015 will require all urban cars and light trucks to achieve an average of 36.9 miles per gallon (mpg) (27 percent improvement over 2002 levels).<sup>8</sup>
- *Coal Levy*—Introduced a levy in July 2010 on domestic and imported coal of about 50 rupees (about \$1) per ton. The funds raised will go towards a National Clean Energy Fund.

### India

- *Copenhagen Accord Pledge*—Reduce emissions intensity (excluding agricultural emissions) 20 to 25 percent by 2020 below 2005 levels.
- *National Action Plan on Climate Change*—Comprehensive plan adopted in 2008 outlining existing and future policies and programs addressing climate change mitigation and adaptation, and directing ministries to develop detailed implementation plans.<sup>9</sup>
- *Renewable Energy*—Target of achieving installed solar capacity of 20 GW by 2022 as part of the National Action Plan on Climate Change. 19 states have renewable purchase obligations ranging from 1 to 15 percent of total electricity generation and India is launching a renewable energy certificate mechanism.
- *Energy Efficiency*—National program including energy efficiency labels for appliances, mandatory energy audits of large energy-consuming industries, demand-side management programs, and benchmarks for industrial energy use. Mandatory energy efficiency decreases in consumption in large, energy-consuming industries to be met through energy-efficiency certificate mechanism.

## EU Emissions Trading System

The world's most far-reaching GHG reduction policy is the EU's Emissions Trading System (ETS), which limits CO<sub>2</sub> emissions from 12,000 facilities across Europe. The ETS was launched in 2005 and in 2009 traded 6.3 billion tons of CO<sub>2</sub> at a market value of \$118 billion USD.<sup>10</sup>

In its current second phase, which coincides with the Kyoto Protocol compliance period (2008–2012), the ETS covers electricity and major industrial sectors (including oil, iron and steel, cement, and pulp and paper) that together produce nearly half of the EU's CO<sub>2</sub> emissions. Most rules are set at the EU level, but allocation of emission allowances is handled by individual member states. Excess emissions incur a penalty (100 euros/ton) and must be made up in the next phase. In mid 2010, emission allowance prices ranged from about 15 euros to 20 euros.

Changes proposed for the third phase (2013–2020) include: increasing coverage to the petrochemical, chemical, and aviation sectors; setting an EU-wide cap of 21 percent below 2005 levels by 2020 (rather than targets set individually by member states); harmonizing allocation of allowances in key sectors; 100 percent auctioning of allowances for the power sector; and phasing in full auctioning of allowances for some sectors by 2020.

**Table 1****Copenhagen Pledges**

More than 80 countries have submitted mitigation pledges under the Copenhagen Accord. Below are the pledges submitted by major developed and developing countries.

**Developed Countries**

Party	2020 economy-wide emissions target	Notes
<b>Australia</b>	5-15-25% below 2000 levels	Australia will reduce its GHG emissions by 25% on 2000 levels by 2020 if the world agrees to an ambitious global deal capable of stabilizing levels of GHGs in the atmosphere at 450ppm CO <sub>2</sub> -eq or lower. Australia will unconditionally reduce its emissions by 5% below 2000 levels by 2020, and by up to 15% by 2020 if there is a global agreement which falls short of securing atmospheric stabilization at 450ppm CO <sub>2</sub> -eq and under which major developing economies commit to substantially restrain emissions and advanced economies take on commitments comparable to Australia's.
<b>Canada</b>	17% below 2005 levels	To be aligned with the final economy-wide emissions target of the United States in enacted legislation.
<b>European Union*</b>	20-30% below 1990 levels	As part of a global and comprehensive agreement for the period beyond 2012, the EU reiterates its conditional offer to move to a 30% reduction by 2020 compared to 1990 levels, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities.
<b>Japan</b>	25% below 1990 levels	Premised on the establishment of a fair and effective international framework in which all major economies participate and on agreement by those economies on ambitious targets.
<b>Russia</b>	15-25% below 1990 levels	The range of the GHG emission reductions will depend on the following conditions: <ul style="list-style-type: none"> <li>• Appropriate accounting of the potential of Russia's forestry in frame of contribution in meeting the obligations of the anthropogenic emissions reduction;</li> <li>• Undertaking by all major emitters the legally binding obligations to reduce GHG emissions.</li> </ul>
<b>United States</b>	In the range of 17% below 2005 levels	In the range of 17%, in conformity with anticipated U.S. energy and climate legislation, recognizing that the final target will be reported to the Secretariat in light of enacted legislation. The pathway set forth in pending legislation would entail a 30% reduction in 2025 and a 42% reduction in 2030, in line with the goal to reduce emissions 83% by 2050.

\* Member States (Austria, Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, United Kingdom). Currently, not all EU Member States are Annex I Parties.

## Developing Countries

Party	Nationally Appropriate Mitigation Actions	Notes
<b>Brazil</b>	36.1-38.9% below business as usual (BAU) by 2020	Domestic actions voluntary in nature
<b>China</b>	40-45% emission intensity reduction below 2005 levels by 2020  Increase the share of non-fossil fuels in primary energy consumption to around 15% by 2020 and;  Increase forest coverage by 40 million hectares and forest stock volume by 1.3 billion cubic meters by 2020 from the 2005 levels.	Autonomous domestic actions voluntary in nature
<b>India</b>	20-25% emission intensity reduction below 2005 levels by 2020 (excludes agricultural emissions)	Domestic actions voluntary in nature, and will not have a legally binding character.
<b>Indonesia</b>	26% below reference levels by 2020	
<b>Korea</b>	30% below BAU by 2020	
<b>Mexico</b>	Up to 30% reduction below BAU by 2020 (including 51 million tons CO <sub>2</sub> -e by 2012)	Conditional on support
<b>South Africa</b>	34% below BAU by 2020, 42% below BAU by 2025	Conditional on support and the finalization of an ambitious, fair, effective and binding multilateral agreement under the UNFCCC and Kyoto Protocol at COP-16 and CMP-6 in Mexico.

2 degrees Celsius; called for a new multilateral climate fund and set goals of mobilizing \$30 billion in public finance in 2010-2012 and \$100 billion in public and private finance in 2020; further defined how countries' actions are to be reported and verified; and called on countries to list mitigation pledges (economy-wide emission targets for developed countries, and mitigation actions for developing countries). Although the Accord was not formally adopted by UNFCCC parties in Copenhagen, 140 countries have now associated themselves with the agreement and more than 80—including all the major economies—have pledged specific mitigation targets or actions for 2020 (See Table 1).

## COMPETITIVENESS

In considering the U.S. policy response to climate change, both at home and abroad, one concern is the potential impact on U.S. competitiveness. Any potential competitiveness risks would be felt most directly by energy-intensive industries whose goods are traded internationally, a relatively small segment of the U.S. economy.<sup>11</sup> Potential concerns include relocation of energy-intensive U.S. industry to countries with no or looser

controls, loss of market share to competitors in those countries, or a shift in U.S. investment to those countries.

Past experience with the adoption of new environmental standards shows little evidence of significant competitiveness impacts. One major review—synthesizing dozens of studies assessing the impacts of a range of U.S. regulations across a variety of sectors—concluded that while environmental standards may impose significant costs on regulated industries, they do not appreciably affect patterns of trade.<sup>12</sup> Other studies indicate that when U.S. producers do relocate to developing countries, factors such as wages and access to raw materials and markets are far more decisive than environmental costs.<sup>13</sup>

In gauging the potential impacts of GHG regulation, it is important to distinguish the “competitiveness” effect from the broader economic impact on a given industry or firm. A mandatory climate policy would present costs for U.S. firms regardless of what action is taken by other countries. In the case of energy-intensive industries, one likely impact will be a decline in demand as consumers substitute less

GHG-intensive products. The “competitiveness” impact is only that portion of the total impact on a firm resulting from an imbalance between GHG constraints within and outside the United States.

A Pew Center report, *The Competitiveness Impacts of Climate Change Mitigation Policies*, analyzes the historical relationship between energy prices and production, trade, and employment in order to project the potential competitiveness impacts of mandatory domestic GHG limits, at a price of \$15/ton CO<sub>2</sub>. Looking at paper, iron and steel, aluminum, cement, and bulk glass, the analysis concludes that most of the anticipated decline in production within those sectors (–1.6 percent to –3.4 percent) reflects a decline in consumption. The gap made up by imports, or the “competitiveness” effect, ranges from –0.7 percent to –0.9 percent.<sup>14</sup>

While most research has focused on the potential negative competitiveness impacts of climate policy, less attention has been paid to the opportunity presented by climate and clean energy policy to enhance the competitiveness of U.S. firms by driving innovation in the high-growth industries of the future. Some economists believe that stronger environmental standards in many cases confer a competitive advantage by driving firms to innovate and become more efficient. By fostering markets for new technologies, new standards are at least as likely to create jobs in some sectors as to reduce them in others—though the circumstances under which this is true remain a subject of ongoing debate.<sup>15, 16</sup>

The fact is that clean energy technology markets are already substantial in scope and likely to grow significantly in the coming decades as worldwide demand for lower-carbon technologies increases. Between 2004 and 2009, clean energy investments (including renewables, efficiency technologies, biofuels, CCS, nuclear power, and other low-carbon technologies) grew at an average compound annual growth rate of 39 percent.<sup>17</sup> Thanks in part to government stimulus packages, global clean energy investments will total about \$200 billion in 2010,<sup>18</sup> and even under a business-as-usual case that assumes no changes to existing climate change policy by any

major emitters, the International Energy Agency estimates that cumulative global investments in clean power generation technologies between 2010 and 2020 will total about \$1.58 trillion, and will be even larger in the following decade.<sup>19</sup>

Recognizing the size and potential of these markets, other nations—most notably China—are aggressively expanding their own domestic clean energy markets by taking steps to reduce GHG emissions, become more energy independent, support lead markets for clean energy technologies, and build up their manufacturing capacity to meet expanded domestic

and international demand for new technologies such as wind and solar power, advanced batteries, carbon capture and storage, and nuclear energy. In 2009 Europe led the world in clean energy investments with \$41 billion and China invested \$34.6 billion, while the United States only invested \$18.6 billion.<sup>20, 21</sup>

The United States stands to benefit from the development of these mar-

kets, but only if it moves quickly to support domestic demand for and production of clean energy technologies.

## NEXT STEPS

Mobilizing an effective global response to climate change requires stronger efforts both within and outside the UNFCCC.

For the past 15 years, the primary thrust of negotiations within the UNFCCC has been the establishment, and then the extension, of a legally binding regime to reduce GHG emissions. This should remain the long-term objective. Binding commitments are the ultimate expression of a countries’ will to address an issue of international concern. They provide countries a higher degree of confidence that others will fulfill their obligations. This confidence, in turn, enables each to deliver a stronger level of effort.

The Copenhagen summit, however, demonstrated the difficulty of achieving a new round of binding climate commitments. Most countries with binding targets under the Kyoto Protocol are unwilling to commit to new targets without commensurate commitments from the United States and the major emerging economies. These countries, however, are not yet prepared to assume binding commitments.

**To be fair and effective, the international effort must engage all the world’s major economies, which requires a flexible international framework allowing countries to take on different types of commitments.**

Under these circumstances, the best course forward within the UNFCCC may be an evolutionary one. In other international arenas, such as trade, human rights and the law of the sea, multilateral regimes have evolved gradually over time. As initial steps help build parties' confidence in the regime, and in one another's performance, they become willing to assume stronger obligations.

On climate, parties could take incremental steps to strengthen the multilateral architecture in ways that promote stronger action in the near term, while providing a stronger foundation for future binding commitments. Drawing political guidance from both the Bali Action Plan and the Copenhagen Accord, parties could strengthen existing UNFCCC mechanisms and, where necessary, establish new ones. Of central importance are a financial architecture to deliver strong, sustained support to developing countries, and an improved system of reporting and verifying countries' actions to ensure transparency and a measure of accountability.

In parallel, countries could pursue other opportunities outside the UNFCCC to address key aspects of the climate challenge on a multilateral, plurilateral or bilateral basis. For instance, the International Maritime Organization and the International Civil Aviation Organization are examining measures to control GHG emissions from international shipping and aviation, respectively. Other possibilities include further steps under the Montreal Protocol to phase out substances contributing to global warming or an agreement within the World Trade Organization to phase out fossil fuel subsidies.

Over time, efforts within and outside the UNFCCC can strengthen countries' confidence in one another's actions and in the emerging climate change regime. The success of the international effort will hinge heavily on domestic action by the United States. Stronger U.S. action will be critical both because it will promote stronger action by other countries, and because it will better position the United States to take on the types of binding commitments needed to ensure a sustained and effective global effort.

## ENDNOTES

- 1 Global CO<sub>2</sub> emissions from 1850-2030 (Figure 1) includes energy-related CO<sub>2</sub> only. All other data and figures are for all six greenhouse gases, excluding emissions associated with land use, unless otherwise stated. Energy-related CO<sub>2</sub> data: CDIAC 2010. "Global CO<sub>2</sub> Emissions from Fossil-fuel burning, cement manufacture, and gas flaring: 1751-2007" and; IEA, 2010. "CO<sub>2</sub> Emissions from Fuel Combustion 2010 Highlights". Other GHG emissions data: USEPA, 2006. "Global Anthropogenic Non-CO<sub>2</sub> Greenhouse Gas Emissions: 1990-2020." Projections: WEO, 2010. "World Energy Outlook 2010."
- 2 Figures for the European Union represent emissions of the 27 EU members—the original EU-15 (Austria, Belgium, Denmark, France, Finland, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom) and EU +12 (Czech Republic, Estonia, Latvia, Lithuania, Slovak Republic, Slovenia, Hungary, Poland, Bulgaria, Romania, Malta and Cyprus). The EU is treated here as a "country" because, as a regional economic integration organization, the European Community has "Party" status under the U.N. Framework Convention on Climate Change.
- 3 National total GHG emissions data (2005): World Resources Institute, Climate Analysis Indicators Tool. Accessed October 2010.
- 4 Cumulative emissions data: World Resources Institute, Climate Analysis Indicators Tool. Accessed October 2010.
- 5 Allowances are legally established units entitling those holding them to emit a given level of GHGs.
- 6 For more details, see "Climate Change Mitigation Measures in the European Union" by Pew Center on Global Climate Change, Available at <http://www.pewclimate.org/brief/international/mitigation-measures-european-union>
- 7 ChinaFAQs: Energy and Climate Policy Action in China <http://www.chinafaqs.org/library/chinafaqs-energy-and-climate-policy-action-china>
- 8 International Council on Clean Transportation: Global passenger vehicle fuel economy and GHG emissions standards: April 2010 update <http://www.theicct.org/2010/04/ghg-fe-standards-update/>
- 9 For more details see "Summary: India's National Action Climate Change Plan," by the Pew Center on Global Climate Change, Available at <http://www.pewclimate.org/international/country-policies/india-climate-plan-summary/06-2008>
- 10 Kossoy Alexandre and Philippe Ambrosi. 2010. "State and Trend of the Carbon Market 2010." Carbon Finance Unit, The World Bank. May 2010. Available at [http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/State\\_and\\_Trends\\_of\\_the\\_Carbon\\_Market\\_2010\\_low\\_res.pdf](http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/State_and_Trends_of_the_Carbon_Market_2010_low_res.pdf)
- 11 Energy-intensive industries (those whose energy costs are 4 percent or more of shipped value) consume more than half of the energy used in U.S. manufacturing but generate only 16 percent of production and 20 percent of employment (less than 1 percent of total U.S. employment). Aldy, Joseph E. and William A. Pizer, *The Competitiveness Impacts of Climate Change Mitigation Policies*, Pew Center on Global Climate Change (forthcoming).

- 12 The authors found “relatively little evidence to support the hypothesis that environmental regulations have had a large adverse effect on competitiveness...” Jaffe, A.B., S.R. Peterson, P.R. Portney, and R.N. Stavins. “Environmental Regulation and the Competitiveness of U.S. Manufacturing: What Does the Evidence Tell Us?” *Journal of Economic Literature*. Vol. XXXIII, March 1995.
- 13 Goodstein, Eban. 1994. *Jobs and the Environment: The Myth of a National Trade-Off*. Island Press. Jeppesen, Tim, John List and Henk Folmer, 2002. *Environmental Regulations and New Plant Locations Decisions: Evidence from a Meta-Analysis*, 42 *J. Regional Science*. 19, 36.
- 14 Aldy, Joseph E. and William A. Pizer, 2009. “The Competitiveness Impacts of Climate Change Mitigation Policies.” Pew Center on Global Climate Change. May 2009.
- 15 See, for example, Greaker, Mads. “Spillovers in the development of new pollution abatement technology: A new look at the Porter-hypothesis,” *Journal of Environmental Economics and Management*, Vol. 52, 2006; Porter, Michael. “America’s Green Strategy,” *Scientific American*, 264, 4: 96, 1991; Porter, M. and C. van der Linde, “Toward a New Conception of the Environment-Competitiveness Relationship,” *Journal of Economic Perspectives* 9, 4:97–118, 1995. As discussed in endnote three, this concept remains controversial and has its critics; see Ziesemer, Thomas. “The Porter Hypothesis Revisited: An Overview on Empirical and Theoretical Evidence,” *Papers in Global Business Management*, Universität Augsburg, December 2007, and Palmer, Oates, and Portney, “Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm?” *J. of Economic Perspectives*, 9(4), 1995.
- 16 The Pew Center has compiled a review summarizing several studies on the links between environmental policy and job creation, available here.
- 17 Overall clean energy investment growth estimates are derived using data from United Nations Environment Program (UNEP) and New Energy Finance, “Global Trends in Sustainable Energy Investment 2009: Analysis of Trends and Issues in the Financing of Renewable Energy and Energy Efficiency,” 2009 and Pew Charitable Trusts 2010. This figure includes total financial investment (including venture capital, private equity expansion capital, public markets, and asset finance) as well as government research and development (R&D), corporate R&D, and small projects. “Clean Energy Trends 2009,” Clean Edge Inc., March 2009.
- 18 Bloomberg New Energy Finance, March 2010 and Pew Charitable Trusts. “Who’s Winning the Clean Energy Race?” Pew Charitable Trusts, 2010.
- 19 IEA 2009. Unless otherwise noted, all IEA investment figures are in 2008 dollars. Clean power generation technologies includes renewables, CCS, and nuclear power. Cumulative totals for each of these categories in the decade 2010-2020 are \$1.25 trillion, \$2 billion, and \$297 billion, respectively. As noted, investments in the following decade (2021-2030) are significantly higher; for example, cumulative investment in CCS could be \$43 billion in those years.
- 20 Bloomberg New Energy Finance. “Clean energy investment down just 6.5% in 2009; Asia outstrips the Americas,” Press release, January 7th, 2010 and Pew Charitable Trust 2010.
- 21 Pew Charitable Trusts, 2010.

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