

**INTERNATIONAL**

**DEVELOPING COUNTRY ANALYSIS AND DIALOGUE**

**Greenhouse Gas Mitigation in  
China, Brazil and Mexico:  
Recent Efforts and Implications**

CENTER FOR CLEAN AIR POLICY  
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## **Acknowledgments**

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## I. INTRODUCTION

In November 2006, the Center for Clean Air Policy (CCAP) released a groundbreaking report, *Greenhouse Gas Mitigation in Brazil, China and India: Scenarios and Opportunities Through 2025*. This report shattered a commonly held myth that developing countries are not taking meaningful action to reduce greenhouse gas (GHG) emissions, and identified further reductions that these countries could undertake. It revealed that measures already undertaken will significantly reduce GHG emissions in these countries.

The CCAP report looked at the impact of policies adopted in these countries through the end of 2005. Over the past two years, developing countries have adopted additional policies and programs that will reduce their GHG emissions. Most dramatically, Brazil has undertaken an aggressive effort to reduce deforestation in the Amazon that has succeeded in lowering the deforestation rate by 50%, reducing GHG emissions by over 440 million metric tons of carbon dioxide-equivalent (MMTCO<sub>2</sub>e) in 2006, while China has set a goal of lowering its economy-wide energy intensity per unit of GDP 20% by 2010—a policy projected to reduce emissions by as much as 1,500 MMTCO<sub>2</sub>e in that year alone. In addition, while many of these efforts continue to be driven primarily by non-climate concerns (e.g., energy security, air quality), they have been accompanied by a more proactive and expanded participation by developing countries in both domestic and international climate change efforts. Key developing countries have increasingly recognized the importance of addressing the problem and the need for them to contribute to the solution. This has been demonstrated by the pathbreaking release of detailed national plans laying out concrete strategies for combating climate change in both China and Mexico in 2007, along with the active participation and development of original proposals by forested countries such as Brazil and Papua New Guinea in discussions on reducing emissions from deforestation in developing countries (RED) under the UNFCCC.

**This report, *Greenhouse Gas Mitigation in China, Brazil and Mexico: Recent Efforts and Implications*, provides an updated consideration of developing country “unilateral actions.”** Once again, we find that full implementation of developing country “unilateral” actions is estimated to significantly reduce GHG emissions. **The combined emission reductions in China, Brazil, and Mexico from these unilateral measures are estimated to be greater than the reductions under the Kyoto Protocol (without the US), EU’s reduction commitments in 2020, and reductions estimated in current US legislative proposals in 2015.** Most of these reductions have been financed domestically, independent of the Kyoto Protocol’s Clean Development Mechanism (CDM), and many of these measures are not simply the “low-hanging fruit” in domestic-oriented sectors, but are in fact policies with positive costs in sectors such as cement and iron and steel where international competition is a concern.

As negotiations are about to begin on the structure of the post-2012 international response to climate change, the “unilateral actions” undertaken by developing countries will be a crucial piece of the puzzle. **Recognizing and encouraging these and other “unilateral actions”**

**and providing incentives (and appropriate international policy structures) to undertake further reductions will be an essential element of the post-2012 response.** The actions to reduce emission undertaken by China, Brazil and Mexico highlighted in this report represent an important first step toward a successful post-2012 international effort to combat climate change.

## II. CHINA’S “UNILATERAL ACTIONS”: AN UPDATE

In 2006, CCAP and Tsinghua University in China estimated that absent the impact of policies adopted from 2000 through the end of 2005, CO<sub>2</sub> emissions from China’s electricity, cement, iron and steel, pulp and paper and transportation sectors would more than double, increasing from about 2,300 MMTCO<sub>2</sub>e in 2000 to more than 5,300 MMTCO<sub>2</sub>e in 2020.<sup>1</sup> **But policies adopted between 2000 and 2005 will reduce GHG emissions in key energy-intensive sectors below their business-as-usual (BAU) levels by almost 400 MMTCO<sub>2</sub>e in 2020—a combined reduction of over 7% (see Table 1).**

**Table 1. Change in China’s Emissions Due to Recent Policies (MMTCO<sub>2</sub>e)**

Sector	BAU Scenario		Recent Policies Scenario		
	2000 Emissions	2020 Emissions	2020 Emissions	Emissions Change from BAU	% Change from BAU
Electricity	1,199	3,102	2960	(142)	-5%
Cement	643	1,098	937	(162)	-15%
Iron/Steel	200	323	294	(29)	-9%
Pulp/Paper	63	141	111	(30)	-21%
Transport	195	676	643	(34)	-5%
<b>TOTAL</b>	2,299	5,340	4,945	(395)	-7%

New policies and programs have been adopted since the end of 2005, and further progress has been made in implementation of a number of the measures identified in the earlier report.

**Most significantly, in 2006 China adopted one of the most comprehensive and aggressive energy-related proposals yet undertaken in developing countries: a plan to reduce national energy intensity per unit of GDP 20% by 2010.**<sup>2</sup> In March 2006, China released the *Eleventh Five Year Plan*, the principal and comprehensive guidelines covering development of every sector of the national economy. The Plan sets a goal to reduce economy-wide energy use per unit of GDP by 20% between 2005 and 2010. This is no small undertaking given that China has already improved energy intensity by 77% between 1990 and 2003, but the goal has become a major focus of China’s energy-related initiatives. The achievement of this goal is projected to reduce China’s emissions by over 1,500

<sup>1</sup> For a copy of this report, see:

[http://www.ccap.org/international/Developing\\_Country\\_Unilateral\\_Actions\\_2007\\_Update.pdf](http://www.ccap.org/international/Developing_Country_Unilateral_Actions_2007_Update.pdf)

<sup>2</sup> This program was not analyzed in the CCAP 2006 project as it was beyond the scope.

MMTCO<sub>2e</sub> annually by 2010.<sup>3</sup>

In June 2007, the Department of State released the *Comprehensive Working Plan for Energy Saving and Pollutant Reduction*, which details the goals and policies that will be employed to achieve the 20% target.

***The National Climate Change Programme details GHG reduction policies and measures to be adopted through 2010.*** In June 2007, another major milestone was achieved with the release of *China's National Climate Change Programme* by the National Development and Reform Commission (NDRC), detailing GHG reduction policies and measures to be adopted through 2010. This document reviews China's current situation and the efforts to date to reduce GHG emissions, addresses the possible impacts of climate change on China's environment and population, and highlights major policies to be implemented in a range of sectors. Specifically, this plan calls for improving energy efficiency in industry, transportation and end-use sectors; increasing the hydro/renewable energy share up to 10% by 2010; expanding nuclear, IGCC and clean power technologies; and coal-bed methane recovery. The estimated emission reductions from all measures quantified in the report would exceed 1,500 MMTCO<sub>2e</sub> by 2010.<sup>4</sup>

While China's energy and climate protection plans are far-reaching and ambitious, it should be emphasized that achievement of the 2010 energy intensity target and the energy efficiency and other goals announced in the national climate plan will depend upon effective implementation and consistent enforcement at both the national and local levels. To date China has had considerable success in implementing climate-friendly measures in key sectors (discussed below), but not all of its short-term goals have been achieved. For example, meeting a 20% improvement in energy intensity by 2010 would require a 4% annual average reduction after 2005, but in 2006 China achieved a reduction in economy-wide energy intensity of only 1.33% (though this was the first decline since 2003).<sup>5</sup> Realization of the full climate benefits of China's plans is thus not guaranteed, and will require a sustained national commitment.

## **II.A RECENT ACTIONS IN KEY SECTORS**

Chinese policies and programs adopted between 2000 and 2007 in electricity, industry and transportation include the following:

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<sup>3</sup> Lin, Jiang, Nan Zhou, Mark Levine, and David Fridley, "Taking out one billion tons of CO<sub>2</sub>: the magic of China's 11th five year plan?," *Energy Policy*, in press.

<sup>4</sup> The NDRC. China's National Climate Change Programme. Available at <http://www.chinaembassy.org.sg/chn/xwdt/P020070611577558281561.pdf> [in English]

<sup>5</sup> According to National Bureau of Statistics of China's *Energy Intensity Reduction Report 2006*, available at <http://env.people.com.cn/GB/5982516.html> [in Chinese]

## II.A.1 Electricity

The *Renewable Energy Law* encourages the construction of renewable energy (RE) facilities, requires power grid operators to purchase resources from registered RE producers, offers financial incentives for RE projects, and stipulates penalties for non-compliance. The law also requires that the NDRC develop and set specific targets for RE development.<sup>6</sup> The government has developed a *renewables feed-in program* which provides direct incentives for renewable programs.<sup>7</sup>

- As a result, even though China is already the world leader in RE capacity (with 42 GW in 2005, excluding large hydro projects), China tied with Germany in 2005 for the largest national investment in renewable energy, excluding large hydropower—\$7 billion. This was primarily directed to small hydro and solar hot water projects, and an additional \$10 billion was invested in large hydro facilities.
- Wind generation expanded significantly in China, with 500 MW of new wind capacity installed in 2005—the fifth largest amount among any country.<sup>8</sup> The pace of installation accelerated considerably in 2006, with 1.3 GW installed—equal to the total over the previous two decades. In addition, while official plans call for China to reach a total wind capacity of 5 GW in 2010, this level is now expected to be achieved in 2007.<sup>9, 10</sup> In terms of installed capacity, China ranked sixth worldwide in 2006, raising from tenth in 2004.<sup>11</sup>
- In 2006, NDRC and its national and local counterparts approved 39 new biomass projects with a total installed capacity of 1.28 GW and a total investment of \$1.34 billion. By the end of 2006, nationwide biomass-fired power had reached a total installed capacity of 2.2 GW.<sup>12</sup> The goal is to have 5.5 GW in 2010 and 30 GW in 2020.<sup>13</sup>

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<sup>6</sup> See [http://www.renewableenergyaccess.com/assets/download/China\\_RE\\_Law\\_05.doc](http://www.renewableenergyaccess.com/assets/download/China_RE_Law_05.doc) for an unofficial copy of the text of China's Renewable Energy Law.

<sup>7</sup> "The China Sustainable Energy Program: China Program Update and Clippings." *The Energy Foundation*. Issue 19. February 2006. pp. 2 and 15. Available at [http://www.efchina.org/documents/CSEP\\_Clippings\\_Feb\\_2006.pdf](http://www.efchina.org/documents/CSEP_Clippings_Feb_2006.pdf)

<sup>8</sup> REN21, Renewables Global Status Report: 2006 Update, available at: [www.ren21.net/globalstatusreport/download/RE\\_GSR\\_2006\\_Update.pdf](http://www.ren21.net/globalstatusreport/download/RE_GSR_2006_Update.pdf)

<sup>9</sup> He Dexin. *Current Situation of China's Wind Power Development*. Available at <http://rwny.blog.sohu.com/61232501.html>

<sup>10</sup> Greenpeace, *China Wind Power Report 2007*, Available at <http://www.greenpeace.org/raw/content/china/en/press/reports/wind-power-report.pdf>.

<sup>11</sup> Data came from *China Renewable Energy Report 2006*, available at [http://www.efchina.org/csepupfiles/report/200762245840354.3728109999679.pdf/China%20RE%20Industry%20Development%20Report\\_070330%20CN.pdf](http://www.efchina.org/csepupfiles/report/200762245840354.3728109999679.pdf/China%20RE%20Industry%20Development%20Report_070330%20CN.pdf) [in Chinese]

<sup>12</sup> Liu Bin. Analyzing the current situation and potential of China's Biomass Industry. Available at <http://www.bioinfo.cn/readNews.php?id=56274>

<sup>13</sup> See *China's Medium and Long-term Development plan for Renewable Energies*. Available in Chinese at <http://www.ccchina.gov.cn/WebSite/CCChina/UpFile/2007/20079583745145.pdf>

- China's first commercial solar power plant, located in one of Shanghai's counties, started operation in September 2007.<sup>14</sup> In addition, Dunhuang city in Gansu province signed a contract in November 2006 to build a 100 MW unit at a cost of \$800 million, which will be the largest solar power plant in the world.<sup>15</sup> By 2010, China plans to have solar power capacity of 300 MW, increasing to 1.8 GW by 2020.<sup>16</sup>

In the *Medium and Long-term Development Plan for Renewable Energies*, released in August 2007, China calls for the future share of renewable energy (including large hydro) in primary energy to reach 10% and 15% in 2010 and 2020, respectively. For hydro, the key focus is small scale generators, with a set target of 50 GW installed by 2010 and 75 GW by 2020.

- The 50 GW target was reached ahead of schedule in 2006. The nation-wide installed hydro capacity has also reached 135 GW, well on track to reach the goal of 190 GW in 2010.<sup>17</sup>

The *Tenth Five-Year Plan* includes plans to shut down inefficient power plants, developing nuclear power and renewables, etc.

- A recent policy requires that new coal facilities be greater than 300 MW.<sup>18</sup>
- In 2006, China shut down 38 small thermal plants with a total installed capacity of 1.21 GW. In 2006, China shut down 38 small thermal plants with a total installed capacity of 1.2 GW, and in the first ten months of 2007 China shut down another 343 plants with a total capacity of over 10 GW.<sup>19, 20</sup>

## II.A.2 Cement

*Policy Outlines of Energy Conservation Technologies* (rev. 1996) in the cement sector proposed to close small, illegal plants, promote retrofitting of inefficient operations (wet to dry process), and recover waste heat for re-use. The NDRC 2004 China *Medium and Long Term Energy Conservation Plan* set goals for the improvement of industry-wide energy

<sup>14</sup> See the news at <http://news.eefoo.com/xxzycontent/2007/1022/200710221060643.html>

<sup>15</sup> Estimated using a 7.5:1 currency convert ratio. See the news at <http://news.eastday.com/eastday/node81741/node81762/node172935/u1a2457473.html>

<sup>16</sup> See *China's Medium and Long-term Development plan for Renewable Energies*. Available in Chinese at <http://www.ccchina.gov.cn/WebSite/CCChina/UpFile/2007/20079583745145.pdf>.

<sup>17</sup> See <http://www.zgbfw.com/info/pump-news-520731.html>

<sup>18</sup> China September 2006 CCAP GHG Report Final. p37. Also available at: "Laws & Regulations – The 10<sup>th</sup> Five-Year Plan for Energy Conservation and Resources Comprehensive Utilization." Available at: <http://www.ccchina.gov.cn/en/NewsInfo.asp?NewsId=5389>.  
[http://www.ccchina.gov.cn/en/Public\\_Right.asp?class=17](http://www.ccchina.gov.cn/en/Public_Right.asp?class=17)

<sup>19</sup> News source can be seen at [http://www.gov.cn/jrzg/2007-09/05/content\\_738445.htm](http://www.gov.cn/jrzg/2007-09/05/content_738445.htm) [in Chinese]

<sup>20</sup> Data came from NDRC's news report, available at [http://www.sdpc.gov.cn/xwfb/t20071029\\_168475.htm](http://www.sdpc.gov.cn/xwfb/t20071029_168475.htm) [in Chinese]

intensity to 148 kilogram of coal equivalent per ton (kgce/t) cement in 2010 and 129 kgce/t cement in 2020.<sup>21</sup>

The 11<sup>th</sup> five-year-period Development Plan for Construction Industry (March 2007) set a goal for the phase-out of outdated cement production capacity totaling 250 million metric tons (Mt) by 2010.<sup>22</sup>

*Developing Policies for Cement Industry* (October 2006) sets out goals for 2010, including increasing the share of new, dry-process cement kiln production from 40% to 70%. This policy also requires the number of cement enterprises decrease from 5,000 to about 3,500 by 2010 and to about 2,000 by the end of 2020. Outdated production lines like mechanized vertical kilns will be completely phased out by the end of 2008.<sup>23</sup>

- Dry technology-based production, which had a share of only 12% in 2000, increased to 45% by the end of 2005,<sup>24</sup> with a 55% target set for the end of 2007. Through new energy saving technologies, the goal is to achieve a 25% reduction in comprehensive energy consumption per unit of production in 2010 (from a 2005 baseline).<sup>25</sup>

### II.A.3 Iron and Steel

China *Medium and Long Term Energy Conservation Plan* (2005) in the iron and steel sector aims to improve its energy intensity. Specific goals include: (1) industry-wide energy intensity to achieve the level of the advanced world in the 1990's by 2010; (2) medium and large entities to achieve advanced world levels in the 2000's by 2010; and (3) industry-wide energy intensity to achieve the level of advanced world by 2020.<sup>26</sup>

The NDRC's 2006 *Notification on controlling the total production capacity, phasing out the outdated capacity, and expediting the structure reform in Iron and Steel Industry* aims to shut down and phase out outdated capacity.<sup>27</sup>

- In April 2007, ten provinces and regions signed contracts with NDRC with a target of shutting down and phasing out 39.9 Mt and 41.7 Mt of outdated iron and steel production capacity, respectively, by the end of 2010. In the first eight months of

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<sup>21</sup> Price, L. and C. Galitsky (2006), Opportunities for Improving Energy and Environmental Performance of China's Cement Kilns, August, Lawrence Berkeley National Laboratory.

<sup>22</sup> "China's 11<sup>th</sup> five-year-period Development Plan for Building Material Industry." China Building Material Industry Association (CBMIA). March 2007. <http://www.chinacements.com/news/2007/3-6/C13403705.htm> [in Chinese]

<sup>23</sup> Available at <http://www.sdpc.gov.cn/zcfb/zcfbl/12006/W020061019575763293670.doc> [in Chinese]

<sup>24</sup> China's National Development and Reform Commission. Policy Outlines of Cement Industry. Available at <http://www.ndrc.gov.cn/zcfb/zcfbtz/tz2006/W020061019573686371500.doc>

<sup>25</sup> NDRC. Expediting the Restructuring of Cement Industry. Available at <http://www.ndrc.gov.cn/zcfb/zcfbtz/tz2006/W020060425577511246436.doc> [in Chinese]

<sup>26</sup> "China Medium and Long-Term Energy Conservation Plan." National Development and Reform Commission (NDRC). People's Republic of China. January 2005. <http://www.sdpc.gov.cn/> [in Chinese].

<sup>27</sup> NDRC's notification is available at [http://www.gov.cn/zw/gk/2006-07/17/content\\_337825.htm](http://www.gov.cn/zw/gk/2006-07/17/content_337825.htm) [in Chinese]

2007, these provinces and regions had shut down or phased out outdated capacities of 9.7 Mt and 8.7 Mt, respectively.<sup>28</sup>

In October 2007, the NDRC set guidelines for enhancing policy implementation, requirements for certifications by local development and reform commissions verifying that specific facilities have been shut down successfully, and enforcement from other agencies. The policy also calls for local agencies to monitor the process and make sure no outdated production capacity enters other industrial sectors.<sup>29</sup>

#### **II.A.4 Pulp and Paper**

Measures in the pulp and paper industry—composed mostly of state-owned enterprises—are modernizing facilities and operations that were significantly outdated compared to world standards. China's government is currently attempting to modernize its industry through restructuring—encouraging state-owned plants to automate their operations, promoting mergers, facilitating foreign investment, and closing down smaller, older facilities. China plans to shut down outdated pulp and paper production capacity up to 6.5 Mt during the 11<sup>th</sup> five-year-period (2006 - 2010). The goal for 2007 is 2.3 Mt.<sup>30</sup>

#### **II.A.5 Cross-Cutting Industry**

In the *1000 highest energy-consuming enterprises*<sup>31</sup> program, the 1000 facilities in China accounting for the greatest energy use are to benchmark their energy performance, install efficient equipment, and attain a 20% efficiency improvement by 2010.

- According to an NDRC progress report in September 2007,<sup>32</sup> this program reduced energy consumption by about 20 million metric tons coal equivalent (Mtce) in 2006, with an additional 8 Mtce reduced in the first four months of 2007.<sup>33</sup>

In June 2007, China's Department of State issued the *Comprehensive Working Plan for Energy Saving and Pollutant Reduction*<sup>34</sup> as the principal guidelines regarding energy and environment policies during the 11<sup>th</sup> five-year period. The general goals include: a 20% reduction of energy consumption per unit of GDP; a 30% reduction in water consumption per unit of industrial added value; a 10% reduction of total emissions of major pollutants; a reduction in energy consumption of 118 Mtce (the 2007 goal is 31.5 Mtce) by phasing out outdated production capacity in 13 sectors; and a reduction in energy consumption of 240

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<sup>28</sup> Data came from NDRC's news report, available at [http://gys.ndrc.gov.cn/gtttlh/t20070905\\_157585.htm](http://gys.ndrc.gov.cn/gtttlh/t20070905_157585.htm) [in Chinese]

<sup>29</sup> The NDRC's new policy, available at [http://gys.ndrc.gov.cn/gtttlh/t20071025\\_166958.htm](http://gys.ndrc.gov.cn/gtttlh/t20071025_166958.htm) [in Chinese]

<sup>30</sup> Data from the Department of State's "*Comprehensive Working Plan for Energy Conservation and Pollutant Reduction*", available at [http://www.gov.cn/jrzg/2007-06/03/content\\_634545.htm](http://www.gov.cn/jrzg/2007-06/03/content_634545.htm) [in Chinese]

<sup>31</sup> These facilities account for an estimated 30% of China's energy consumption.

<sup>32</sup> Available at <http://www.sdpc.gov.cn/zcfb/zcfbgg/2007gonggao/W020071009598162122784.pdf> [in Chinese]

<sup>33</sup> Data came from <http://info.jrj.com.cn/news/2007-09-23/000002713853.html> [in Chinese]

<sup>34</sup> Available at [http://www.gov.cn/jrzg/2007-06/03/content\\_634545.htm](http://www.gov.cn/jrzg/2007-06/03/content_634545.htm) [in Chinese]

Mtce (equal to a reduction in total CO<sub>2</sub> emissions of 550 MMT) by enforcing the *Top Ten Energy Conservation Programs*.<sup>35</sup>

Economic incentives have been utilized to expedite the process of energy conservation. Over \$900 million has been added into the central fiscal budget, exclusively providing support for the *Top Ten Energy Conservation Programs* and for rewarding enterprises judged by their amount of energy conserved.

Governmental policies are also using economic means to restrain industrial sectors that have high energy consumption and high emissions of pollutants. By the end of 2006, 535 export tax refunds for products with high energy consumption rates and high pollutant emission rates had been canceled, and as many as 2,268 export tax refund rates had been lowered.<sup>36</sup>

The government has established energy conservation as an important political task, and localized energy consumption reduction objectives have been listed as one of the major performance criteria for local officials.<sup>37</sup>

In October 2007, the NDRC released a new regulation expediting the phasing out of outdated capacity in the pulp and paper, alcohol production, monosodium glutamate, and lemon acid sectors. Technical definitions of outdated production lines in each sector are outlined; yearly goals from 2006 through 2010 are detailed. For the pulp and paper industry, the target is to reduce capacity by about 6.5 MMT through the five-year period.<sup>38</sup> Moreover, to ensure the process of phasing out, the NDRC released a regulation prohibiting any kind of transfer of the outdated production lines and mandating their dismantling and disposal in time.<sup>39</sup>

## **II.A.6 Transportation**

*Maximum Limits of Fuel Consumption (L/100-km) for Passenger Cars* establish fuel efficiency standards for passenger vehicles – passenger cars, SUVs and multi-purpose vans. The requirements are divided into 16 weight classes, with each class having a designated maximum fuel consumption rate.<sup>40</sup> These standards are implemented in two phases, with an estimated equivalent vehicle efficiency of 34 miles per gallon (MPG) in 2005 and 37 MPG in

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<sup>35</sup> Available at <http://www.ndrc.gov.cn/zcfb/zcfbtz/tz2006/W020060802519161919548.doc> [in Chinese]

<sup>36</sup> News source available at [http://www.sepa.gov.cn/hjyw/200709/t20070925\\_109536.htm](http://www.sepa.gov.cn/hjyw/200709/t20070925_109536.htm) [in Chinese]

<sup>37</sup> China's Department of State. Decisions to Enhance Energy Conservation. Available at [http://www.gov.cn/zwzk/2006-08/23/content\\_368136.htm](http://www.gov.cn/zwzk/2006-08/23/content_368136.htm) [in Chinese]

<sup>38</sup> Data available at [http://www.sdpc.gov.cn/zcfb/zcfbtz/2007tongzhi/t20071029\\_168793.htm](http://www.sdpc.gov.cn/zcfb/zcfbtz/2007tongzhi/t20071029_168793.htm) [in Chinese]

<sup>39</sup> NDRC. Notes on forbidding the transfer of the out dated production capacity. Available at [http://www.sdpc.gov.cn/zcfb/zcfbtz/2007tongzhi/t20071031\\_169573.htm](http://www.sdpc.gov.cn/zcfb/zcfbtz/2007tongzhi/t20071031_169573.htm) [in Chinese]

<sup>40</sup> Stricter standards apply for passenger cars with manual transmissions in each weight class; SUVs and multi-purpose vans must meet the same standards as passenger cars with automatic transmissions. The stringency of the maximum fuel efficiency standards also increases with weight, so lighter vehicles can meet their respective standards more easily than heavier vehicles.

2008 (An and Sauer, 2004).<sup>41</sup> Phase I of this program went into effect on July 1, 2005, for new models of vehicles and on July 1, 2006, for existing models. Phase II will take effect on January 1, 2008, for new models and on January 1, 2009, for existing models; this phase is expected to allow achievement of the 11<sup>th</sup> Five-Year Plan's goal of reducing oil consumption by 15% from current levels.

*Vehicle excise taxes* are now based on the vehicle engine size—ranging from 3-20% of the vehicle purchase price—with the tax on four-liter engines (e.g., SUVs) more than doubling from 8% to 20% (to about \$8,000 per vehicle).<sup>42</sup>

## **II.B COSTS AND RELATIONSHIP TO CDM**

Some of these actions have been undertaken at a positive economic cost. While precise cost estimates for these unilateral actions are not available, many of the renewable opportunities in China are estimated to cost greater than \$10 per metric ton CO<sub>2</sub>e reduced, and the overall investment needed to accomplish the 2020 renewable energy goal is estimated to be about \$267 billion.<sup>43</sup> A similar result is evident in the cement and iron and steel sectors, where a number of the mitigation options needed to meet the level of reductions achieved in the recent policies case cost in the \$5 to \$10 per ton range.

A number of reductions are being financed domestically, without support from the Clean Development Mechanism, and are thus becoming China's "contribution to the protection of the atmosphere." China has a total of 860 projects in the CDM pipeline with average total reductions of 224 MMTCO<sub>2</sub>e per year.<sup>44</sup> Of this total, 574 are renewable energy (biomass, hydroelectric, wind, and solar energy) electricity generation projects—accounting for an average reduction of around 63 MMTCO<sub>2</sub>e per year—far fewer reductions than the 142 MMTCO<sub>2</sub>e estimated in the electricity sector for 2020 through "unilateral actions." In addition, there are 118 projects in the cement and iron and steel sectors (but none in pulp and paper production)—accounting for 23 MMTCO<sub>2</sub>e per year—significantly lower than the 220 MMTCO<sub>2</sub>e reductions in 2020 from unilateral actions in these industry sectors. Lastly, the improvements achieved from the vehicle efficiency standard have not been developed into a CDM project—so the estimated reductions of 34 MMTCO<sub>2</sub>e are not being captured by CDM projects.

## **III. BRAZIL'S "UNILATERAL ACTIONS": AN UPDATE**

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<sup>41</sup> This standard was modeled in this analysis based upon the rates in the "Mid- and Long-Term Specific Plan on Energy Conservation" level of 6.7-8.2 L/100-km by 2010 (13.4 km/L, 31.5 mpg), so the level of reduction could be even greater depending on the fleet mix.

<sup>42</sup> China Program Update & Clippings, 2006, newsletter of The China Sustainable Energy Program, Issue 19, February, p. 3-4.

<sup>43</sup> See *China's Medium and Long-term Development plan for Renewable Energies*. Available in Chinese at <http://www.ccchina.gov.cn/WebSite/CCChina/UpFile/2007/20079583745145.pdf>.

<sup>44</sup> UNEP RISOE, CDM Pipeline, 7 November 2007.

Based on its 2006 study, CCAP and its in-country partners estimated that absent the impact of policies adopted between January 1, 2000 and December 31, 2005, CO<sub>2</sub> emissions from Brazil's electricity, cement, iron and steel, pulp and paper, transportation, residential and commercial sectors would more than double over the next two decades, increasing from about 230 MMTCO<sub>2</sub>e in 2000 to over 510 MMTCO<sub>2</sub>e in 2020. **But CCAP found that recent government policies and programs adopted since 2000 will slow this projected growth in GHG emissions significantly.** These policies will lower emissions in all sectors analyzed except cement (where the impact of recent policies will be negligible); **the combined seven-sector (not including deforestation) CO<sub>2</sub> emissions in Brazil will fall by a dramatic 14% from BAU levels in 2020—a total cut of 73 MMTCO<sub>2</sub>e.** (see Table 2).

**Table 2. Change in Brazil's Emissions Due to Recent Policies (MMTCO<sub>2</sub>e)**

Sector	BAU Scenario		Recent Policies Scenario		
	2000 Emissions	2020 Emissions	2020 Emissions	Emissions Change from BAU	% Change from BAU
Electricity	23	38	33	(5)	-14%
Cement	26	40	41	0.2	0.5%
Iron/Steel	46	82	76	(5)	-6.5%
Pulp/Paper	25	59	57	(2)	-3%
Transport	106	245	202	(44)	-18%
Residential	NA	36	23	(13)	-37%
Commercial	NA	12	8	(4)	-32%
<b>TOTAL</b>	227	512	439	(73)	-14%

These estimates do not include emissions or reductions in the land-use change and forestry sector, which accounts for roughly three-quarters of Brazil's total annual GHG emissions. This highlights the importance of controlling deforestation as a key element of reducing emissions growth in Brazil. Brazil's recent efforts in this sector are discussed below.

### **III.A RECENT ACTIONS IN KEY SECTORS**

New policies and programs have been adopted since the end of 2005, and further progress has been made in implementation of a number of the measures identified in the earlier report. As in the case of China, however, harnessing the full benefits of the measures already undertaken in Brazil will require consistent and successful implementation of each measure in the years to come.

#### **III.A.1 Deforestation**

Over the past two years, Brazil has made impressive efforts at both the national and state levels to reduce deforestation in the Amazon. In the Brazilian Amazon, the deforestation rate increased steadily from 2000 through 2004, rising from 18 thousand km<sup>2</sup> to 27 thousand km<sup>2</sup>, a 50% increase. Recent efforts have contributed to a major reversal in this trend, however, and the deforestation rate in the Amazon has fallen for each of the past two years. From 2004 to 2006, the annual rate of deforestation declined by nearly 50%, to a level (14

thousand km<sup>2</sup> in 2006) not seen since the mid-1990s. The fall in the deforestation rate is estimated to have avoided the emissions of more than 442 MMTCO<sub>2</sub>e in 2006, assuming that the rate of deforestation in 2006 would have been the same as the very high rate observed in 2004 and that this is maintained.<sup>45</sup> The decline has been attributed in part to the government forest protection plan, although macroeconomic factors such as a fall in commodity prices also have played a role. For comparison, the estimated reduction from deforestation actions in the Amazon in 2006 was over one-third higher than Brazil's CO<sub>2</sub> emissions from combustion (over 320 MMTCO<sub>2</sub>e) in the previous year.<sup>46</sup> The specific measures to address deforestation undertaken in Brazil include the following:

The *Action Plan for Protection and Control of Deforestation in the Legal Amazon (PPCDA)*, launched by the Presidency in 2004, was created to develop measures to reduce deforestation in the Amazon through fiscal incentives to enhance the economic potential of deforested areas, and to encourage programs that can create income through regeneration of degraded areas. The measures to be implemented include valuation of forest to conserve biodiversity; improved forest management, forest plantations and substitution, including the creation of 20 million hectare (ha) of Conservation Units; incentives for sustainable recovery of deforested areas; territorial zoning; improved monitoring and licensing procedures; and decentralized management and partnerships between federal, state and local governments.<sup>47</sup>

In 2006, as part of the PPCDA, the government launched the Forest Exploitation Detection System (DETEX) and the Certificate of Forest (DOF) program that allows for online control of the transport of forest products. These and other enforcement measures to date have resulted in Rs 2.3 billion in fines and 364 arrests. Recent incentives to encourage sustainable productive activities include the Law on the Management of Public Forests (Law no. 11.284), which guarantees the allocation of areas to be managed by local communities. The Law has also led to the creation of the First Sustainable Forest District to combat illegal deforestation near road BR163, with another two planned for BR 319 and in the Carajas region.<sup>48</sup>

The *Amazon Regions Protected Areas Program (ARPA)*, started in 2002 with the German Development Bank, the Global Environment Facility, the World Bank and the World Wildlife Fund, aims to protect the forest by bringing 50 million ha (12%) of the Brazil Amazon into a

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<sup>45</sup> *Brazil's Contribution to Prevent Climate Change*, White Paper, Brazil Ministry of Science and Technology, 37, [http://www.mct.gov.br/upd\\_blob/0018/18294.pdf](http://www.mct.gov.br/upd_blob/0018/18294.pdf).

<sup>46</sup> *Brazil's Contribution to Prevent Climate Change*, 8-10. Calculated from population and per capita emissions given in paper.

<sup>47</sup> *Brazil's Contribution to Prevent Climate Change*, 36-37; Embassy of Brazil, *Official Aggregate Data on the Deforestation of the Legal Amazon for the Period 2005-6*, [http://www.brasilemb.org/environment/Official\\_Aggregate\\_Data\\_Deforestation\\_Legal\\_Amazon.shtml](http://www.brasilemb.org/environment/Official_Aggregate_Data_Deforestation_Legal_Amazon.shtml).

<sup>48</sup> *Official Aggregate Data on the Deforestation of the Legal Amazon for the Period 2005-6*.

network of parks and reserves over ten years. To date the program has already reserved 23 million ha for protection or sustainable use<sup>49</sup>—over 5% of Brazil’s total forest land.

### **III.A.2 Electricity**

The *Program for Incentive of Alternative Electric Energy Sources (PROINFA)*, launched in 2002, sets an overall goal to produce 10% of the total electricity from renewable sources by 2022, in two phases. The first phase is to achieve 3,300 MW of renewables—split equally among biomass, small hydro and wind—through long-term power purchasing agreements between Eletrobrás and independent power producers (IPPs) and fiscal incentives for each type of renewable energy (e.g., wind energy subsidy of \$86.32 – 97.90/MWh). PROINFA has made Brazil the largest wind power producer in Latin America. To date, power purchase agreements with a total capacity of 1,423 MW (over 40% of the phase one goal) have been signed, with all expected to be operational by December 2008. Brazil added 208 MW of wind in 2006, giving the country a total installed wind energy capacity of 237 MW.<sup>50</sup>

### **III.A.3 Transportation**

The *National Program of Fuel Alcohol (PROALCOOL)* aimed to promote ethanol use in transportation in response to oil crisis of the 1970s. Although it was discontinued in the late 1980s, PROALCOOL transformed 85% of the vehicle fleet into ethanol vehicles. More recently, this program has laid the important groundwork for the introduction of flex-fuel vehicles (which can use either gasoline or ethanol) into the market. As a result, these vehicles accounted for 77% of sales of new LDVs in February 2006, and the flex fuel LDV share increased to 84% as of June 2007.<sup>51</sup> These types of vehicle now account for 12% of the entire national fleet, and their share is projected to rise to 52% by 2013.<sup>52</sup> This is estimated to grow to the point where in 2020 all light-duty vehicles sold in Brazil are flex-fuel and 70% of the fuel used in these vehicles is ethanol.

## **III.B COSTS AND RELATIONSHIP TO CDM**

It should be noted that some of the recent actions have been high cost measures, highlighting that other positive benefits have driven these efforts. For example, Brazil’s flex fuel vehicle program, begun in 2003, is estimated to achieve about 20 MMT reductions in 2020 (about 1.7 tonne CO<sub>2</sub> per new vehicle) at a cost greater than \$30 per ton.

Some of the emissions reductions achieved through these policies are not being developed as CDM projects, and are thus becoming Brazil’s “contribution to the protection of the

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<sup>49</sup> Roger D. Stone, “The Search for Solutions,” *The American Prospect*, August 13, 2007,

[http://www.prospect.org/cs/articles?article=the\\_search\\_for\\_solutions](http://www.prospect.org/cs/articles?article=the_search_for_solutions).

<sup>50</sup> World Wind Energy Association, “World wind energy award for Brazil,” October 5, 2007,

<http://www.jecomposites.com/composites-news/3974/wind-energy.html>.

<sup>51</sup> NDTV, “Brazil shows the way in fuel cars,” June 4, 2007,

<http://www.ndtv.com/convergence/ndtv/story.aspx?id=NEWEN20070014346&ch=6/4/2007+8:16:00+AM>.

<sup>52</sup> *Brazzil Magazine*, “84% of Cars Sold in Brazil Run on Ethanol, Gasoline, or Both,” March 7, 2007,

<http://www.brazzilmag.com/content/view/7996/54>.

atmosphere.” Brazil has a total of 240 projects in the CDM pipeline with average total reductions of over 24 MMTCO<sub>2</sub>e per year.<sup>53</sup> The introduction of Brazilian flex-fuel vehicles and the associated emissions reductions have not been registered as a CDM project, so the total estimated reductions in the transportation sector from “unilateral actions”—44 MMTCO<sub>2</sub>e are estimated to be mitigated in 2020—are not being scored as a CDM project. However, some of the ensuing reductions from these policies are likely being captured as CDM projects. For example, a large number of wind, hydro, and biomass projects have been proposed in Brazil as CDM projects. These projects are estimated to reduce emissions by around 7 MMTCO<sub>2</sub>e per year<sup>54</sup>—roughly the same level of reduction estimated in the electricity sector from recent policies. Similarly, since deforestation emissions reductions are not eligible for CDM credits, the large drop in emissions from deforestation are not being converted to CDM credits.

#### **IV. MEXICO’S “UNILATERAL ACTIONS”**

In the last few years, Mexico has implemented a variety of policies and measures that are reducing its GHG emissions below business-as-usual levels. To better coordinate these efforts, the country has also created an Inter-Ministerial Commission on Climate Change, established on April 25, 2005, to integrate government ministries into a cooperative climate change planning and decision-making process. The recent climate-related efforts being undertaken in Mexico are discussed below.

In May of 2007, **Mexico formally released its *National Strategy for Climate Change, or ENACC (its Spanish acronym)***. This strategy identified the most promising GHG mitigation opportunities in Mexico, and the ENACC is now being used to develop an official climate plan for the country. Full and effective implementation of the energy measures identified in the ENACC is estimated to reduce GHG emissions by 106.8 MMTCO<sub>2</sub>e annually through 2014; the proposed measures include:

- Cogeneration at oil-sector facilities (7.7 MMT) and industry (>25 MMT)
- Expansion of National Commission for Energy Conservation (CONAE) programs for energy efficiency in the electricity sector and of Electric Power Saving Trust Fund (FIDE) energy efficiency programs for industry, irrigation, and households are expected to produce emissions reductions in the range of 28 MMTCO<sub>2</sub>e per year by 2014
- 2% increase in efficiency of electricity transmission and distribution lines (6.0 MMT)
- 2% increase in thermal efficiency of thermoelectric plants using fuel oil (0.7 MMT)
- Centralized electricity supply (115 MW CC plant) for oil platforms (1.9 MMT)
- 5% improvement in the energy performance of refineries (2.7 MMT)
- Repowering of thermoelectric plants on the Pacific coast and switch to NGCC (21.0 MMT)
- Increased use of renewable energy (RE) – install 7000 MW capacity to generate 16,000 GWh/yr (8.0 MMT)

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<sup>53</sup> UNEP RISOE, CDM Pipeline, 7 November 2007.

<sup>54</sup> To be conservative, we have included all projects listed in the CDM pipeline classified as biomass, wind, and hydro.

- Reduce fugitive emissions of methane (2.4 MMT)
- Replace diesel trucks and buses more than ten years old (2.0 MMT)
- 10% increase in the mode share of freight transported by rail (1.5 MMT)
- Generation of electricity using municipal waste
- Geological sequestration of CO<sub>2</sub>
- Terrestrial conservation and sequestration of CO<sub>2</sub>, including:
  - Increasing the land area undergoing sustainable forest management by 2.6 million ha/yr
  - Increasing the land area covered by current programs that pay for environmental services to 2.49 million ha
  - Increasing the size of protected areas by 500,000 ha/yr
  - Integrating about 6 million ha of land into Wildlife Management Areas
  - Phytosanitary treatment of 640,000 ha/yr of forest land
  - The ProÁrbol reforestation program (15-35 MMT over 6 years), which has a goal to plant 250 million trees in Mexico in 2007 and to reforest an average 400,000 ha/yr over the 2007-2012 period
  - Expand commercial forestry plantations by 100,000 ha/yr (3-7 MMT)
- Install 500,000 high-efficiency wood-burning stoves in rural areas (2.5 MMT)
- Restore farmland and rangeland and improve agricultural practices (9.7 MMT)

## **IV.A RECENT ACTIONS IN KEY SECTORS**

Prior to implementation of these new measures, Mexico has adopted a variety of additional policies and measures that are already serving to reduce its GHG emissions below business-as-usual levels, some of which are detailed below.

### **IV.A.1 Electricity**

In December of 2005, Mexico enacted the *Law for the Use of Renewable Energy Sources (LAFRE)*, which established a goal of achieving 8% of electricity generation from renewables, excluding large hydroelectric facilities, by 2012.

New regulations have been put in place to change the way in which capacity charges are calculated for intermittent RE sources to make these types of power generation more competitive, and to allow taxpayers who invest in RE systems to write off the total investment in a single fiscal year.

Since April of 2006, certain new business establishments (e.g., dry cleaners, laundromats, and large-scale kitchens) in Mexico City must obtain at least 30% of their water heating from solar power. It has been estimated that this will reduce GHG emissions by 355,264 MTCO<sub>2</sub>e through 2012.

Funding has been obtained or established to provide RE for rural electrification for 5000 households between 2006 and 2010, install 60,000 solar photovoltaic systems in 20 Mexican states, promote private-federal co-investment in rural electrification using RE, and lower the

differential investment and electricity generation costs between RE systems and traditional power plants.

CONAE established energy efficiency standards for appliances which are estimated to have resulted in GHG emissions savings of 8 MMTCO<sub>2e</sub> in 2006. Similarly, energy efficiency programs and the use of daylight savings time in summer adopted under FIDE are estimated to have reduced GHG emissions by 5.6 MMTCO<sub>2e</sub> in 2005.

#### **IV.A.2 Transportation**

A program was established in 2002 that provides financial incentives for the retirement of old commercial transport vehicles.

Several BRT systems have been constructed in Mexico. The first was built in León in 2003. The Insurgentes BRT system, a proposed CDM project, was constructed in Mexico City and began operation in July of 2005. This system, with 36 stations, serves 71.1 million passengers per year and replaced 380 less efficient buses with 100 modern buses, reducing emissions by 37,472 MTCO<sub>2e</sub> per year. Existing plans call for BRT systems in a dozen or more cities, including as many as 19 BRT lines in Mexico City.

#### **IV.A.3 Forestry and Agriculture**

The ProÁrbol reforestation program, launched in 2006, is expected to avoid 15-35 MMTCO<sub>2e</sub> through 2012.

The program for commercial forest plantations (PRODEPLAN) was established in 1997 and redesigned in 2001. Its purpose is to revive degraded forest lands and promote sustainable commercial forestry projects. Between 2001 and 2008, 351,700 ha of forest land will have been brought into PRODEPLAN, and it is estimated that this program will save between 3 and 7 MMTCO<sub>2e</sub> between 2007 and 2012 and up to 30 MMTCO<sub>2e</sub> by 2020.

Other programs have been established to:

- Pay owners of forested land to conserve their carbon and water resources (launched in 2003);
- Convert agricultural land to have greater vegetative cover and higher carbon content per hectare;
- Promote improved farming practices, including better irrigation practices, increased mechanization, more widespread use of RE systems (such as solar water pumps for irrigation) and greater use of the sugar industry's biomass waste; and
- Improve the detection, prevention and fighting of forest fires.

### **IV.B COSTS AND RELATIONSHIP TO CDM**

CCAP and the Centro Mario Molina are currently estimating the costs of GHG emission reduction measures in Mexico. Analysis of similar measures in other countries has shown that some of these options—such as wind energy and BRT systems—are generally expensive

to implement. In Mexico, some of these are being implemented under the CDM, but others are not. Mexico currently has 175 projects in the CDM pipeline,<sup>55</sup> which will produce 10.6 MMTCO<sub>2</sub>e in estimated annual emissions reductions. Only about 3 MMT of these reductions are achieved through renewable energy projects; none are in transportation, but the Insurgentes BRT system in Mexico City does not yet appear in the CDM pipeline.

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<sup>55</sup> UNEP RISOE, CDM Pipeline, 7 November 2007.

## V. “UNILATERAL ACTIONS”: COMPARING TO OTHER REGIONS

The CCAP analysis released in 2006 found that unilateral policies and programs adopted by China and Brazil between 2000 and the end of 2005, if fully implemented, were projected to be greater in 2010 than those to be achieved by the United States’ voluntary carbon intensity reduction goal and approximately 40% of the domestic reductions to be achieved in the 15 EU countries under their Kyoto Protocol target. As discussed above, a number of additional measures have been adopted since the end of 2005 in these countries which are expected to further reduce emissions. These reductions are significant when compared with the reductions in developed countries under various commitments or proposals.

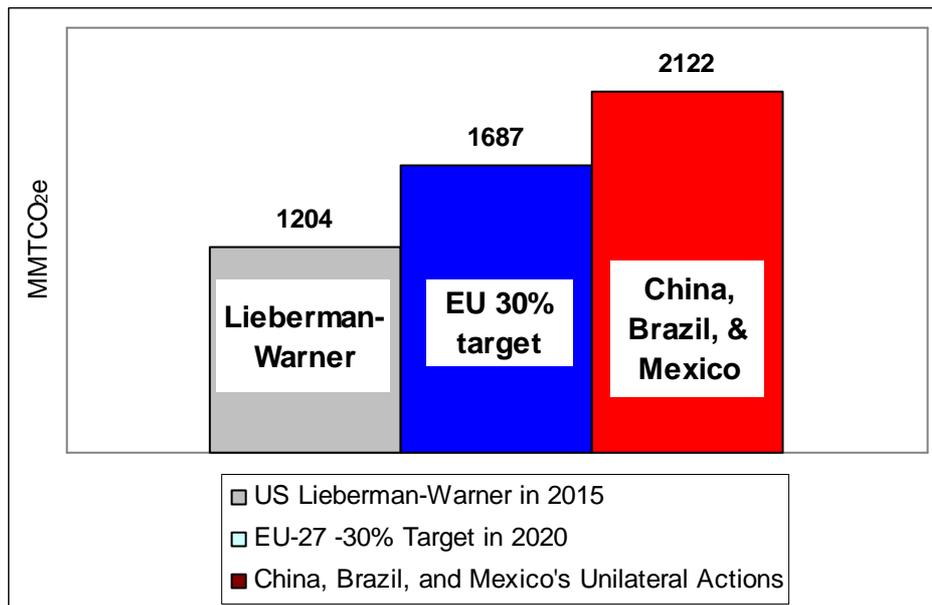
With full implementation, **combining the measures identified in our earlier report with these new measures yields total annual GHG emissions reductions in China, Brazil, and Mexico that are greater than the annual reductions under the Kyoto Protocol (without the US), EU’s reduction commitments in 2020, and the reductions estimated in the early years of the main US legislative proposals** (see figure below)—with a total reduction of 2,100 MMTCO<sub>2</sub>e.<sup>56, 57, 58</sup>

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<sup>56</sup> Estimated reductions for meeting the Kyoto Protocol with the US meeting its target vary across the different literature, as different reference rates are used and the interpretation of the Bonn agreement and Marrakesh accords are often handled differently. For purposes of the comparisons in this report, we used 1,305 MMTCO<sub>2</sub>e from: Reily, J, 2002, MIT EPPA Model Projections and the U.S. Administration’s Proposal, available at: <http://web.mit.edu/globalchange/www/technote3.html>.

<sup>57</sup> For the EU’s reduction commitments in 2020 of 20% and 30% below 1990 levels, we used values in this report of 1,183 and 1,687 MMTCO<sub>2</sub>e, respectively (den Elzen et al., 2007, Exploring European countries’ emissions reduction targets, abatement costs and measures needed under the 2007 EU reduction objectives, Netherlands Environmental Assessment Agency, available at: [www.mnp.nl/bibliotheek/rapporten/500114009.pdf](http://www.mnp.nl/bibliotheek/rapporten/500114009.pdf)).

<sup>58</sup> For the reductions under the US legislative proposals in this report we used a value of 1,204 MMTCO<sub>2</sub>e in 2015 and 2,424 MMTCO<sub>2</sub>e from the analysis of 167 bmt case—approximately 1990 levels in 2020—without banking and international emissions trading since we are interested in the reductions needed to meet the target—not when and where those reductions are generated. These values are from: Paltsev, S. et al., 2007, Assessment of U.S. Cap-and-Trade Proposals, MIT Joint Program on the Science and Policy of Climate Change, available at: [http://web.mit.edu/globalchange/www/MITJPSPGC\\_Rpt146.pdf](http://web.mit.edu/globalchange/www/MITJPSPGC_Rpt146.pdf). The emissions cap level in 2020 used in this analysis is similar to the values estimated for the Lieberman-Warner bill under a “conservative case” (NRDC and WRI, 2007, Greenhouse Gas Emission Reductions under the Lieberman-Warner Bill (S. 2191) Full Committee Chairman’s Mark with Boxer 1st Degree Amendment). Greater reductions could be achieved under an “optimistic case.”



According to one estimate, meeting the Chinese goal to improve economy-wide energy intensity by 20% from 2005-2010 would generate reductions of over 1,500 MMTCO<sub>2e</sub> in 2010, as mentioned above. Combined with forestry and non-CO<sub>2</sub> gas reductions outlined in the Chinese *National Climate Change Programme*—about 280 MMTCO<sub>2e</sub> cumulative over the 5-year period—even greater reductions could be achieved. **These reductions in China alone would be greater than the reductions required to meet the EU’s commitments for 2020 of 20% below 1990, and are greater than the reductions achieved by the most stringent current US legislative proposal in 2015—1,183 and 1,204 MMTCO<sub>2e</sub>, respectively.**

The recent reduction in deforestation rates in Brazil is estimated to have produced emissions reductions of 442 MMTCO<sub>2e</sub> in 2006. Combined with the reductions estimated from policies adopted from 2000-2005—73 MMTCO<sub>2e</sub> in 2020—implementation of recent Brazilian policies is estimated to generate reductions of 515 MMTCO<sub>2e</sub>. **This reduction is equivalent to over 40% of the reduction estimated for the EU in meeting its target to unilaterally reduce emissions 20% below 1990 in 2020 and over 40% of the reduction in the most stringent US legislative proposal in 2015.**

The energy measures identified in the Mexican *National Strategy for Climate Change*, if fully implemented, would yield an estimated reduction of 107 MMTCO<sub>2e</sub> per year—**equivalent to about 20% of the EU-15’s domestic reductions under the Kyoto Protocol of 573 MMTCO<sub>2e</sub> in 2010.**<sup>59</sup>

<sup>59</sup> Values for the base year (4,269 MMTCO<sub>2e</sub>) and the expected use of Kyoto Mechanisms (110.5 MMTCO<sub>2e</sub>) are from the European Environment Agency (2006), *Greenhouse gas emission trends and projections in Europe 2006*. Business-as-usual values in 2010 (4,611 MMTCO<sub>2e</sub>) based upon values presented in: European

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