U.S.-MEXICO BORDER REGION GREENHOUSE GAS INVENTORIES AND POLICY

Review Draft (3/1/09)
Prepared for U.S. EPA

March 2009

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U.S.-MEXICO BORDER REGION GREENHOUSE GAS INVENTORIES AND POLICY

1. Introduction

The U.S.-Mexico border region encompasses 10 states in two countries, fourteen urbanized "sister cities," tribal land and indigenous communities, and large areas of rural and undeveloped land. It is home to 12 million people divided by a border but also connected by history, culture, family, and economic integration. It is also connected by a climate and environment that knows no border. These connections create common cause for the people living in the border region to address the region's vulnerability to climate change by harnessing their shared will and institutions to reduce greenhouse gas (GHG) emissions and adapt to climate change where it is already occurring.

The purpose of this report is to identify and describe current activities related to measuring and mitigating GHG in the border region and to outline a framework of strategies for regional collaboration to reduce GHGs. Just as the West Coast of North America has done through the Western Climate Initiative and the Northeastern States of the United States have done through the Regional Greenhouse Gas Initiative, this paper takes a regional perspective. It draws on activities at the national, state, and local levels but examines them in terms of their implications for the border region and what they imply about regional approaches. The report is based on discussions with people knowledgeable about climate policy in the region and review and analysis of GHG inventories, action plans, and other relevant documents.

Following this introductory section, Section 2 describes and analyzes existing GHG inventories in the region, focusing on key categories of emissions sources. Section 3 describes policies, programs, and projects aimed at mitigating GHG emissions in the region. This includes activities already underway in the region and activities that could be implemented or expanded (e.g., voluntary programs). Section 4 describes international, national, and regional initiatives for regional GHG policy coordination and regional GHG reporting, offsets, and credit trading. Section 5 identifies and discusses possible approaches for cross-board collaboration to reduce GHG emissions. Section 6 concludes with an overview of the key points in the report.

2. GHG Emissions Inventories and Implications for the Border Region

Some U.S. and Mexico border states have completed GHG inventories and others are in the process of developing them. This section describes work to date on these state inventories and other inventories related to the border region. Drawing on the state inventories, the section identifies likely key sources of GHG emissions in the region.

2.1 U.S. and Mexico Border State Inventories

Since 2005, the U.S. states of California, New Mexico, and Arizona and the Mexican states of Baja California and Sonora have completed comprehensive GHG emissions inventories. Texas also completed a less detailed emissions inventory, which was released in 2002. The Mexican states of Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas are, as of the fall of 2008, in the process of developing inventories using the Sonora inventory as a model.[1]

The remainder of this section is based mainly on the five state emissions inventories completed since 2005. Of these states, the inventories developed by California, New Mexico, Arizona, and Sonora present estimates of historical GHG emissions from the years 1990 through 2003, 2004 or 2005 and projected emissions to 2020. Baja California provides GHG emissions information for the year 2005 only. Appendix A provides summary information about each of the five inventories, and Appendix B provides summary data from these inventories.

The five state inventories completed since 2005 cover six types of gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6).[2] These gas types are the same ones that are included in the U.S. Greenhouse Gas Inventory and the Mexican National Inventory described later in this report. All of the reports present emissions of these GHGs using a metric called carbon dioxide equivalence (CO_2e), which describes the amount of CO_2 that would have the same global warming potential as the actual mix of GHGs emitted. The calculation of CO_2e accounts for the fact that some gases contribute more to warming than others.

Each of the five states used methodologies consistent with the Intergovernmental Panel on Climate Change (IPCC) guidelines. The methodologies used by Arizona, New Mexico, and Sonora were very similar because the states collaborated with each other in the inventory effort and were all supported by the same organization, The Center for Climate Strategies. The approach used in these states followed the same approach to emissions accounting used by the U.S. EPA in its national GHG emissions inventory and was consistent with EPA's guidelines for states, which were developed based on IPCC guidelines. Baja used the 2006 IPCC methodology. California's approach also followed IPCC guidance.

Four of the five states present estimates of both *gross* emissions and *net* emissions. Gross emissions are the total emissions in the state while net estimates take into account the amount of CO_2e that has been removed from the atmosphere by the process of sequestration in carbon sinks (e.g., tree growth). Some states caution that their net emissions numbers are rough estimates due to the methodological challenges of assessing carbon sinks.

For electricity—a major component of all GHG inventories—some states present consumption-based results, some present production-based results, and some present both. The key distinction between consumption-based and production-based approaches is how the analyses treat electricity imports and

[1] Note: the final version of this report will have more detailed information on the status of these inventory efforts.
[2] Instead of analyzing HFCs, PFCs, and SF_6, Baja analyzed "fluorated gases" (chlorodifluoromethane and hydrofluorocarbon 134).

exports. A consumption-based approach counts emissions from all electricity used in the state, including within-state production and electricity imports. The advantage of a consumption-based approach is that it focuses on activities occurring in a particular state and is more amenable to reflecting emissions reduction strategies (e.g., increased energy efficiency). A production-based approach counts all emissions from electricity produced in the state, even if some of it is exported. Although Arizona, New Mexico, and Sonora all calculated and reported production-based estimates, only New Mexico used this approach as its preferred final inventory amount.

Table 1 summarizes the total gross and net emissions results from the five state inventories for their most recent year. Information from Texas' 2002 inventory is provided for comparison. Within the United States, the ranking of these states' GHG emissions generally tracks their relative population, with the exception that the least populated U.S. border state, New Mexico, has higher emissions than Arizona but less than a third of Arizona's population. New Mexico attributes its high per capita emissions (nearly twice the U.S. average) to its GHG-intensive gas, oil, and electricity production industries.[3]

Table 1: Summary of Border State Inventories

Border State	Year Inventory Completed	Period Covered	Annual Emissions million metric tons (mmt)	Population (Millions)[4]	Emissions per capita (mmt CO_2e)
California	2007	1990-2004 (Projections to 2020)	484.4 mmt CO_2e (2004)--gross 479.7 mmt CO_2e (2004)--net	36.6 (2007)	13.2--gross 13.1--net
Arizona	2005	1990-2003 (Projections to 2020)	89 mmt CO_2e (2000)--gross 82.3 mmt CO_2e (2000)--net	6.3 (2007)	14.1--gross 13.1--net
New Mexico	2006	1990-2003 (Projections to 2020)	82.9 mmt CO_2e (2000)—gross 62 mmt CO_2e (2000)—net (rough estimate) *Note: this is New Mexico's production-based estimate*	2.0 (2007)	41.5--gross 31—net
Texas	2002	1990-1999	189 mmt CO_2e (1999)--net	23.9 (2007)	7.9--net
Baja California	2007	2005	17.7 mmt CO_2e (2005)—gross	2.8 (2005)	6.3--gross
Sonora	2008	1990-2005 (Projections to 2020)	19.9 mmt CO_2e (2005)—gross 11.5 mmt CO_2e (2005)—net (rough estimate)	2.4 (2005)	8.3—gross 4.8--net

[3] New Mexico Climate Change Advisory Group. 2006. "New Mexico Climate Change Advisory Group Final Report." Pp. 2-2. Available: http://www.nmclimatechange.us/ewebeditpro/items/O117F10150.pdf

[4] Source: wikipedia.org. Available at: http://en.wikipedia.org/wiki/List_of_U.S._states_by_population and http://en.wikipedia.org/wiki/List_of_Mexican_states_by_population.

Mexican states have substantially lower per-capita gross emissions than U.S. states. Sonora has higher emissions than its more populous neighbor Baja. This is driven mainly by higher per-capita emissions from energy consumption (Sonora relies mainly on oil, while Baja relies mainly on natural gas) and from agriculture. At 8.31 mmt CO_2e per capita, Sonora also has higher per capita emissions than the Mexican national average of 6.35 mmt CO_2e for 2005.[5]

2.1.2 Sectoral Breakdown of State GHG Emissions

Table 2 illustrates the distribution of emissions across categories of source types for each of the five states that have completed inventories since 2005. Brief descriptions of the categories of sources described in the table are as follows:

- **Energy Use Other than Transportation**: This category accounts for 40-50% of emissions in most states and over 70% in New Mexico due to its large fossil fuel industry. The main sources are fuel used for electricity production and fuel for heating residential, commercial, and industrial buildings.

- **Transportation Energy Use**: This sector accounts for 25% to 40% of emissions in most border states. It reflects emissions from the burning of transportation fuels—mainly gas and diesel from cars and trucks.

- **Industrial Processes (non-energy)**: This sector accounts for 2% to 9% of emissions in the border states. It includes all releases of GHGs <u>not</u> related to the energy used to power and heat industrial facilities (e.g., emissions of non-$C0_2$ GHGs from refrigeration units)

- **Agriculture (non-energy)**: This sector accounts for 5-17% of emissions in border states. It includes releases of GHGs not related to energy use (e.g., for agricultural vehicles and facilities). The main sources are 1) methane from livestock via enteric fermentation and manure, 2) nitrous oxides from the use of fertilizers, and 3) the release of soil carbon from cultivation.

- **Waste Management**: Waste management accounts for 1-13% of GHG emissions in the border region. It includes releases of GHGs not related to energy use. The main sources are methane from landfills and wastewater treatment plants.

- **Forestry and Land Use (sources only)**: This sector accounts for a very small fraction (generally less than 1%) of GHG emissions. However, forestry is an important sink for sequestering carbon.

[5] Comision de Ecologia y Desarrollo Sustenable del Estado de Sonora and The Center for Climate Strategies. 2008. "Greenhouse Gas Emissions in Sonora and Reference Case Projections 1990-2020." (June 2008), p. viii.

Table 2: Sectoral Breakdown of Emissions Sources

Source Sector	Arizona (2000)		New Mexico (2000)		California (2004)		Baja California (2005)		Sonora (2005)		Regional Avg.
	MMT CO2e	%	MMT CO2e	%	MMT CO2e	%	MMT CO2e	%	MMT CO2e	%	%
Energy Use Other than Transportation	43.8	49%	60.2	72%	238.5	49%	6.99	39.5%	8.12	40%	50%
Transportation Energy Use	35	39%	14.2	17%	181.1	38%	7	39.6%	5.1	26%	32%
Industrial Processes (non-energy)	4.1	5%	1.5	2%	30.78	6%	0.44	2.5%	1.76	10%	5%
Agriculture (non-energy)	4.2	5%	6	7%	23.09	5%	0.98	5.5%	3.36	17%	8%
Forestry and Land Use (sources only)		0%		0%	0.19	0%	0	0.0%	0.00023	0%	0%
Waste Management	1.9	2%	1.2	1%	9.44	2%	2.28	12.9%	1.58	8%	5%
Gross Emissions	**89**		**82.9**		**484**		**17.7**		**19.9**		

2.1.3 Key GHG Emissions Sources in the Border Region

Although the border state inventories analyzed many different individual sources of GHG emissions, there are ten key sources that account for over 90% of all of the emissions for each of these states. These ten emissions sources are described in Table 3, along with the corresponding emissions in each state. Because this table focuses on electricity production as a source of emissions, it compares the GHG emissions accounted for in this table to a total production-based estimate of emissions for the state. (Where a total production-based estimate was not reported for the state, it was calculated using information from the inventories.)

Table 3: Contribution of Key Emissions Sources to State Totals

Source Sector	Arizona (2000)	New Mexico (2000)	California (2004)	Baja California (2005)	Sonora (2005)
	MMT CO2e	MMT CO2e	MMT CO2e	MMT CO2e	MMT CO2e
1. Electricity Production (all fuels)	44.5	33.2	123.2	4.82	6.84
Coal	*39.2*	*30.7*		*--*	*--*
Natural Gas	*5.1*	*2.5*		*4.65*	*2*
Oil	*0.2*	*0*		*0.16*	*4.84*
Other	*--*	*--*		*0.17*	*--*
2. Residential, Commercial, and	9.3	7.3	60.9	2.15	1.06

Source Sector	Arizona (2000) MMT CO2e	New Mexico (2000) MMT CO2e	California (2004) MMT CO2e	Baja California (2005) MMT CO2e	Sonora (2005) MMT CO2e
Industrial Energy Use (e.g. heating)					
3. Transportation--Gasoline Cars and Trucks	22.8	8.7	135	4.61	2.44
4. Transportation--Diesel Trucks	6.5	4.2	35.7	1.74	1.54
5. Fossil fuel industry	--	19.5	43.2	--	0.22
6. Cement Industry (non-energy)	1	0.4	5.8	0.23	1.56
7. Agriculture--Enteric ferment. & Manure mgmt.	4.2[6]	3.5	13.9	0.98	2.01
8. Agriculture--Soils		2.4	8.24	--	1.28
9. Solid Waste Management/Landfills	1.3	1	5.62	1.87	0.7
10. Wastewater Management	0.5	0.2	3.82	0.414	0.6
Gross Emissions from Ten Key Sources	**90.1**	**80.4**	**435.54**	**16.81**	**18.25**
Gross State Emissions (production-based: not adjusted for energy exports)	99	82.9	456.1	17.68	18.41
Ten Key Emissions as a % of Total Emissions	91%	97%	95%	95%	99%

The fact that these ten sources account for such a large percentage of total emissions suggests some key data needs for understanding GHG emissions sources in the border region in the following categories:

- Energy: 1) Inventory of power plants and 2) characterization of residential, commercial, and industrial infrastructure that uses electricity and fuel.
- Transportation: 1) Characterization of the fleet of cars and light trucks using gasoline and 2) characterization of the fleet of heavy duty vehicles using diesel. Transportation "hot spots" in the region include large border cities and border crossings.

[6] Arizona does not break out estimates of emissions from agricultural soils, enteric fermentation or manure management.

- Agriculture: 1) Characterization of livestock industry generating emissions through enteric fermentation and manure management and 2) characterization of agricultural regions in the border generating emissions from agricultural soils and fertilizer use.

- Key Industries: Inventory of facilities in two key industries that stand out in GHG inventories: 1) fossil fuel industry and 2) cement plants.

- Waste: 1) Landfills that generate methane and 2) wastewater treatment plants that generate methane and CO_2.

2.1.4 Focus on Electricity Production

Because electricity production is such an important component of the inventories, additional information on this sector is provided below. Tables 4 and 5 list the 29 power plants in the border region—17 in the United States (Table 4) and 12 in Mexico (Table 5; Figure 1). Three of these power plants burn coal, which accounts for the majority of GHG emissions from energy production in the state inventories, and many of the rest use natural gas.

Table 4: Energy Plants in Border Region: United States

Name	City	State	Type	Capa-city (MW)
South Bay Power Plant	San Diego	CA	Natural Gas	693
Larkspur Energy Facility	San Diego	CA	Natural Gas	100
El Centro	El Centro	CA	Natural Gas	184
Kearny	San Diego	CA	Natural Gas	127
Encina	Carlsbad	CA	Natural Gas	958
Palomar	Escondido	CA	Natural Gas	510
Yucca	Yuma	AZ	Natural Gas	163
Apache Station	Cochise	NM	Coal/Natural Gas	350/350
Pyramid	Hidalgo	NM	Natural Gas	158
Luna Energy Facility	Luna	NM	Natural Gas	559
Afton Generating Station	Dona Ana	NM	Natural Gas	141
Newman	El Paso	TX	Natural Gas	474
Laredo	Laredo	TX	Natural Gas	171
Frontera Energy Center	Hidalgo	TX	Natural Gas	475
Hidalgo Energy Center	Hidalgo	TX	Natural Gas	470
La Palma	Cameron	TX	Natural Gas	203
Silas Ray	Cameron	TX	Natural Gas	125

Source: http://tonto.eia.doe.gov/state/index.cfm

Table 5: Energy Plants in Border Region: Mexico[7]

Name	Municipality	State	Type	# of Units	Capacity (MW)	Generation (GWh)
Pdte. Juarez (Rosarito)	Rosarito	Baja CA	Steam /Conventional Thermal /Combined Cycle (fuel: natural gas)	11	1,326	3,828
Cerro Prieto	Mexicali	Baja CA	Geothermic	13	720	5,112
Mexicali (PIE)	Mexicali	Baja CA	Combined cycle	1	489	1,641
Puerto Libertad (not shown on map)	Pitiquito	Sonora	Steam (Fuel: oil)	4	632	3,127
Naco Nogales	Agua Prieta	Sonora	Combined cycle	1	258	572
Samalayuca	Cd. Juarez	Chihuahua	Steam	2	316	1,360
Samalayuca	Cd. Juarez	Chihuahua	Combined cycle	6	522	3,486
Rio Escondido	Rio Escondido	Coahuila	Coal	4	1,200	8,387
Carbon II	Nava	Coahuila	Coal	4	1,400	8,294
La Amistad	Acuna	Coahuila	Hydroelectric	2	66	24
Rio Bravo II (PIE)	Valle Hermoso	Tamaulipas	Combined cycle	1	495	3,300
E. Portes G. (Rio Bravo)	Rio Bravo	Tamaulipas	Steam/ Conventional Thermal	4	520	2,068

Source: http://www.sener.gob.mx/webSener/res/PE_y_DT/pub/prospec_elec_04_13.pdf

2.1.5 Estimate of Total Border Region Emissions from State Inventories

A very rough estimate of border region GHG emissions can be estimated based on the border state inventories multiplying population data for the border region by per-capita emissions. Table 6 presents population and emissions data for each state along with estimated emissions. (An average of per-capita emissions for Baja California and Sonora was used as a proxy for per-capital emissions for Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas). Using this very rough approach, border region annual emissions can be estimated at 129 MMT CO2e. If the border region were its own country, this would put it 33rd in the world in terms of emissions (between Uzbekistan and Pakistan).[8]

Table 6: Estimate of Border Region Emissions Based on Border Population and Per-capita Emissions

State	Border Population (2005)[9]	State Population (2005, Mexico; 2007, U.S.)	Percent Population n Border Region	Gross GHG tons per capita	Gross Border GHG est. (MMT CO2e)
Baja	2,351,723	2,844,469	82.7%	6.3	14.82
Sonora	585,883	2,394,861	24.5%	8.3	4.86

[7] Direccion General de Planeacion Energetica. 2004. "Prospectiva del Sector Electrico, 2004-2013." Pp. 104-105. Available: http://www.sener.gob.mx/webSener/res/PE_y_DT/pub/prospec_elec_04_13.pdf .
[8] Source: wikipedia.org. Available: http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions
[9] Source: Border 2012. Undated. "Data Tables for the *State of the Border Region* Indicators Report, 2005." Available: http://www.epa.gov/usmexicoborder/docs/bitf_table.pdf. "

State	Border Population (2005)[9]	State Population (2005, Mexico; 2007, U.S.)	Percent Population n Border Region	Gross GHG tons per capita	Gross Border GHG est. (MMT CO2e)
Chihuaha	1,520,510	3,241,444	46.9%	*7.3*	11.10
Coahuila	321,556	24,952,000	1.3%	*7.3*	2.35
Nuevo Leon	18,985	4,199,292	0.5%	*7.3*	0.14
Tamaulipas	1,569,009	3,024,238	51.9%	*7.3*	11.45
California	3,122,946	36,553,215	8.5%	13.2	41.22
Arizona	1,250,986	6,338,755	19.7%	14.1	17.64
New Mexico	219,298	1,969,915	11.1%	41.5	9.10
Texas	2,146,987	23,904,380	9.0%	7.9	16.96
					Total: 129.64

The accuracy of this approach for each state depends on how much of that states' overall population is in the border region and/or how similar border region conditions are to those for the state as a whole. For some border states, the statewide GHG inventories are a relatively accurate picture of that state's border region emissions because much of the population and economic activity takes place near the border. That is true of Baja California, where over 80% of the state's population lives in the border cities of Tijuana, Tecate, and Mexicali. California is far to the other end of the spectrum, where less than 9% of the population lives in the border counties of San Diego and Imperial. (However, it is interesting to note that an emissions inventory for San Diego county, which accounts for much of the population of California's border region estimates the county's emissions at 34 mmt CO_2e, which is 83% of the California border region estimate above). In states that don't have populations concentrated in the border region, large cities (e.g., Los Angeles, Phoenix, Monterrey, etc.) and significant sources (e.g., coal-fired power plants in the Four Corners region of northwestern New Mexico) outside of the border region make it less accurate to use these state inventories to deduce border-related emissions.

2.2 Other Relevant Inventories

National GHG inventories for the United States and Mexico, as well as some local and private sector inventories, provide context for the state-level inventories in the region. This section briefly describes these other inventories.

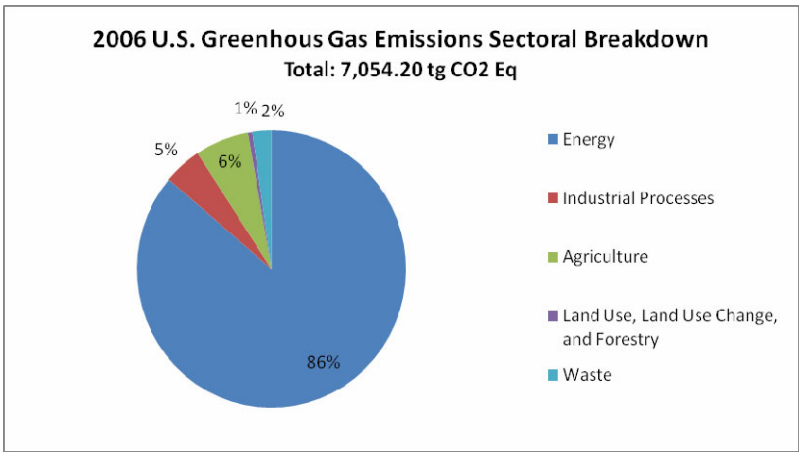
2.2.1 United States: Inventory of U.S. GHG Emissions and Sinks

The United States published its most recent national inventory of GHGs in 2008. It covers the years 1990 to 2006. The inventory was prepared by the Environmental Protection Agency's Office of Atmospheric Programs consistent with U.S. commitments under the United Nations Framework Convention on Climate Change (UNFCCC). The methodology used to calculate emissions for this inventory were consistent with those recommended in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, the IPCC Good Practice Guidance and Uncertainty Management in National

Greenhouse Gas Inventories, and the IPCC Good Practice Guidance for Land Use, Land-Use Change, and Forestry. The United States' GHG emissions in 2006 were estimated to be 7,054.2 mmt CO2e. [10]

Figure 2 illustrates the sectoral breakdown of emissions. The largest source of emissions comes from energy, which accounted for 86% of the total. The figure does not depict the net amount of CO2 that was captured by carbon sinks. The amount of emissions captured in carbon sinks in 2006 was 883.7 mmt CO_2e. With this figure taken into account, the total net GHG emissions for the U.S. in 2006 was 6170.5 mmt CO_2e. Based on these net U.S. emissions, the U.S. border states account for around 13% of total U.S. GHG emissions.

Figure 2: Sectoral Breakdown of the United State's National GHG Inventory (note: 1tg = 1 million metric tons



2.2.2 Mexico: Inventario Nacional de Emisiones de Gases de Efecto Invernadero

[10]This total includes preliminary estimates for energy, industrial processes, solvent and product use, agriculture, land-use, land-use change, and forestry, and waste. See: U.S. EPA. 2008. "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2006." Available: http://www.epa.gov/climatechange/emissions/usinventoryreport.html.

Mexico published its most recent national inventory of GHGs in 2006. It covers the years 1990 to 2002. The inventory was prepared by Mexico's National Institute of Ecology as part of Mexico's obligation as a signatory to the Kyoto Protocol. The methodology followed the guidelines promulgated by the Kyoto Protocol Conference of Parties. Including preliminary estimates for Land-use, Land-use Change, and Forestry (LULUCF), Mexico's GHG emissions in 2002 were estimated to be 643.2 mmt CO_2e. (without LULUCF, they were estimated at 553.3 mmt CO_2e).[11] Based on the higher of these figures, the Mexican border states of Baja California and Sonora together account for around 6% of Mexico's total emissions.

Figure 3: Sectoral Breakdown of Mexico's National GHG Inventory

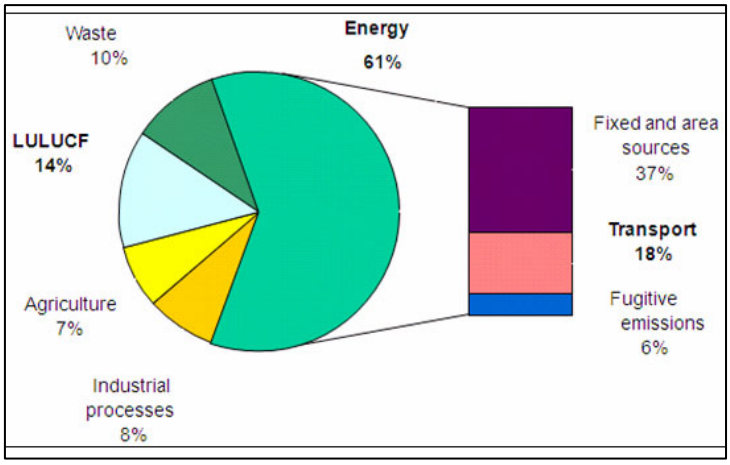
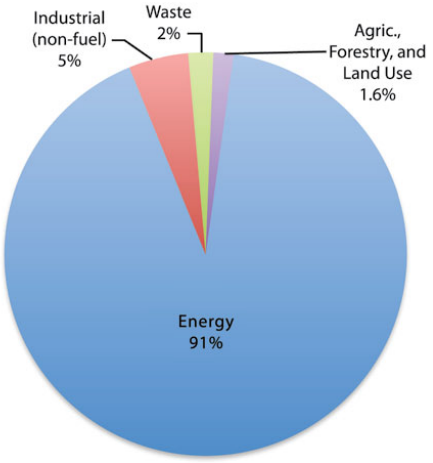


Figure 3 illustrates the sectoral breakdown of Mexico's emissions. The largest source of emissions was energy, which accounted for 61% of the total. The energy category breaks down into 24% for energy generation, 13% for other fixed-source and area emissions (e.g., manufacturing, construction, etc.), 18% for transportation, and 6% for fugitive methane emissions.

2.2.3 San Diego County GHG Inventory

San Diego County, California published a countywide inventory of GHGs in 2008.[12] It covers the years 1990 to 2006. The inventory was prepared by the Energy Policy Initiatives Center at the University of San Diego (USD) School of Law and the Department of Chemistry and Biochemistry at USD to better understand the emissions sources in the region and to serve as a resource for local and regional decision makers. The methodology followed the calculations used by the California Air Resources Board (CARB) to develop California's statewide GHG inventory. Including estimates for industrial emissions, waste, agriculture, forestry, land use, and energy, San Diego County's GHG emissions in 2006 were estimated to be 34

Figure 4: 2006 San Diego County GHG Emissions by IPCC Category



[11] Secretaria de Medio Ambiente y Recursos Naturales y Instituto Nacional de Ecologia. Undated. "Inventario Nacional de Emisiones de Gases de Efecto Invernadero 1990 – 2002." Available: http://www.ine.gob.mx/cclimatico/inventario3.html.

[12] University of San Diego. 2008. "San Diego County Greenhouse Gas Inventory." Available: http://www.sandiego.edu/epic/ghginventory/.

million metric tons of CO2e, an increase of 5 million metric tons of CO2e over 1990 level emissions.

Figure 4 illustrates the sectoral breakdown of San Diego County emissions by IPCC category. The largest source of emissions is energy, which accounted for 91% of the total.

2.2.4 Company Inventories: Programa GEI

In Mexico, a public-private initiative known as the "Pilot Voluntary Program of Accounting and Green House Gas Reporting in Mexico" has been created. This program encourages private companies in Mexico to inventory GHG emissions and manage climate change risks. Forty-seven companies in all of Mexico have registered and have made their GHG emissions inventories public. In 2007, these companies reported combined emissions of 118 mmt CO_2e. This figure represents 18% of the emissions inventory reported in the Mexico's National Inventory of Greenhouse Gases.

3. Action Plans and Programs for Reducing GHG Emissions in the Border Region

Developing GHG inventories is often a prelude to developing action plans for reducing GHG emissions. The first part of this section describes GHG action planning in the border region, beginning with border state action plans and then providing context for these plans by describing national and local GHG reduction planning efforts. The second part of the section describes U.S. and Mexican voluntary GHG reduction programs that may be part of a strategy for reducing border region GHG emissions.

3.1 State, National, and Local GHG Reduction Plans and Strategies

3.1.1 U.S. Border State Climate Action Plans

Three out of the four U.S. border states—California, Arizona, and New Mexico—have climate action plans that specify GHG reduction targets for the state and a series of actions to achieve those targets (see Table 7). All three either have, or anticipate having, mandatory reporting programs to support the plans.

Table 7: Summary of U.S. Border State Action Plans

States	State Target	State Action Plan	Mandatory Reporting
California	Executive Order: 2000 levels by 2010 1990 levels by 2020 80% below 1990 by 2050 State Law (AB32): 1990 levels by 2020	Completed 2006	Mandatory reporting for major sources

States	State Target	State Action Plan	Mandatory Reporting
Arizona	Executive Order: 2000 levels by 2020 50% below 2000 by 2040	Completed 2006	In process
New Mexico	Executive Order: 2000 levels by 2012 10% below 2000 by 2020 75% below 2000 by 2050	Completed 2006	Large emitters required to report by January 2009

Arizona Climate Change Action Plan

Arizona's *Climate Change Action Plan* was released in 2006 by the state's Climate Change Advisory Group, a stakeholder body established by Executive Order 2005-02 and supported by the Center for Climate Strategies.[13] The report provides 49 policy recommendations in agriculture and forestry; transportation and land use; energy supply; and residential, commercial, industrial, and waste management fuel use. Together, the measures are estimated to:

- Reduce Arizona's GHG emissions from "business as usual" by more than 69 mmt CO_2e in 2020 (5% below the 2000 level); and
- Reduce cumulative GHG emission for the period 2007-2020 by more than 485 mmt CO_2e

The plan is estimated to result in net economic savings of more than $5.5 billion between 2007 and 2020, which equates to $13 per ton of GHG emissions avoided.

New Mexico Climate Change Action Plan and GHG Reporting

The final report from New Mexico's Climate Change Advisory Group, produced in 2006, recommends 69 activities to meet the state's GHG reduction goals. [14] The stakeholder body was established by Executive Order 05-33, and—like Arizona—was supported by the Center for Climate Strategies. The 69 policy recommendations in the plan cover agriculture and forestry; transportation and land use; energy supply; and the residential, commercial, and industrial sectors. Together, the recommendations are estimated to:

- Reduce New Mexico's GHG emissions more than 36 mmt CO_2e in 2020 compared to a "business as usual" reference case of 70 mmt CO_2e, putting the state well beyond its target for 2020 (equivalent to a 26 mmt CO2e reduction)
- Reduce cumulative GHG emission for the period 2007-2020 by 267 mmt CO2e.

[13] Arizona Climate Change Advisory Group. 2006. "Climate Change Action Plan." (August 2006). Available: http://www.azclimatechange.gov/download/O40F9347.pdf

[14] New Mexico Climate Change Advisory Group. 2006. "New Mexico Climate Change Advisory Group Final Report." Available: http://www.nmclimatechange.us/ewebeditpro/items/O117F10150.pdf.

The plan is estimated to result in net economic savings of more than $2 billion between 2007 and 2020.

New Mexico intends to have mandatory reporting for GHG emissions from all electrical generating units with capacity greater than 25 megawatts, petroleum refineries, and cement manufacturing plants. These facilities will submit reports through either The Climate Registry or the California Climate Action Registry (see below).

California Climate Change Draft Scoping Plan and GHG Reporting

California's draft plan for reducing GHG emissions, the *Climate Change Draft Scoping Plan*, was developed by the California Air Resources Board (ARB) with input from the California Climate Action Team.[15] Development of the plan was required under California's Global Warming Solutions Act of 2006 (Assembly Bill 32). The draft scoping plan was released in June 2008 for review and comments.

The plan outlines 19 recommended reduction strategies (some with sub-components), including a statewide cap and trade program covering electricity, transportation, residential/commercial buildings, and industrial sources. The cap and trade program is to be developed in coordination with that of the Western Climate Initiative (described below). Other recommendations will be implemented via new and existing regulations, and cover areas such as more efficient vehicles, energy efficiency, renewable energy, landfill methane control, and others.

The plan is estimated to reduce GHG emissions by 169 mmt CO_2e in 2020 compared to a reference case. This represents nearly a 30% reduction from "business as usual." California's preliminary analyses estimated that overall savings (e.g., from increased efficiency and development of alternatives to petroleum fuel) will outweigh the costs.

Assembly Bill 32 required mandatory reporting for major source facilities in five industrial sectors. California also tracks emissions under the voluntary California Climate Action Registry, through which over 300 member companies, local governments, and other organizations report emissions annually.[16] The action registry is similar in design to the Climate Registry, described in Section 4.[17] The Action Registry also has a feature—called the Climate Action Reserve—for reporting voluntary carbon reductions.

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[15] California Air Resources Board. 2008. "Climate Change Draft Scoping Plan: A Framework for Change, June 2008 Discussion Draft." Available: http://www.arb.ca.gov/cc/scopingplan/document/draftscopingplan.pdf

[16] Program website: http://www.climateregistry.org/.

[17] For an explanation of differences between The CA Climate Registry, CA's mandatory reporting requirement, and TCR, see "Comparison of Reporting Requirements for the Climate Registry (TCR), The California Climate Action Registry (CCAR) and The California Air Resources Board's Mandatory Reporting Program." Available: http://www.climateregistry.org/resources/docs/misc/ca-voluntary-mandatory-reporting-matrix.pdf.

Top Five Greenhouse Gas Reduction Strategies from State Action Plans for Arizona, New Mexico, and California

Below are the top five reduction strategies expected to achieve the greatest greenhouse gas emissions reductions for California, Arizona, and New Mexico.

Arizona

- Environmental portfolio standard/renewable energy standard and tariff (116 mmt CO2e)
- Demand-side efficiency goals, funds, incentives, and programs (103 mmt CO2e)
- Carbon intensity targets (70.4 mmt CO2e)
- Solid waste management (36 mmt CO2e)
- State clean car program (32.5 mmt CO2e)

New Mexico

- Methane reduction in oil and gas operations (35.3 mmt CO2e)
- Renewable portfolio standard with financial incentives for centralized renewables (26 mmt CO2e)
- CO2 capture and storage or reuse in oil and gas operations (25.1 mmt CO2e)
- Energy generation performance standard (24.3 mmt CO2e)
- Advanced coal/fossil technologies (e.g., integrated combined cycle gasification with carbon capture) (22.7 mmt CO2e)

California

- Additional emissions reductions from capped sectors (35.2 mmt CO2e)
- California light-duty vehicle GHG emissions standards (31.7 mmt CO2e)
- Energy efficiency in electricity, commercial, and residential sectors (26.4 mmt CO2e)
- Renewable portfolio standard (21.2 mmt CO2e)
- Low carbon transportation fuel standard (16.5 mmt CO2e)

Note: Reductions for California are expressed as annual emissions reduced from business as usual in 2020. For Arizona and New Mexico, they are expressed as cumulative reductions from business as usual over the period 2007 to 2020.

3.1.2 Status of Mexican Border State Climate Action Planning

All of the Mexican border states anticipate developing climate action plans as a follow-up to their GHG inventory development efforts. The president of Mexico's Instituto Nacional de Ecologia (INE) recently announced an effort to develop state climate action plans in Mexico, using a plan developed by Veracruz as a model.[18] In addition to an inventory, these plans would include an analysis of vulnerability to changes in climate, an analysis of legal and institutional frameworks, and the design and evaluation of potential climate change mitigation and adaptation measures.

Much more than climate action plans for U.S. border states, the Veracruz plan that will be a model for Mexican border states focuses on the impacts of climate change. Among other things, it analyzes

[18] Adrian Fernandez, Instituto Nacional de Ecologia. 2008. "Climate Change State Action Plans in Mexico." Presented at Border 2012 Air Policy Forum, July 29, 2008, San Diego, CA. Veracruz's action plan is available at: http://www.ine.gob.mx/cclimatico/descargas/e2007j.pdf?

impacts on health, forests, and artisanal fisheries. The discussion of emissions reductions focuses on energy use in the residential sector and the role of forests in sequestering carbon.

3.1.3 Mexico's National Strategy for Climate Change

State-level action planning in Mexico is taking place in the context of Mexico's National Strategy for Climate Change (Estrategia Nacional de Cambio Climatico) published in 2007.[19] This strategy outlined a series of mitigation strategies that, if fully implemented, were estimated to reduce 106.8 mmt CO_2e annually to 2014.[20] This strategy provides the foundation for Mexico's national climate plan, the "Programa Especial de Cambio Climatico, 2008-2012." Table 8 lists the components of the national strategy and the expected reductions in GHGs.

Table 8: Summary of Mitigation Activities in Mexico's National Strategy for Climate Change

Activity	**Estimated GHG Reductions (in mmt CO_2e)**
Cogeneration at oil-sector facilities	7.7
Cogeneration at industrial facilities	>25
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	28 mmt CO2e per year by 2014
2% increase in efficiency of electricity transmission and distribution lines	6.0
2% increase in thermal efficiency of thermoelectric plants using fuel oil	0.7
Centralized electricity supply (115 MW CC plant) for oil platforms	1.9
5% improvement in the energy performance of refineries	2.7
Repowering of thermoelectric plants on the Pacific coast and switch to NGCC	21.0
Increased use of renewable energy (RE) – install 7000 MW capacity to generate 16,000 GWh/yr	8.0
Reduce fugitive emissions of methane	2.4
Replace diesel trucks and buses more than ten years old	2.0
10% increase in the mode share of freight transported by rail	1.5
Generation of electricity using municipal waste	Not specified
Geological sequestration of CO2	Not specified
Terrestrial conservation and sequestration of CO2, 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, 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,	Total not specified; estimates for specific activities: ProÁrbol reforestation program: 15-35 MMT over 6 years Expand commercial forestry plantations: 3-7 MMT

[19] Comision Intersectoral de Cambio Climatico. 2007. "Estrategia Nacional de Cambio Climatico." Available: http://www.semarnat.gob.mx/Documents/Estrategias_libro_completo_compress2.pdf.

[20] Center for Clean Air Policy. 2007. "Greenhouse Gas Mitigation in China, Brazil and Mexico: Recent Efforts and Implications." Available: http://www.ccap.org/docs/resources/64/Developing_Country_Unilateral_Actions_2007_Update.pdf

Activity	Estimated GHG Reductions (in mmt CO_2e)
• Expand commercial forestry plantations by 100,000 ha/yr	
Install 500,000 high-efficiency wood-burning stoves in rural areas	2.5
Restore farmland and rangeland and improve agricultural practices	9.7

Source: Center for Clean Air Policy

3.1.4 Local GHG Reduction Planning

Ninety percent of the population of the U.S.-Mexico border region lives in fourteen sister cities. Examples include San Diego-Tijuana and El Paso-Laredo. There are a number of initiatives in the United States and worldwide that encourage and assist cities in developing climate change inventories and action plans. This section describes two of these programs with involvement by border region cities.

ICLEI Cities for Climate Protection

The Cities for Climate Protection Campaign, run by the non-profit organization Local Governments for Sustainability (ICLEI), helps and encourages cities to reduce GHG emissions. Over 680 local governments around the world have joined the program. To join, they need to pass a resolution to reduce GHG emissions in their own operations and in their jurisdictions. ICLEI estimates that partner cities account for 15% of global human-produced GHG emissions.[21]

ICLEI provides member cities with technical support to take them through a series of five milestones:

- **Milestone 1.** Conduct a baseline emissions inventory and forecast
- **Milestone 2.** Adopt an emissions reduction target for the forecast year
- **Milestone 3.** Develop a Local Action Plan
- **Milestone 4.** Implement policies and measures
- **Milestone 5.** Monitor and verify results

In the border region, the cities of San Diego, Ciudad Juarez, and Tijuana are members of the Cities for Climate Protection Program.

As part of its commitment under the program, San Diego published a citywide Climate Protection Action Plan in 2005.[22] Including estimates for energy, transportation, and waste, San Diego's GHG emissions in 1990 were 15.5 mmt CO_2e per year. Actions described in the plan would reduce the city's 2010 "business as usual" baseline of 22.5 mmt CO_2e by 13.2 mmt CO_2e. The inventory was prepared by the Climate Protection Action Plan Ad Hoc Advisory Committee and the City of San Diego Environmental Services Department staff.

[21] See ICLEI website: http://www.iclei.org/index.php?id=811.
[22] City of San Diego Environmental Services Division. 2005. "City of San Diego Climate Protection Action Plan." (July 2005). Available: http://www.sandiego.gov/environmental-services/sustainable/pdf/action_plan_07_05.pdf.

U.S. Mayor's Climate Protection Agreement

The U.S. Mayor's Climate Protection Agreement, under the auspices of the U.S. Conference of Mayors, aims to help cities achieve the Kyoto Protocol goals.[23] To join the agreement, participating cities commit to:

- Meet or exceed the Kyoto Protocol targets in their city operations and communities;
- Urge their state and federal governments to enact policies and programs to meet or exceed the Kyoto Protocol targets; and
- Urge the U.S. Congress to establish a national emissions trading system.

Member cities are encouraged to develop inventories, set targets, and create action plans covering a wide range of sectors, including land use, transportation, clean energy, energy efficiency, building standards, and others. In the border region, San Diego, El Paso, and Laredo have signed onto the U.S. Mayor's agreement. San Diego's inventory and climate planning efforts are described above. No action plans for El Paso or Laredo were identified for this report.

3.2 Voluntary Programs to Reduce GHGs

Beyond border region action planning efforts and the state and local laws, regulations, and programs to implement them, there are a number of well-established voluntary programs in the U.S. and Mexico that could be introduced or enhanced in the border region. This section describes the most promising set of voluntary programs and describes current border region activity related to these programs.

3.2.1 Green Power Partnership[24]

U.S. EPA's Green Power Partnership is a voluntary program that encourages public and private institutions to increase their use of clean energy from solar, wind, geothermal, biogas, biomass, and low-impact small hydroelectric sources. EPA provides tools for partner organizations to estimate their energy use, set green power targets, and identify sources of green power in their states. There are over 300 partner institutions in the U.S. border states.

3.2.2 Combined Heat and Power Partnership[25]

EPA' s Combined Heat and Power (CHP) Partnership is a voluntary program that promotes CHP technologies by working with public and private partners to facilitate the development of new CHP projects and to promote their environmental and economic benefits. CHP is an approach for generating power and thermal energy from a single fuel source, including biomass. Systems typically produce electricity or mechanical power and remove the waste heat for heating, air conditioning and other applications. Examples are gas turbines with heat recovery units or steam boilers with steam turbines.

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[23] Program website: http://usmayors.org/climateprotection/documents/mcpAgreement.pdf.
[24] Program website: http://www.epa.gov/greenpower.
[25] Program website: http://www.epa.gov/chp/partnership.

While a typical fossil fuel power plant operates at 33% efficiency (mainly due to wasted heat), a CHP system can operate at 60 to 80 percent efficiency.[26]

To support the CHP Partnership, EPA evaluates technologies, conducts market analyses, provides education and outreach, and gives direct project assistance. Potential CHP users that can benefit from the program include industry, utilities, commercial buildings, and other institutions (e.g., colleges and universities). The Partnership has focused particular attention on four market sectors: municipal wastewater treatment facilities, hotels and casinos, utilities, and dry mill ethanol plants. There are over 50 CHP Partnership program participants in the U.S. border states.

3.2.3 Climate Leaders[27]

Climate Leaders is an EPA partnership program that assists companies in developing GHG reduction strategies. Companies that sign on to the program agree to develop a GHG inventory, set targets, reduce emissions, and report annually on their reductions. EPA provides technical assistance for inventory development, public recognition, and opportunities to engage with other partner companies. There are over 225 partner companies across the United States that collectively account for 11% of the U.S. gross domestic product and 8% of total annual U.S. GHG emissions. There are over 50 Climate Leaders partners in the U.S. border states.

3.2.4 Energy Star[28]

Energy Star is a joint program of EPA and the U.S. Department of Energy to identify products and services that use less energy. The program also provides information and tools to help homeowners and businesses save money by lowering heating and electricity costs. Program documents estimate that energy efficient choices can save a household about a third on their energy bills.

Product manufacturers, retailers, public energy efficiency programs, the construction industry, architects, and other public and private institutions are eligible to become Energy Star Partners. There are over 2,700 Energy Star partners in the U.S. border states.

3.2.5 Methane to Markets

Methane to Markets is an international partnership launched in November 2004 to pursue cost-effective, near-term recovery of the GHG methane and use it as a clean energy source. The program targets methane produced from landfills, underground coal mines, natural gas and oil systems, and agriculture.

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[26] See: http://www.epa.gov/chp/basic/efficiency.html.
[27] Program website: http://www.epa.gov/climateleaders.
[28] Program website: http://www.energystar.gov.

Methane to Markets currently has fourteen country partners, including the U.S. and Mexico. The United States ranks third in the world in anthropogenic methane emissions, and Mexico ranks sixth.[29] Sixty-eight percent of anthropogenic methane emissions in the United States and 62% in Mexico come from agriculture, coal mines, landfills, and natural gas and oil systems.

Mexico and the United States signed a letter of cooperation in 2006 committing to collaborate on methane projects in Mexico, including working with local governments and the private sector. The two governments collaborated in developing the Mexico Landfill Gas (LFG) Model, which assesses the feasibility and benefits of collecting and using landfill gas for energy recovery. Also under this agreement, the two countries are collaborating on three border region landfill projects in Ensenada, Sonora, and Nuevo Laredo.

A related program in the U.S. is the **Landfill Methane Outreach Program**.[30] This is a program to create partnerships with communities, landfill owners, utilities, power marketers, states, project developers, tribes, and non-profit organizations to encourage projects the reduce methane emissions and encourage the use of methane as an energy resources. The program helps partners assess project feasibility, find financing, and market the benefits of project development to the community. EPA launched the program as part of the United States' commitment to reduce GHG emissions under the United Nations Framework Convention on Climate Change.

3.2.6 AgStar

The Environmental Protection Agency's (EPA) AgSTAR Program is an outreach program designed to reduce methane emissions from agriculture by encouraging confined animal feeding operations to use methane recovery (biogas) technologies. A biogas recovery system is an anaerobic digester with biogas capture and combustion to produce electricity, heat or hot water. EPA provides tools and resources to those interested in using anaerobic digesters for their manure waste management needs. Some examples of program activities include:

- Conducting farm digester extension events and conferences,
- Providing "how-to" project development tools and industry listings, and
- Conducting performance characterizations for digesters and conventional waste management systems.

3.2.7 SmartWay and Transporte Limpio

The SmartWay Transport Partnership in the U.S. is a collaborative program between EPA and the freight industry to reduce fuel use and emissions from diesel trucks. For carriers, the SmartWay program assists partners in identifying techniques to increase fuel economy, reduce emissions, and save money by using technologies such as wide-based tires and improved aerodynamics. The costs of alterations can

[29] 2005 data; Source: EPA. 2006. "Global Anthropogenic Emissions of Non-CO2 Greenhouse Gases." EPA-430-R-005. Available: http://www.epa.gov/climatechange/economics/downloads/GlobalMitigationFullReport.pdf.
[30] See: http://www.epa.gov/landfill/overview.htm.

be offset by fuel savings over time, and there are financing programs available to use these savings to pay for SmartWay upgrades. EPA works with shippers to favor SmartWay carriers for shipping their products.

Mexico has launched a program similar to SmartWay called Transporte Limpio. As in the U.S. , the focus is on heavy duty diesel trucks, which account for over 25% of GHG emissions in Mexico.[31] Partners in the program sign an agreement and letter of intent with SEMARNAT, which then assesses the environmental performance of the fleet. Partners must set goals, develop a three year implementation plan and report annual fuel and GHG reductions to SEMARNAT. Qualifying companies can use the "Transporte Limpio" logo.

3.2.8 Clean Diesel Campaign[32]

Under the auspices of the Clean Diesel Campaign, EPA operates a number of programs focused on reducing emissions from diesel vehicles and equipment. Although emissions standards are in place to reduce emissions from new vehicles, these programs focus on retrofitting or replacing older engines to reduce emissions. The Clean Diesel Campaign includes **Clean School Bus USA**, which is a national partnership to minimize pollution from school buses by installing effective emission control systems on newer buses and replacing the oldest buses in the fleet. Other programs include **Clean Agriculture**, **Clean Construction, and Clean Ports**, which focus on reducing diesel emissions from non-road agricultural, construction, and port equipment and vehicles. The **Smartway Transportation Partnership** (see above) is also a component of the Clean Diesel Campaign.

4. Programs for Coordinating Policy, Reporting Emissions and Trading Credits and Offsets

Emissions inventories and action plans typically focus on activities within national, state, and municipal borders. A number of initiatives are underway to coordinate, report, and trade emissions reductions across these borders. This section describes these efforts and discusses their implications for the border region.

4.1 Programs for Coordinating Climate Policy in the Border Region

This section describes institutions and initiatives in place to coordinate climate policy and planning across state and national borders in the region.

[31] SEMARNAT. 2008. "Transporte Limpio." Presented at Border 2012 Air Policy Forum meeting, July 29-30, 2008, San Diego, CA.

[32] Program website: http://www.epa.gov/cleandiesel/.

4.1.1 Arizona-Sonora Climate Change Initiative

Arizona and Sonora entered into the Arizona-Sonora Climate Change Initiative in 2005 to establish a coordinated effort for GHG inventory development and emissions reduction and sequestration efforts.[33] The Arizona-Mexico Commission and the Sonora-Arizona Commission coordinate and track the initiative.

Under the initiative, Arizona and Sonora pledged to:

- Work towards developing an Arizona-Sonora regional GHG inventory;
- Coordinate the identification of emissions reduction and carbon sequestration opportunities along the shared border;
- Facilitate Mexican Clean Development Mechanism[34] project certifications; and
- Develop a climate change advisory group in Sonora as a counterpart to the advisory group established in Arizona in 2005.

Since signing the initiative, the main focus of cooperation has been in the development of the GHG emissions inventory for Sonora (described in Section 2 above) with the cooperation of the states of Arizona and Sonora, the U.S.-based Center for Climate Strategies, the University of Sonora, and Mexico's National Institute for Ecology (INE). Under the initiative, and through the coordination activities of the Arizona-Mexico Commission, the states collaborated on inventory planning, training of Sonora officials, and technical and logistical support for inventory development.

4.1.2 Southwest Climate Change Initiative

Arizona and New Mexico signed the Southwest Climate Change Initiative in 2006, which provides a framework for the states to cooperate on GHG reduction activities and efforts to adapt to a changing climate.[35] Under the initiative, the states agree to:

- Develop consistent approaches for emissions measuring, forecasting, and reporting;
- Identify and evaluate state, regional, and cross-border policy options;
- Establish cooperative policies, programs, and demonstration projects; and
- Undertake other coordinated efforts to 1) recognize actions that reduce GHGs, promote clean energy and energy efficiency, 2) collaborate with tribes, 3) advocate for regional and national policy, and 4) increase state analytical capacity.

4.1.3 Border 2012

Border 2012 is a collaborative agreement between the United States and Mexico to improve environmental quality and environmental health in the U.S.-Mexico border region. Border 2012 is the latest commitment between the U.S. and Mexico based on the 1983 La Paz agreement. Participants in

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[33] The lead institutions are the Arizona Department of Environmental Quality and Sonora's Secretariat of Urban Infrastructure and Ecology. The agreement can be found at: http://www.azclimatechange.gov/initiatives/download/signed_agreement.pdf

[34] These are GHG offset projects described later in this report.

[35] The initiative is a governor's initiative to be administered by the Arizona Department of Environmental Quality and the New Mexico Environment Department. See: http://www.azclimatechange.gov/download/O40F8085.pdf.

Border 2012 include U.S. EPA, SEMARNAT, all 10 border states, tribal governments, indigenous communities, and other federal, state, local, and non-governmental partners.

Under the heading of the Border 2012 goal to improve regional air quality, Border 2012 recently added a new objective related to GHG reduction:

> "By 2012, build border greenhouse gas (GHG) information capacity using comparable methodologies and expand voluntary cost-effective programs for reduction of GHG emissions in the border area:
>
> - By 2010, estimate GHG emissions in at least eight border states to identify the sources and locations from which reductions may be achieved.
> - Promote and/or expand voluntary energy efficiency and other GHG reduction programs (i.e., methane to markets, Smartway, others) in at least two border states, and track the emissions reductions associated with those programs."

Border 2012's Air Policy Forum, which is made up of governmental and non-governmental representatives from the U.S. and Mexico, is implementing this objective as part of its strategy for improving air quality in the border region.

4.1.4 PG&E-California Agreement

Governor Arnold Schwarzenegger announced the PG&E-Mexico-California agreement at the XXVI Border Governor's conference in 2008. The agreement—signed by all six Mexican border states, California, Pacific Gas & Electric (PG&E), and the California Climate Action Registry (CCAR)—helps encourage and coordinate projects to reduce GHG emissions in Mexico. These projects help PG&E meet its customer's goals to reduce GHG emissions under its voluntary emissions production program, ClimateSmart. Under the agreement, projects in the Mexican border region would act as offsets for PG&E's customers.

4.1.5 SEMARNAT-California Agreement

SEMARNAT and the California Environmental Protection Agency signed a Memorandum of Understanding (MOU) on environmental cooperation in February 2008. The MOU identifies topics of common interest with a vision for carrying out cooperative activities between the Parties, including cooperation in addressing climate change. Under the MOU the two Parties agreed to the following:

- Cooperative exchanges of information through plans and experts in the field of research on climate change, including: impacts of climate change on natural ecosystems, agriculture and water resources, and infrastructure.
- Development of principles for mutual benefit and opportunities for collaboration in the fields of GHG emissions registry and carbon markets.
- Mutual commitment for capacity development, particularly among the U.S. and Mexican border states, to support the development of comprehensive state plans for climate change.
- Fostering capacity development at the state level.

- Exploring the possibility of Mexican states joining the Western Climate Initiative and The Climate Registry as full partners.

4.1.6 Border Governors Conference

The border governor's conference is a mechanism for the leaders of the ten U.S. and Mexico states to address important challenges in the border region through policy coordination. The effort culminates in an annual border governor's conference, the most recent of which took place in California in August 2008.[36]

Representatives from each of the states work on policy "worktables," including energy and environment worktables. The energy worktable has been the most active forum for addressing issues related to climate change. In the most recent joint communication, the governor's conference set the following objectives on energy:

- Identify and promote a border region strategy on energy efficiency,
- Develop a best practices program for energy savings and efficiency in border region communities, and
- Exchange information on energy infrastructure.

4.2 Programs for Reporting Emissions and Trading Credits and Offsets

A number of initiatives have emerged in the border region for reporting emissions and potentially trading credits and offsets across state and national borders. This section describes these efforts, focusing particularly on opportunities for generating and trading offsets from projects in Mexico.

4.2.1 Clean Development Mechanism of the Kyoto Protocol

The Kyoto Protocol, a protocol under the Framework Convention on Climate Change, is an agreement among the Conference of Parties (COP) to the convention to reduce GHG emissions. It was adopted by participating countries in 1997 and came into force in February 2005. Mexico signed the Kyoto Protocol in 1998 and ratified it in 2000. The United States signed the treaty but has not ratified it.

As a non-Annex 1 party to the Kyoto Protocol, Mexico is not required to reduce emissions. However, it is obliged to:

- "Develop, periodically update, publish and make available to the COP, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all GHG not controlled by the Montreal Protocol;"
- "Formulate, implement, publish and regularly update national, and where appropriate, regional programmes containing measures to mitigate climate change… and measures to facilitate adequate adaptation to climate change" and

[36] Program website: http://www.bordergovernors.ca.gov/ .

- "Communicate to the COP information related to implementation;"[37]

Consistent with its obligations under Kyoto, Mexico has developed:

- A series of national GHG inventories, the most recent published in 2006 covering the years 1990 to 2002 (see Section 2),[38] and
- Three national communications to the U.N. Framework Convention on Climate Change.[39]

As a developing country signatory to the Kyoto Protocol, Mexico is eligible to participate in the Clean Development Mechanism, which allows countries that have obligations to reduce GHGs under the Kyoto protocol to get emissions reduction credit for investing in projects that reduce emissions in developing countries. Mexico currently has over 115 CDM projects registered with the UNFCCC.[40] Thirty-three of the CDM projects are in Mexican border states. The vast majority involve methane recovery at livestock operations through improved manure management. Countries financing the CDM projects are Switzerland, the UK, Northern Ireland, and Japan.

Clean Development Mechanism: Ciudad Juarez Landfill Gas to Energy Project

This project, developed by Biogas de Juarez, S.A. de C.V. captures and uses methane from landfill gases generated by decomposing municipal solid waste. It is expected to reduce 1.19 MMT CO2e from 2007-2014.

4.2.2 U.S. Draft GHG Reporting Rule

In 2008, Congress authorized the Environmental Protection Agency (EPA) to publish a mandatory GHG reporting rule using the Agency's existing authority under the Clean Air Act (CAA). EPA was directed to propose a draft Greenhouse Gas Reporting Rule by September 2008 and the final rule by June 2009. The objective of the Rule is to collect comprehensive and accurate data relevant to future policy decisions. Sections 114 and 208 of the CAA allow for data collection and measurement from stationary or mobile sources. The EPA will determine the appropriate thresholds of emissions above which reporting is required and how frequently reports are to be submitted. The methods used will build on existing mandatory and voluntary reporting systems. For example, the EPA will have discretion to use existing

[37] Adapted from Adrian Fernandez, Instituto Nacional de Ecologia. 2008. "Climate Change State Action Plans in Mexico." Presented at Border 2012 Air Policy Forum, July 29, 2008, San Diego, CA. Veracruz's action plan is available at: http://www.ine.gob.mx/cclimatico/descargas/e2007j.pdf?

[38] For the most recent national inventory, see: Secretaria de Medio Ambiente y Recursos Naturales y Instituto Nacional de Ecologia. Undated. "Inventario Nacional de Emisiones de Gases de Efecto Invernadero 1990 – 2002" Available: http://www.ine.gob.mx/cclimatico/inventario3.html.

[39] For the most recent communication, see: Secretario de Medio Ambiente y Recursos Nacionales and Instituto Nacional de Ecologia. 2006. "Mexico Tercera Communicacion Nacional Ante la Convention de las Naciones Unidas Sobre el Cambio Climactico". Available at: http://www.ine.gob.mx/cclimatico/comnal3.html

[40] The United Nation's CDM project database is available at: http://cdm.unfccc.int/index.html.

reporting requirements for electric generating units under Section 821 of the CAA. The EPA has reached out to stakeholders for input during the development of this Rule.[41]

4.2.3 Western Climate Initiative

The Western Climate Initiative is a collaborative initiative that was launched in 2007 to "identify, evaluate and implement collective and cooperative ways to reduce GHGs in the region, focusing on a market-based cap-and-trade system." Seven U.S. states and four Canadian Provinces are partners in the WCI. In the border region, California, Arizona, and New Mexico are partners and the six Mexican border states have observer status. The WCI goal is to reduce GHG emissions among its partners by 15% percent below 2005 levels by 2020.

In September 2008, the WCI published its recommendations for the design of a regional cap-and-trade system[42] that would cover nearly 90% of regional emissions from:

- Electricity generation, including imported electricity;
- Industrial and commercial fossil fuel combustion;
- Industrial process emissions;
- Gas and diesel consumption for transportation; and
- Residential fuel use.

Western Climate Initiative Partners and Observers

Initial reporting from partners will occur in 2011 with trading for certain sectors beginning in 2012. Additional sectors will be added in 2015.

The WCI design recommendations include provisions for partners to purchase offsets to achieve some of their GHG reduction goals. Offset projects in Mexico are eligible "where such projects are subject to comparably rigorous oversight, validation, verification, and enforcement as those located within the WCI jurisdictions."[43] CDM projects under the Kyoto Protocol may be accepted as offsets.

The use of offsets to achieve WCI goals is capped. Offsets, along with trading in allowances from other market-based

[41] EPA. 2009. "U.S. Draft Greenhouse Gas Reporting Rule." Available: http://www.epa.gov/climatechange/emissions/ghgrulemaking.html

[42] Western Climate Initiative. "U.S. States, Canadian Provinces Announce Regional Cap-and-Trade Program to Reduce Greenhouse Gases." (September 23, 2008). Available: http://www.westernclimateinitiative.org/ewebeditpro/items/O104F19871.PDF

[43] Western Climate Initiative. 2008. "Design Recommendations for the WCI Regional Cap-and-Trade Program" (September 23, 2008). Available: http://www.westernclimateinitiative.org/ewebeditpro/items/O104F19866.PDF

systems cannot exceed 49% of total 2012-2020 emissions reductions for WCI as a whole, and partners can set lower limits in their own jurisdictions. To be eligible, offsets must meet the criteria set by Partner jurisdictions that ensure that they are "real, surplus/additional, verifiable, and permanent."[44] WCI partners have identified the following priority sectors for offsets:

- Agriculture (soil sequestration and manure management),
- Forestry (afforestation/reforestation, forest management, forest preservation/conservation, forest products); and
- Waste management (landfill gas and wastewater management)."[45]

4.2.4 North American Climate Registry

The North American Climate Registry (TCR) is a non-profit organization supporting voluntary & mandatory GHG reporting by governments, the private sector, and other institutions. [46] It sets standards for measurement, verification, and public reporting in a unified registry.

TCR is governed by a Board of Directors. In the United States, California, New Mexico, and Arizona are represented on the Board. All six Mexican states are represented on the Board.

To be represented on the Board, entities must sign on to the Registry's principles and goals supporting common GHG measurement (see call-out box). As members of the Board, entities are not required to report emissions, but they are asked to:

- Work with The Climate Registry to establish and endorse a voluntary entity-wide GHG emissions reporting and verification system;
- Encourage entities in their state, province, or tribe to voluntarily report their emissions; and
- Help TCR identify a set of GHG emissions minimum data quantification standards and work to incorporate these minimum data quantification standards into any mandated GHG reporting and emissions reduction program.

Those that commit to voluntary reporting to the Climate Registry, are expected to calculate emissions each year according to the Registry's General Reporting Protocol, report their emissions annually, and

[44] Western Climate Initiative. 2008. "Design Recommendations for the WCI Regional Cap-and-Trade Program" (September 23, 2008).

[45] By identifying these areas as priorities, "WCI Partner jurisdictions are interested in understanding if they are suitable for the offset system, if they will meet the criteria for environmental integrity, and if adequate protocols/methodologies for their quantification and monitoring can be adapted or developed. Priority does not mean that these project types are guaranteed to be in an offset system." See: Western Climate Initiative. 2008. "Design Recommendations for the WCI Regional Cap-and-Trade Program" (September 23, 2008).

[46] Program website: http://www.theclimateregistry.org.

obtain third party verification of their measures.[47] The focus of TCR is on entities' total annual emissions; it does not accept emissions reporting for particular projects (e.g., offset projects).

- As of October 2, 2008, there were 281 public and private entities voluntarily reporting to TCR. Eighty-two reporting members were in border states: 66 in California, seven in Arizona, seven in Texas, one in New Mexico, and one in the Mexican state of Sonora.

Climate Registry Principles and Goals

GOVERNING PRINCIPLES:

- Openness and Transparency
- Collaboration
- Broad Engagement
- Appropriate Representation
- Economic Efficiency

GOALS:

- Utilize best practices in greenhouse gas emissions reporting;
- Establish a common data infrastructure for voluntary and mandatory reporting and emissions reduction programs;
- Minimize the burden on reporting entities, states, provinces and tribes;
- Provide an opportunity for reporting entities to establish an emissions baseline and document early action;
- Develop a nationally recognized platform for credible and consistent greenhouse gas emissions reporting; and
- Promote full and public disclosure of greenhouse gas emissions while respecting business confidentiality.

Source: TCR " Statement of Principles and Goals"

4.2.5 Chicago Climate Exchange

The Chicago Climate Exchange (CCX) is a voluntary, legally binding GHG reduction and trading system for emission sources and offsets. Its express purpose is to facilitate the market in trading carbon emissions.

CCX involves both trading by members that generate significant amounts of GHG emissions and trading by entities that generate offsets or aggregate offset projects. To be a member, entities make a legally binding commitment to meet annual targets for GHG emissions reductions. They can then sell surplus

[47] For information on The Climate Registry reporting protocol, see: http://www.theclimateregistry.org/protocols.html. For the "Statement of Principles and Goals," see: http://www.theclimateregistry.org/downloads/Statement_of_Principles_and_Goals.pdf.

emissions or buy emissions they need to hit their targets. The only U.S. or Mexico border state member is New Mexico.

Offset generators and offset aggregators can trade offsets on CCX as "Carbon Financial Instrument" (CFI) contracts, which are issued to "owners or aggregators of eligible projects on the basis of sequestration, destruction or reduction of GHG emissions."[48] Offset projects must go through third party verification by an entity approved by CCX in order to qualify for a CFI contract.

There have been two offset projects traded in Mexico by entities that aggregate and sell offsets. These trades are: Digilog Global Environmental Master Fund, Ltd. for an energy efficiency offset project and MGM International Group, LLC for a waste disposal-HFC destruction offset. No additional information is available on these trades.

5. Approaches for Cross-border Collaboration on GHG Reduction Strategies

Drawing on the work to date done to develop GHG inventories, action plans, and systems for reporting and trading emissions, this section outlines approaches for coordinating and collaborating on GHG emissions reduction strategies between the U.S. and Mexico, across state borders, and among border cities, tribes, and indigenous communities. The section presents a series of approaches ranging from basic activities of communication and coordination up to extensive regional planning and policy integration. The description of approaches provides examples of existing efforts that could be adopted elsewhere along the border or expanded border-wide.

Communication and Coordination. Regional communication and coordination in GHG inventory development and action planning can help make state and city-level activities consistent and comparable and highlight opportunities for joint action. For example, a coordinated approach to developing GHG inventories using similar methodologies—such as that pursued between Arizona and Sonora and currently underway with other Mexican states—helps to support border-wide analysis and solutions. A number of communications and coordination mechanisms exist in the border region that can be used to support GHG reduction activities. These include Border 2012, the Border Governor's conference, the SEMARNAT-California agreement and more.

Technical and Financial Assistance. Assistance through financing, development of joint tools and programs and training can enhance coordinated activity and strengthen capacity in the border region. For example, the Arizona-Sonora Climate Change Initiative provided training and technical assistance in

[48] CCX has developed standardized rules for issuing CFI contracts for the following types of projects: Agricultural methane, Coal mine methane, Landfill methane, Agricultural soil carbon, Rangeland soil carbon management, Forestry, Renewable energy, Ozone depleting substance destruction. CDM projects and energy efficiency/fuel switching projects can be approved on a project by project basis. See: http://www.chicagoclimatex.com/content.jsf?id=23.

inventory development and action planning in Sonora. U.S. EPA's development of the Mexico Landfill Gas (LFG) Model under a 2006 letter of cooperation on methane projects in Mexico is another example. Cross-border implementation of voluntary programs—such as the development of Mexico's Transporte Limpio program based in part on the U.S. Smartway program— is another opportunity for cross-border assistance.

Cross-border Collaboration on Mitigation and/or Adaptation Projects. Particularly where resources such as shared airsheds or watersheds are involved, there are opportunities for cross-border collaboration on specific projects that can reduce GHGs. The same is true for shared infrastructure, such as ports of entry. Recent cross-border pilot projects to retrofit diesel vehicles, investigate opportunities for anti-idling at international ports of entry, and develop capacity for biodiesel production from waste oils are all examples of project-level collaboration with air quality and/or GHG reduction benefits.

Cross-border GHG Reduction Planning. Although not a significant component of climate action planning to date, cross-border collaboration in GHG reduction action planning could be developed through shared emissions reduction targets, cross-border strategies, and collaborative program and project implementation. One opportunity may be coordinated action planning for the fourteen sister cities across the region (where 90% of the border region population lives). For example, both San Diego and Tijuana are members of ICLEI Cities for Climate Protection and share an airshed, significant transportation networks, as well as energy, water, and other infrastructure.

Bi-lateral GHG Emissions Offset Trades. The border region is well-situated to pursue offset projects, particularly for offset projects implemented in Mexico, which has significant experience through the Kyoto Protocol's Clean Development Mechanism. Some offset projects in Mexico are being traded through the Chicago Climate Exchange as well. The PGE-California-Mexico agreement envisions serving PG&E's customers desire for "green" power through offset project in Mexico. The Western Climate Initiative envisions formal procedures for including offsets from Mexico as emissions reduction strategies for WCI partners.

Regional Policy Integration and Trading. Over the longer term, the border region may consider deeper policy integration on climate change, potentially including trading mechanisms between the two countries. At the regional level, the Western Climate Initiative is a potential mechanism for integration. Alternatively, national policies in both the U.S. and Mexico—and international agreements joined into by both countries—may be the mechanism.

6. Conclusion

This report described current activities related to measuring and mitigating GHGs (GHG) in the border region and opportunities for continued cross-border collaboration in the future. As described in the report, there is both common purpose and many common strategies and institutions that can be marshaled into a regional approach to reducing GHGs along the border. Opportunities range from a

shared commitment to action planning to the introduction of new programs (such as Transporte Limpio) to nascent efforts trade GHG reduction offsets across the national border. The many opportunities for continued cross-border coordination and collaboration are a starting point for continued discussions about what role a regional strategy can plan in addressing GHG emissions in the region and what regional institutions can play in turning a strategy into action.

Appendix A: Description of California, Arizona, New Mexico, Baja California, and Sonora GHG Inventories

Characteristic	Baja California	Sonora	Arizona	New Mexico	California
Years Covered	2005	1990-2005 (Inventory); 2006-2020 (Projections)	1990-2003 (Inventory); 2004-2020 (Projections)	1990-2003 (Inventory); 2004-2020 (Projections)	1990-2004 (Inventory); 2020 (Projection)
Inventory Author	Mario Molina Center	Center for Climate Strategies	The Center for Climate Strategies and AZ Department of Environmental Quality	New Mexico Climate Change Advisory Group	California Environmental Protection Agency Air Resources Board
GHGs Covered	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorated gases (chlorodifluoromethane, hydrofluorocarbon 134) All emissions reported as CO_2 equivalents; reported in gigagrams (Gg) (1 Gg=1000 metric tons)	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) All emissions reported as CO_2 equivalents; reported in million metric tons (mmt)	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). All emissions reported as CO_2 equivalents; reported in million metric tons (mmt)	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). All emissions reported as CO_2 equivalents; reported in million metric tons (mmt)	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). All emissions reported as CO_2 equivalents; reported in million metric tons (mmt)

Characteristic	Baja California	Sonora	Arizona	New Mexico	California
Sources Analyzed	• Energy use for: o Electric power generation o Transportation o Industry o Residential sector and services o Agriculture (farming and animal husbandry) • Industrial processes and product usage • Agriculture, Animal Husbandry, Forestry, and Land Use • Waste and wastewater	• Energy use for: o Electric power generation o Transportation o Residential, Commercial, and Industrial o Agriculture • Fossil Fuel Industry • Industrial Processes • Agriculture and Animal Husbandry • Forestry and Land Use • Waste and wastewater	• Energy use for: o Electricity Use and Supply o Residential, Commercial, and Industrial o Transportation • Industrial Process • Agriculture, Forestry, and Other Land Use • Waste Management	• Energy use for: o Electricity Use and Supply o Residential, Commercial, and Industrial o Transportation • Industrial Process • Agriculture, Forestry, and Other Land Use • Waste Management	• Energy use for: o Energy Industries o Manufacturing Industries o Residential, Commercial, and Industrial o Transportation • Industrial Process • Agriculture, Forestry, and Other Land Use Waste Management
Approach to Carbon Storage and "Net Emissions"	No analysis of sinks/sequestration; only report gross emissions	Analyzed forest sinks; report gross and net emissions. However, reports says that analysis of sinks is "initial" and that " additional work to improve the forest and agricultural carbon sink estimates could lead to substantial changes in the initial estimates provided in this report."	Analyzed forest sinks; report gross and net emissions.	Analyzed forest sinks; report gross and net emissions. However, the report says that the results for how much carbon is sequestered and released from biomass in the state are very preliminary. Therefore the report uses gross estimate of CO2 equivalent.	Analyzed forest sinks; report gross and net emissions.

Characteristic	Baja California	Sonora	Arizona	New Mexico	California
Approach to Energy Imports/Exports	Analyzed electricity consumed in state (Baja exports a small amount of electricity, but otherwise consumes what it produces)	Analyzed electricity consumed in state (Sonora has no electricity imports or exports so consumption=production)	Analyzed electricity consumed to meet Arizona demands, corresponding to a consumption-based approach to emissions accounting.	Analyzed total statewide electricity production corresponding to a production-based approach to emissions accounting.	Analyzed electricity consumed in the state including electricity imports.
General Methodology	Used 2006 IPCC methodology for national inventories. Mainly used Tier 1 approaches (fuel-based). Used some report specific methodologies for analysis of industrial products and product use.	Consistent with EPA's guidelines for states, which were developed based on IPCC guidelines. In addition to using IPCC methods, used EPA's State Greenhouse Gas Inventory Tool and Emissions Inventory Improvement Program (EIIP) guidance. Followed same approach to emissions accounting used by the U.S. EPA in national GHG emissions inventory. Very similar methodology to Arizona and New Mexico.	This report follows the same approach to emissions accounting used by the US EPA in its national GHG emissions inventory and its guidelines for states. These inventory guidelines were developed based on guidelines from the Intergovernmental Panel on Climate Change.	This report follows the same approach to emissions accounting used by the US EPA in its national GHG emissions inventory and its guidelines for states. These inventory guidelines were developed based on guidelines from the Intergovernmental Panel on Climate Change.	The calculation methodologies are consistent with IPCC guidance. The current inventory uses global warming potential (GWP) from the IPCC Second Assessment Report to be compatible with the national inventory.

Appendix B: Summary of Five Border State Inventories

	Arizona		New Mexico		California			Baja California	Sonora		
	2000	2020	2000	2020	2000	2004	2020	2005 only	2000	2005	2020
Electricity Production			**33.2**	**38.8**							
Coal			30.7	35.5							
Natural Gas			2.5	3.2							
Oil			0	0							
Electricity Use (Consumption)	**34.5**	**72.2**	**19.7**	**26.8**				**4.82**	**7.03**	**6.84**	**12.2**
Electricity Production (in-state)	*44.5*	*75.8*							*7.03*	*6.84*	*12.2*
Coal	39.2	57.5									
Natural Gas	5.1	18.3						4.65	0.3	2	3.32
Oil	0.2	0						0.155	6.72	4.84	8.86
Net Electricity Exports	-10	-3.6									
Diesel								0.01			
Geothermic								0.007			
Energy Industries					**152.5**	**166.43**	**139.2**				
Electricity and Heat Production					111.599	123.201	87.2				
Petroleum Refining					28.025	29.111					
Manufacture of Solid Fuels and Other Energy					12.872	14.121					
Imported Electricity							52				
Res/Comm/Ind (RCI) (Energy Use)	**9.3**	**13.8**	**7.3**	**9.9**					**1.27**	**1.06**	**2.3**
Coal	1.5	1.9	0.2	0.2							
Natural Gas	4.7	7.2	4.6	5.4					0.28	0.33	0.46
Oil	3	4.6	2.5	4.3							
Liquid Petroleum Gas									0.55	0.44	0.52
Diesel									0.37	0.24	1.26
Wood (CH4 and N2O)	0.1	0.1	0	0					0.06	0.05	0.06
Industry (Energy Use)					**23.56**	**19.45**		**0.5**			

	Arizona		New Mexico		California			Baja California	Sonora		
	2000	2020	2000	2020	2000	2004	2020	2005 only	2000	2005	2020
Diesel								0.218			
Liquid Petroleum Gas								0.076			
Natural Gas								0.206			
Chemicals					0.7	0.677					
Pulp, Paper and Print					1.385	1.115					
Food Processing, Beverages and Tobacco					3.599	3.397					
Non-Metallic Minerals					5.495	5.401					
Transport Equipment					0.5	0.259					
Machinery					1.246	1.086					
Mining (excluding fuels) and Quarrying					0.331	0.103					
Wood and Wood Products					0.302	0.109					
Construction					0.643	0.763					
Textile and Leather					0.571	0.563					
Non-specified Industry					7.877	5.5					
Residential and Services (Energy Use)								**1.65**			
Liquid Petroleum Gas								0.696			
Natural Gas								0.009			
Firewood								0.94			
Transportation	**35**	**58.6**	**14.2**	**22.3**	**169.33**	**181.95**	**225.4**	**7**	**4.65**	**5.1**	**8.7**
On-road Gasoline	22.8	36.3	8.7	12.2				4.61	1.96	2.44	4.39
On-road Diesel	6.5	13.6	4.2	7.9				1.74	1.54	1.54	2.55
Jet Fuel and Aviation Gasoline	4.3	7.4	1.2	2				0.495	0.32	0.26	0.31
Civil Aviation					3.5	3.059	4.8				
Natural Gas (pipeline use)	1.1	1.2	0.1	0.1							
Waterborne Navigation					2.938	3.369	6.3		0.17	0.2	0.79
Liquid Petroleum Gas								0.155			

	Arizona		New Mexico		California			Baja California	Sonora		
	2000	2020	2000	2020	2000	2004	2020	2005 only	2000	2005	2020
Other	0.2	0.1					1.4		0.66	0.66	0.66
Cars					65.442	63.078	160.8				
Light-duty trucks					60.558	72.117					
Heavy-duty Trucks and Buses					33.014	35.662	48.3				
Motorcycles					0.243	0.584					
Railways					3.067	3.189	3.8				
Fossil Fuel Industry (Energy Use)			**19.5**	**20.7**							
Natural Gas Industry			17	17.7							
Oil Industry			2.3	2.3							
Coal Mining (Methane)			0.2	0.7							
Other Sectors (Energy Use)					**49.9**	**48.45**	**46.8**	**0.028**			
Commercial/Institutional					12.792	12.331	14.7				
Residential					30.605	29.102	32.1				
Agriculture/Forestry/Fishing/Fish Farms					5.553	4.86					
Agriculture								0.028			
Non-Specified					0.95	2.16					
Fugitive Emissions From Fuels					**4.37**	**4.62**					
Oil and Natural Gas					2.42	2.54					
Other Emissions from Energy Production					1.95	2.07					
Sub-Total of Energy Use (CO2, CH4, N2O) in Million Metric Tons of CO2e--Consumption-Based	**78.8**	**144.6**	60.7	79.7	**399.66**	**420.91**	**411.4**	**13.99**	**12.95**	**13**	**23.25**
Sub-Total of Energy Use (CO2, CH4, N2O) in Million Metric Tons of CO2e--Production-Based			**74.2**	**91.7**							
Industrial Processes	**4.1**	**9.1**	**1.5**	**2.8**	**27.48**	**30.78**	**139.5**	**0.44**	**1.28**	**1.76**	**4.19**

	Arizona		New Mexico		California			Baja California	Sonora		
	2000	2020	2000	2020	2000	2004	2020	2005 only	2000	2005	2020
ODS Substitutes	1.4	6.9	0.5	2.3					0.05	0.07	0.16
PFCs in Semi-conductor Ind.	1	0.3	0.5	0.1							
SF6 from Electric Utilities	0.3	0.1	0.1	0							
Cement and Other Industry	1	1	0.4	0.4	5.43	5.77	12.6	0.23	1.13	1.56	3.71
Methane from Oil & Gas Systems	0.4	0.8									
Lime Manufacture					0.14	0.13			0.05	0.07	0.16
Limestone and Dolomite Use									0.02	0.03	0.08
Methane from Coal Mining	0.1	0.1									
Chemical Industry					1.38	1.32					
Non-Energy Products from Fuels and Solvent Use					1.85	1.37					
Electronics Industry					1.23	0.88					
Product Uses as Substitutes for Ozone Depleting Substances					9.76	13.97	46.9				
Other Product and Manufacture Use (Electrical Equipment)					1.74	1.6					
Refineries							36.7				
Oil and Gas Extraction							14.2				
Cogeneration Heat Output							9.3				
General Fuel Use							19.8				
Food and Beverage								0.07			
Steel								0.092			
Refrigeration and air-conditioning								0.05			
Viticulture and wine production								0.00004			
Other					5.96	5.74			0.02	0.03	0.08
Fossil Fuel Industry (Energy Use)									**0.19**	**0.22**	**0.25**
Natural Gas Industry									0.19	0.22	0.25
Transmission									0.05	0.05	0.06

	Arizona		New Mexico		California			Baja California	Sonora		
	2000	2020	2000	2020	2000	2004	2020	2005 only	2000	2005	2020
Distribution									0.14	0.15	0.17
Pipeline Fuel Use									0	0.02	0.02
Agriculture	**4.2**	**4.7**	**6**	**6.7**	**20.67**	**23.09**	**29.8**	**0.98**	**2.61**	**3.36**	**4.18**
Agriculture (CH4 & N20)	4.2	4.7									
Direct and indirect N20 emissions from agricultural soils					6.94	8.24					
Enteric Fermentation			3.5 (Incl. Manure Mgmt.)	4.4 (Incl. Manure Mgmt.)	6.68	7.01	8.2	0.98 (incl. manure mgmt)	1.36	1.83	2.3
Manure Management			See above cell	See above cell	6.12	6.91	8	See above cell	0.16	0.18	0.2
Agriculture Soils			2.4	2.3			9.1		1.07	1.28	1.66
Rice Cultivation					0.57	0.61			0	0	0
Agricultural Burning					0.09	0.08	0.1		0.03	0.07	0.03
Liming					0.27	0.24					
Agriculture and Animal Husbandry											
General Fuel Use							4.5				
Forestry and Land Use	**-6.7**	**-6.7**	**-20.9**	**-20.9**	**-4.83**	**-4.47**	**0.2**		**-6.29**	**-8.42**	**-8.69**
Forested Landscapes					0.19	0.19			-6.29	-8.42	-8.69
Forest Wildfires							0.2		3.4E-.04	2.30E-04	2.1E-.04
Soils and Forest Sinks	-6.7	-6.7	-20.9	-20.9	-5.02	-4.66					
Waste Management	**1.9**	**1.9**	**1.2**	**1.2**	**9.31**	**9.44**	**7.7**	**2.28**	**1.38**	**1.58**	**1.82**
Solid Waste Management (Landfills)	1.3	1.1	1	0.9	5.64	5.62	7.7	1.87	0.62	0.7	0.82
Wastewater Management	0.5	0.8	0.2	0.3	3.66	3.82		0.414	0.56	0.6	0.68
Waste Combustion									0.21	0.29	0.33
Total Emissions in Million Metric Tons of CO2e--consumption-based											

	Arizona		New Mexico		California			Baja California	Sonora		
	2000	**2020**	**2000**	**2020**	**2000**	**2004**	**2020**	**2005 only**	**2000**	**2005**	**2020**
Gross (excluding Sinks)	**89**	**160.3**	69.5	90.4	**457.29**	**484.4**	**588.6**	**17.68**	**18.41**	**19.9**	**33.64**
Net (including Sinks)	**82.3**	**153.5**	48.6	69.5	**452.27**	**479.74**			**12.12**	**11.5**	**24.95**
Total Emissions in Million Metric Tons of CO2e--production-based											
Gross (excluding Sinks)	99	163.9	**82.9**	**102.4**					18.41	19.9	33.64
Net (including Sinks)	92.3	157.2	**62**	**81.5**					12.12	11.5	24.95

Note: All emissions data in MMT CO2e