

# Greenhouse Gas Emissions in Southern Africa

## Numbers at a Glance (2011)<sup>1</sup>

Country	Total GHG Emissions (MtCO <sub>2</sub> e) <sup>2</sup>	% of global emissions	Population (thousands)	tCO <sub>2</sub> e per capita	GDP (Billion US\$) <sup>3</sup>	tCO <sub>2</sub> e/ million US\$ GDP	Change in GHG emissions (1990–2011) (MtCO <sub>2</sub> e)
Angola	206	0.44%	20,180	10.22	\$52	3,941	+101 (+96%)
Botswana	34	0.07%	1,987	16.89	\$13	2,608	+11 (+50%)
Lesotho	2	0.00%	2,030	1.08	\$2	1,221	+0.3 (+19%)
Madagascar	57	0.12%	21,679	2.65	\$6	9,769	-3 (-6%)
Malawi	15	0.03%	15,458	0.98	\$4	3,744	-1 (-6%)
Mozambique	56	0.12%	24,581	2.28	\$10	5,767	+1 (+2%)
Namibia	22	0.05%	2,218	10.06	\$10	2,345	+7 (+46%)
Seychelles	1	0.00%	87	7.58	\$1	541	+0.5 (+285%)
South Africa	447	0.95%	51,553	8.67	\$310	1,442	+125 (+39%)
Swaziland	3	0.01%	1,212	2.40	\$3	1,004	-0.1 (-4%)
Zambia	120	0.26%	13,634	8.82	\$13	8,943	+4 (+3%)
Zimbabwe	64	0.14%	13,359	4.77	\$6	10,938	-7 (-10%)
<b>Regional Total</b>	1,027	2.19%	167,978	6.12 (weighted average)	\$429	2,392 (weighted average)	+239 (+30%)
World	46,906	100%	6,964,618	6.73	\$54,034	868	+12,969 (+38%)

Of the 12 countries included in the Southern Africa Regional mission, South Africa has the highest total greenhouse gas (GHG) emissions, followed by Angola, Zambia, Zimbabwe, Mozambique, Madagascar, Botswana, Namibia, Malawi, Swaziland, Lesotho, and the Seychelles. The region's emissions represent nearly 2.2% of global emissions and no country is responsible for more than 1% of global emissions. As a region, the average per capita emissions are below the world average, however, the per capita emissions of Botswana, Angola, Namibia, Zambia, South Africa, and the Seychelles are above the world average. The region's GDP carbon intensity is nearly triple the world average, with only the Seychelles' GDP carbon intensity less than the world average. Total emissions since 1990 have increased in eight countries, in particular the Seychelles, and have decreased in Swaziland, Madagascar and Malawi, and Zimbabwe.

The region's GHG emissions by sector, their change over time and the drivers of emissions are described below, followed by an outline of key national climate change commitments and policies as described in the countries' Intended Nationally Determined Contributions (INDCs).

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<sup>1</sup> World Resources Institute Climate Analysis Indicators Tool (WRI CAIT) 2.0, 2015. Emissions including Land-Use Change and Forestry.

<sup>2</sup> Million metric tons of carbon dioxide equivalent.

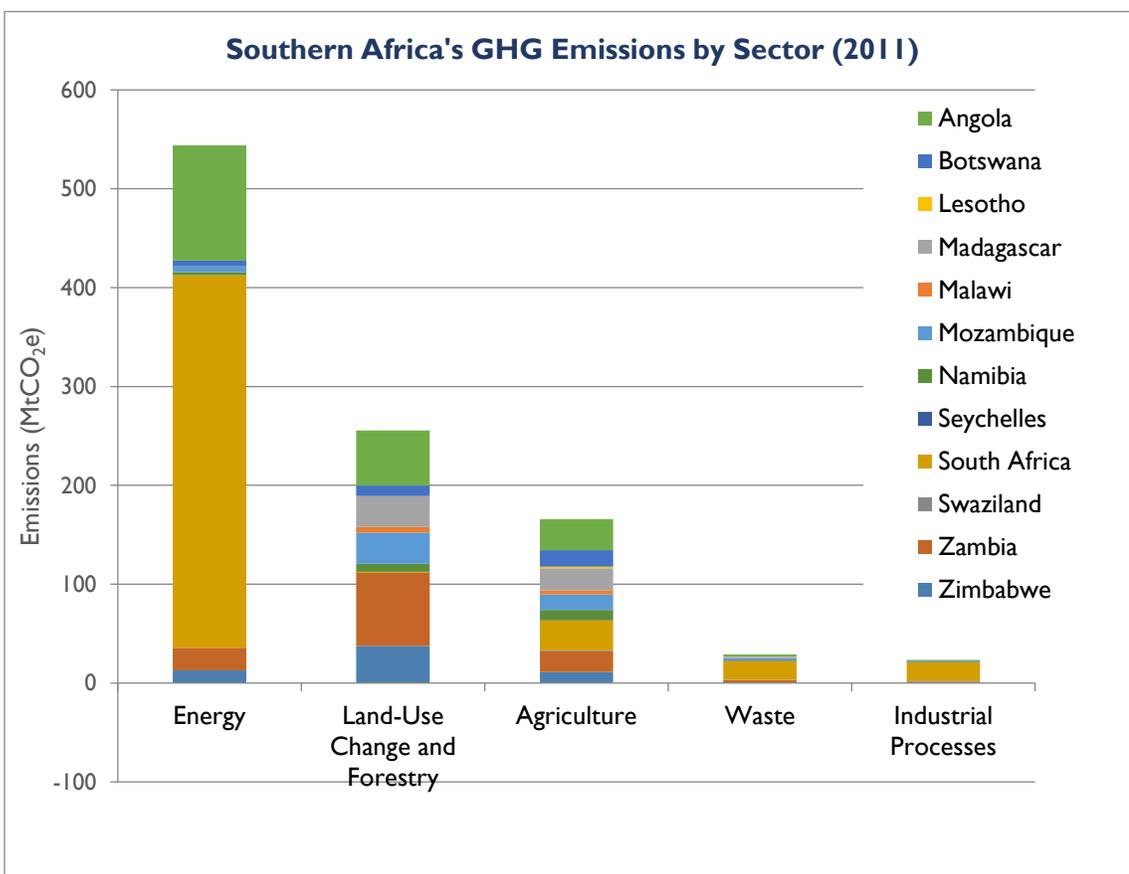
<sup>3</sup> Gross Domestic Product (GDP) in constant 2005 US\$.

## GHG Emissions by Sector (2011)<sup>4</sup>

GHG emissions from the 12 countries included in the Southern Africa Regional mission are primarily from the energy, land-use change and forestry (LUCF), and agriculture sectors. At the regional level, energy is the highest emitting sector (544 MtCO<sub>2</sub>e), followed by LUCF (255 MtCO<sub>2</sub>e), then agriculture (166 MtCO<sub>2</sub>e). GHG emissions from waste and industrial processes (IP) are relatively insignificant.

Although energy is the region's highest GHG emitting sector, it is the leading source of emissions in only two countries, South Africa and Angola. The energy emissions of the two countries combined account for 91% of the region's energy sector emissions. South Africa's energy emissions are more than triple those of Angola's and are overwhelmingly due to electricity and heat production, which accounts for 61% of the country's energy emissions, 51% of the country's total emissions, and 22% of the region's emissions. Approximately 85% of Angola's energy emissions are due to fugitive emissions, which account for 48% of the country's total emissions.

The countries with the highest LUCF emissions are Zambia, Angola, Zimbabwe, Mozambique, and Madagascar. Together, their LUCF emissions constitute 90% of the region's total LUCF emissions. LUCF is the highest GHG emitting sector of six countries, Zambia, Zimbabwe, Mozambique, Madagascar, Botswana, and Malawi, whose combined LUCF emissions constitute 75% of the region's total LUCF emissions.



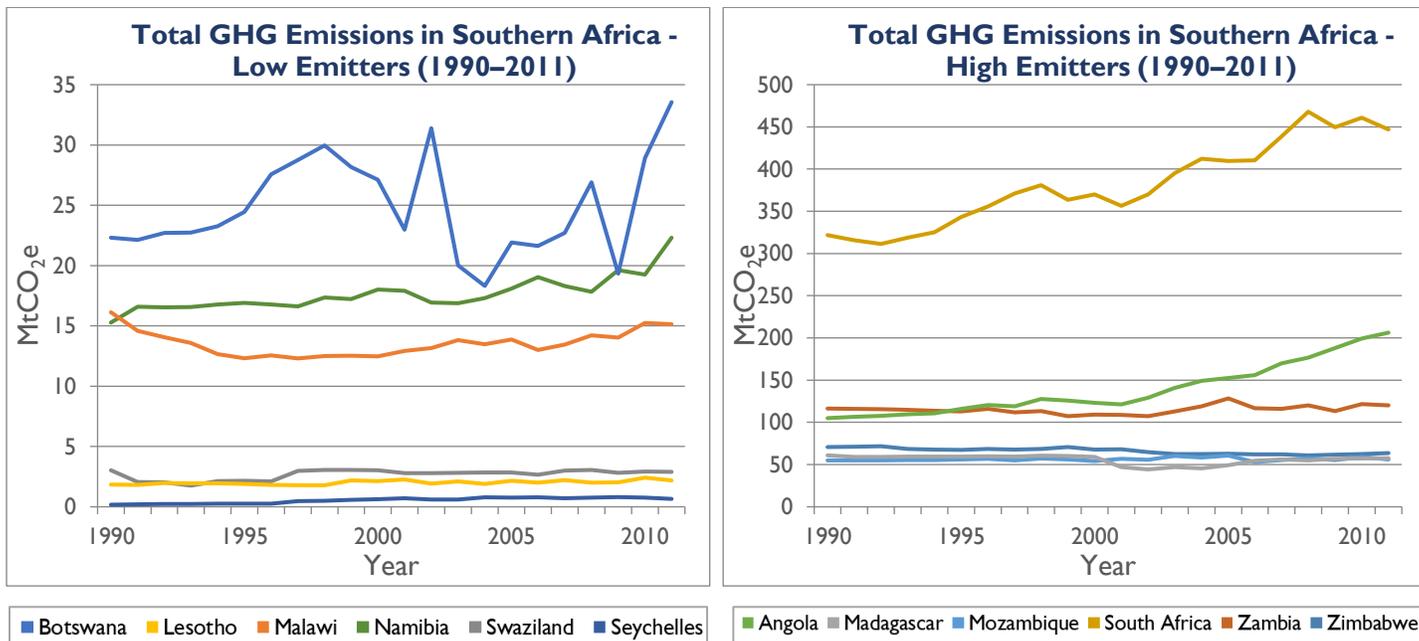
The countries with the highest agriculture emissions are Angola, South Africa, Madagascar, Zambia, Mozambique, Botswana, and Zimbabwe. Their agriculture emissions account for 90% of the region's GHGs from agriculture. Agriculture is the highest emitting sector in three countries: Namibia, Lesotho, and Swaziland. However, none of the three are among the region's top agriculture emitters; their agriculture emissions combined constitute only 8% of the region's total GHGs from agriculture.

Source: WRI CAIT 2.0, 2015

<sup>4</sup> WRI CAIT.

## Change in GHG Emissions in Southern Africa (1990-2011)

The total GHG emissions of the countries in the Southern Africa region increased 30% from 1990 to 2011, the most recent year for which data are available for all countries in the region and for all sectors.<sup>5</sup> Country total emissions are presented in the two line graphs below, with low emitters (Seychelles, Lesotho, Swaziland, Malawi, Namibia, and Botswana) and high emitters (Madagascar, Mozambique, Zimbabwe, Zambia, Angola, and South Africa) shown separately, in order of lowest to highest according to their 2011 emissions.



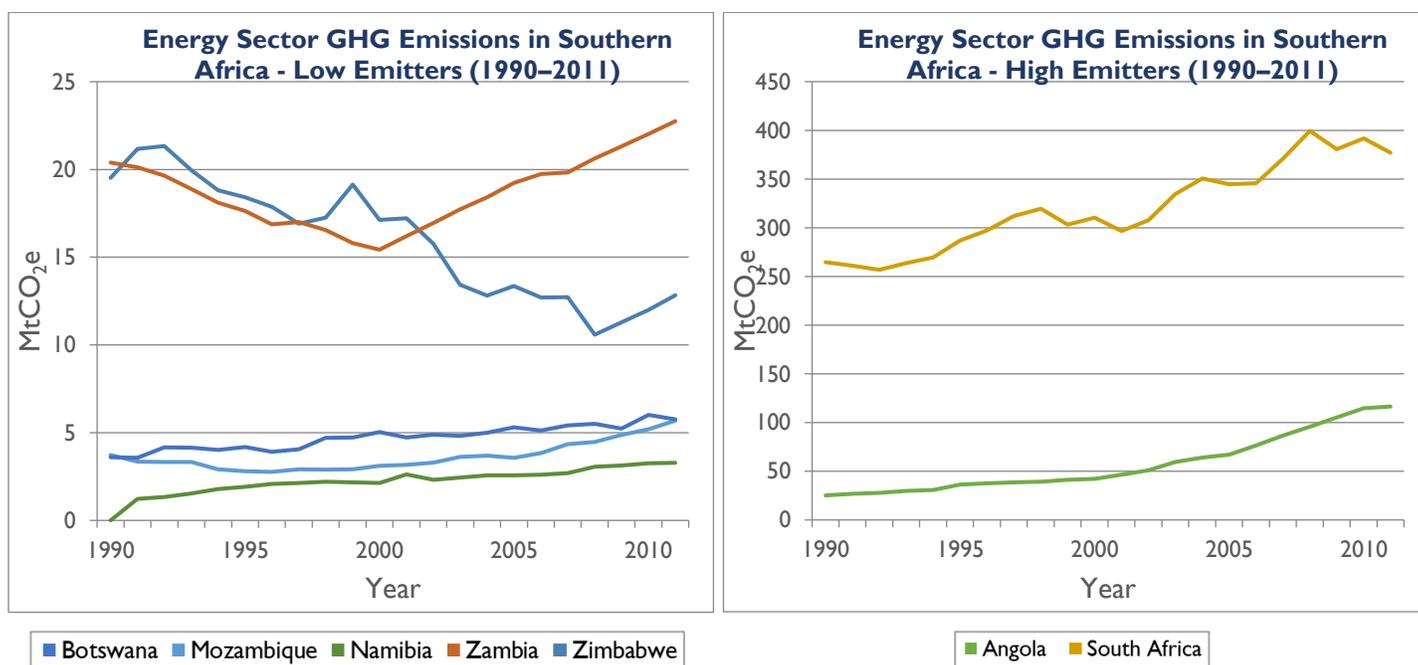
Source: WRI CAIT 2.0, 2015

The drivers of the region's key emitting sectors are summarized below, focusing on the countries whose combined sector emissions total a significant share (90%) of the region's sector emissions.

<sup>5</sup> WRI CAIT. Namibia's energy emissions were not available for 1990, but were 7% of total country emissions in 1991. Energy emissions are not available across the time series for Lesotho, Malawi, Seychelles, and Swaziland. Industrial processes emissions are not available across the time series for Lesotho. WRI CAIT does not provide an explanation for why some data are not available.

**Energy:** Changes in the region's energy sector GHG emissions are driven by South Africa's and Angola's high energy emissions. With 95% of Africa's total coal reserves but limited oil and natural gas, South Africa meets most of its energy needs through coal, in particular for electric power generation which accounts for more than half of the country's coal consumption. According to the U.S. Energy Information Administration (EIA), most coal power plants in South Africa are outdated, poorly maintained, and working at their maximum capacity. The national power utility, Eskom, plans to bring online new coal-fired power plants to alleviate blackouts and to meet growing demand. Meanwhile, South Africa is also diversifying its electricity generation mix and is expanding renewable electricity generation capacity through the Renewable Energy Independent Power Producer Procurement Program (REIPPPP), through which South Africa's Department of Energy reports that 4,322 MW have been procured since the start of the program in 2011.<sup>6</sup> Electric power generated from a wide range of technologies is eligible to compete for procurement, including wind, solar, hydro, biomass, biogas, and landfill.<sup>7</sup> As of 2013, 93% of electricity in South Africa was produced from coal, followed by nuclear generation (6%), hydro (2%), and biofuels and non-hydro renewable (less than 1%).<sup>8</sup>

In Angola, energy sector GHG emissions are overwhelmingly due to fugitive emissions from oil and gas. The vast majority of Angola's natural gas production is associated gas that is produced as a byproduct of crude oil. In 2013, 65% of natural gas production was vented and flared, and 24% was reinjected into oil wells to enhance oil recovery.<sup>9</sup>



Source: WRI CAIT 2.0, 2015. Countries whose energy sector emissions are not available are not included.

<sup>6</sup> Department of Energy, 2015. Media Statement by Ms. Tina Joemat-Pettersson, Minister of Energy: file:///C:/Users/20820/Downloads/MediaStatement-Expansion-and-Acceleration-of-the-Independent-Power-Producer-Procurement-Programme-16April2015.pdf.

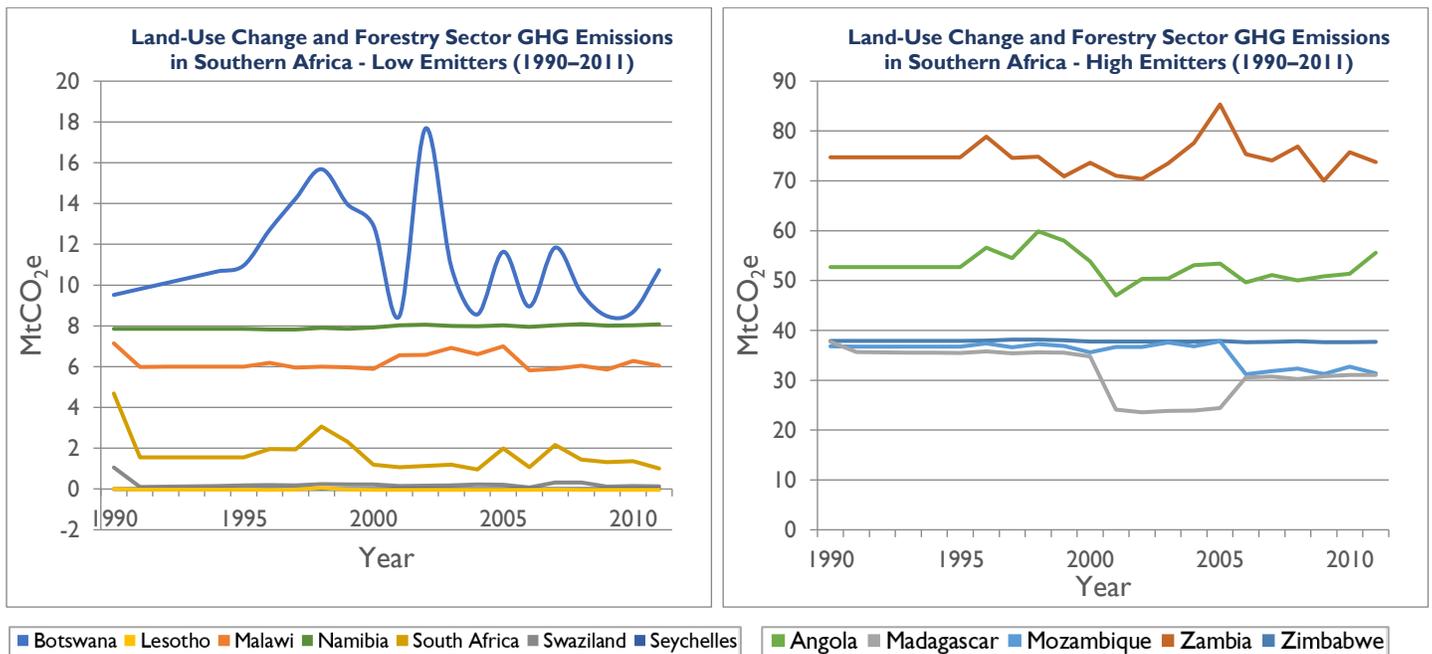
<sup>7</sup> U.S. Energy Information Administration, 2015. Country Analysis Brief: South Africa: [http://www.eia.gov/beta/international/analysis\\_includes/countries\\_long/South\\_Africa/south\\_africa.pdf](http://www.eia.gov/beta/international/analysis_includes/countries_long/South_Africa/south_africa.pdf).

<sup>8</sup> International Energy Agency, 2015. Energy Balances, viewed November 15, 2015: <http://www.iea.org/statistics/statisticssearch/report/?country=SOUTHAFRIC&product=balances&year=2013>. Numbers do not sum to 100% due to rounding.

<sup>9</sup> U.S. Energy Information Administration, 2015. Country Analysis Brief: Angola: <http://www.eia.gov/beta/international/analysis.cfm?iso=AGO>.

**Land-Use Change and Forestry (LUCF):** Changes in the region’s LUCF emissions are driven by LUCF activities in Zambia, Angola, Zimbabwe, Mozambique, and Madagascar, whose emissions are shown below in the graph of the region’s high LUCF sector GHG emitters. Emissions from the other countries are also shown separately in the LUCF low emitters graph.<sup>10</sup>

Among the high LUCF emitters, the amount of land that remains forested<sup>11</sup> ranges from 22% in Madagascar to 66% in Zambia. Although it has the highest proportion of forested land, Zambia also has one of the highest deforestation rates in all of Africa, with 250,000 to 300,000 hectares deforested annually. Across the region, there are similarities in the causes of deforestation and forest degradation, including the harvesting or use of forest resources for energy in the form of charcoal, firewood, or other biomass in Zambia, Angola, Zimbabwe, and Mozambique. Clearing of land for agriculture – both subsistence and commercial agriculture for food and cash crops – is a commonly identified driver of deforestation, in particular small scale, shifting cultivation. Urbanization and industrial activities, with mining being a prominent example, drive deforestation and degradation in Zambia and Mozambique. Bush fires and the setting of fires for various reasons are observed to contribute to forest depletion in Zambia, Madagascar, and Mozambique. Activities such as timber harvesting also deplete forests and commercial logging and mining activities also open access to forests in Zambia and Madagascar.



Source: WRI CAIT 2.0, 2015

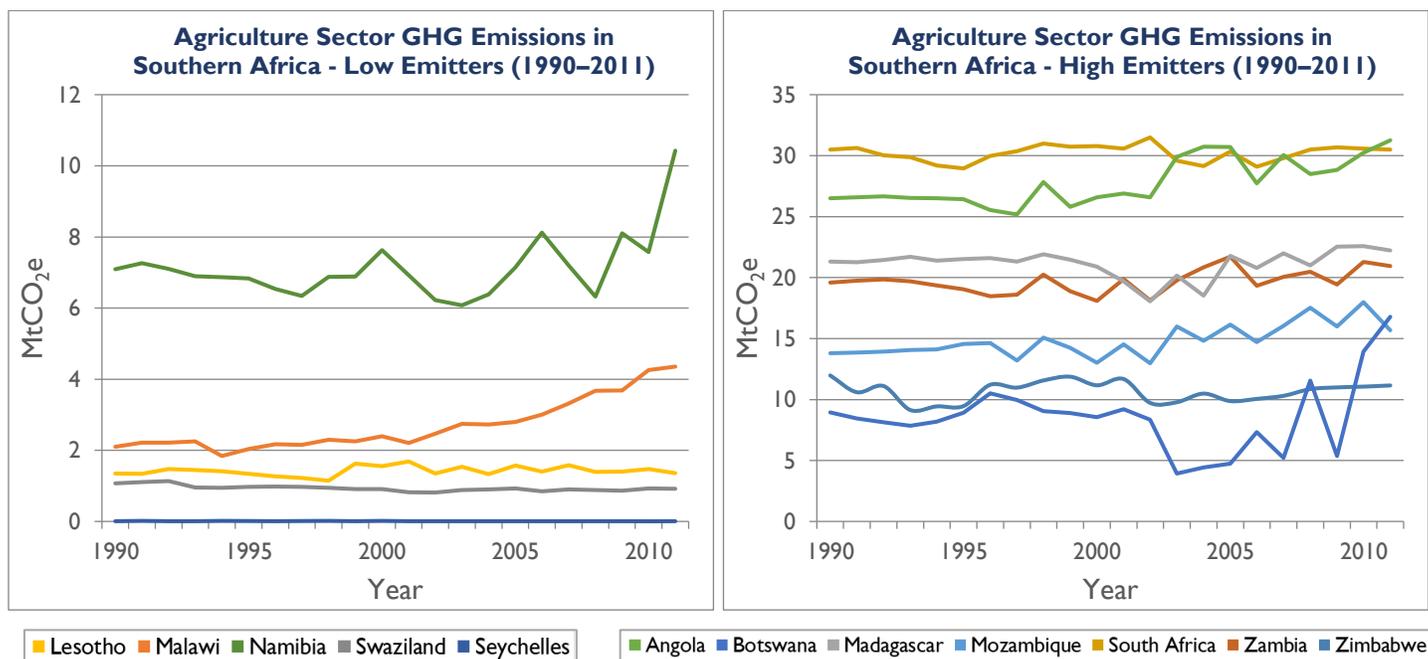
<sup>10</sup> The Seychelles’ emissions are included in the low emitters graph but is difficult to see.

<sup>11</sup> Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT), viewed November 11, 2015: [http://faostat3.fao.org/browse/area\\*/E](http://faostat3.fao.org/browse/area*/E).

**Agriculture:** Changes in the region’s agriculture emissions are driven by agricultural activities in Angola, South Africa, Madagascar, Zambia, Mozambique, Botswana, and Zimbabwe, whose emissions are shown below in the agriculture “high emitters” graph. Emissions from the low emitters are also shown.

In all seven countries, enteric fermentation is among the top three emitting agriculture subsectors. Savanna burning and manure on pasture are key subsectors for six countries.<sup>12</sup> For Madagascar, rice production is a leading subsector, as is the cultivation of organic soils in Zambia.

Agriculture is important to many of the region’s economies, providing both formal and informal sector employment and contributing to the national economy. Countries reported at least half of the population to be engaged in agriculture, especially in rural areas, with Zimbabwe, Madagascar, Mozambique, and Zambia reporting 70% to 85%; however, agriculture employs only 3.5% of the total labor force in South Africa.<sup>13</sup> As a percentage of the national economy, the sector’s importance ranges from less than 3% in South Africa to 40% of Mozambique’s GDP. There is both subsistence and commercial farming, with commercial operations still developing in countries such as Angola, and already mature in South Africa. Countries have identified a range of needs, including improved livestock production (Angola); transferring free-range cattle to feedlots and using improved feed and reducing crop tillage to reduce soil erosion (South Africa); improved seeds and farming practices, promoting livestock breeding, and fighting pastureland fires (Madagascar); biogas and biomass electricity generation, reduction of inorganic fertilizers through application of green manure crops and conservation farming (Zambia); reduction in emissions from savanna burning, livestock, and manure management (Mozambique); livestock waste management through aerobic manure composting and biogas capture (Botswana); and reduction of nitrous oxide emissions from fertilizer production (Zimbabwe).<sup>14</sup>



Source: WRI CAIT 2.0, 2015

<sup>12</sup> Savanna burning is not a key emitting subsector for Madagascar. Manure left on pasture accounts for 8% of agriculture emissions in Zambia but is not among the top three emitting subsectors.

<sup>13</sup> The 3.5% figure is based on data from Statistics South Africa, which states that the agriculture sector in South Africa was 630,000 people in 2011, out of a total labor force of 17,741,000. See <http://www.statssa.gov.za/publications/P0211/P02114thQuarter2011.pdf>

<sup>14</sup> The sector’s contributions to GDP and agriculture sector needs are compiled from each country’s most recent National Communication to the United Nations Framework Convention on Climate Change (UNFCCC). The sector’s contributions to GDP are as follows: Angola (8%), South Africa (2.6%), Madagascar (27%), Zambia (18% to 20%), Mozambique (40%), Botswana (4%), and Zimbabwe (15%). Agriculture sector needs are compiled from each country’s most recent National Communication to the United Nations Framework Convention on Climate Change.

## Key National Climate Change Commitments and Policies<sup>15</sup>

All countries in the region submitted an intended nationally determined contribution (INDC) prior to the UN climate conference (COP 21) that culminated in the Paris Agreement.<sup>16</sup> The commitments are summarized in the table below, which indicates whether the commitments were put forth to be achieved unconditionally, or if they are conditioned upon the receipt of international support, if this distinction was communicated in the INDC. The sectors in which GHG mitigation actions are expected to be achieved are also identified.

Country	Commitment	Sectors for mitigation and enhanced removals
<a href="#">Angola</a>	<p>Unconditional – Reduce GHG emissions by up to 35% relative to the business-as-usual (BAU) scenario.</p> <p>Conditional – Reduce emissions by an additional 15% below the BAU scenario by 2030.</p>	<ul style="list-style-type: none"> <li>• Electric power generation from renewable energy sources (8,491 Megawatts of potential wind, solar, biomass, and hydroelectric projects are identified)</li> <li>• Reforestation</li> <li>• Non-targeted activities (reducing emissions from the production of charcoal, promoting the use of biofuels, and avoiding deforestation)</li> </ul>
<a href="#">Botswana</a>	Reduce GHG emissions by 15% by 2030 from 2010 base year. 2010 base year emissions are estimated to be 8,307 Gigagrams of CO <sub>2</sub> e	<ul style="list-style-type: none"> <li>• Energy (stationary and mobile sources)</li> <li>• Waste</li> <li>• Agriculture (livestock)</li> </ul>
<a href="#">Lesotho</a>	<p>Unconditional – Reduce GHG emissions by 10% by 2030 compared to the BAU scenario.</p> <p>Conditional – Reduce GHG emissions by 35% by 2030.</p>	<ul style="list-style-type: none"> <li>• Energy efficiency and demand management</li> <li>• Increased investment in renewable energy in the electricity generation, buildings, and waste sectors</li> </ul>
<a href="#">Madagascar</a>	Conditional – Reduce GHG emissions by 14% (approximately 30 MtCO <sub>2</sub> ) in 2030 compared to the BAU scenario. Additionally, enhanced removals from land use, land-use change and forestry (LULUCF) by 32% (estimated at 61 MtCO <sub>2</sub> ) in 2030 compared to the BAU scenario.	<ul style="list-style-type: none"> <li>• Energy</li> <li>• Agriculture</li> <li>• LULUCF (diversified reforestation program)</li> <li>• Waste</li> </ul>
<a href="#">Malawi</a>	The INDC identifies unconditional and conditional actions that combined could reduce per capita emissions from 1.4 tCO <sub>2</sub> e in 2010 to 0.7 – 0.8 tCO <sub>2</sub> e in 2030 compared to a BAU of 1.5 tCO <sub>2</sub> e per capita in 2030.	<ul style="list-style-type: none"> <li>• Forestry</li> <li>• Agriculture</li> <li>• Energy</li> </ul>
<a href="#">Mozambique</a>	Conditional – Reduce approximately 76.5 MtCO <sub>2</sub> e in the period from 2020 to 2030, with 23.0 MtCO <sub>2</sub> e by 2024 and 53.4 MtCO <sub>2</sub> e from 2025 to 2030. The estimates are uncertain and will be updated with the results from the Biennial Update Report (BUR) to be available by early 2018. The INDC does not specify whether reductions will be relative to a BAU scenario or baseline year.	<ul style="list-style-type: none"> <li>• Energy</li> <li>• LULUCF</li> <li>• Waste</li> <li>• Potential actions in the industry and agriculture sectors</li> </ul>

<sup>15</sup>The source of information presented in the table is each country's INDC.

<sup>16</sup> INDCs are hyperlinked in the table below, please click on the country name to access the submission.

<a href="#"><u>Namibia</u></a>	<p>Unconditional – Emissions avoided unconditionally by Namibia prior to 2010 are included in the BAU scenario. This unconditional share will represent about 10% (2,000 Gg CO<sub>2</sub>e) of the mitigation potential when taking into consideration implemented and planned measures up to 2030.</p> <p>Conditional – Reduction of 89% of its GHG emissions (20,000 Gg CO<sub>2</sub>e inclusive of sequestration in the agriculture forestry and other land use (AFOLU) sector) by around 2030 compared to the BAU scenario.</p>	<ul style="list-style-type: none"> <li>• Economy-wide emission reductions: <ul style="list-style-type: none"> <li>○ AFOLU (major contributor)</li> <li>○ Energy</li> <li>○ Industrial processes and product use (IPPU)</li> <li>○ Waste</li> </ul> </li> </ul>
<a href="#"><u>Seychelles</u></a>	<p>Conditional – Reduce 122.5 ktCO<sub>2</sub>e (21.4%) in 2025 and an estimated 188 ktCO<sub>2</sub>e in 2030 (29.0%) relative to baseline emissions.</p> <p>The baseline is a BAU scenario of emission projections based on economic growth in the absence of climate change policies, starting from 2010 for public electricity production and consumption and land transport, and 2012 for solid waste.</p>	<ul style="list-style-type: none"> <li>• Energy (public sector power generation and demand side management; land transport)</li> <li>• Waste (solid waste management)</li> </ul>
<a href="#"><u>South Africa</u></a>	<p>“Peak, Plateau, and Decline trajectory” capping emissions by 2025 and 2030 to a range between 398 MtCO<sub>2</sub>e-614 MtCO<sub>2</sub>e.</p>	<ul style="list-style-type: none"> <li>• Economy-wide emission reductions: <ul style="list-style-type: none"> <li>○ Energy</li> <li>○ IPPU</li> <li>○ Waste</li> <li>○ AFOLU</li> </ul> </li> </ul>
<a href="#"><u>Swaziland</u></a>	<p>Conditional – Swaziland’s mitigation contribution is framed as an action-based approach that includes national level action, actions in the energy sector to double the share of renewable energy, introducing the commercial use of a 10% ethanol blend in petrol by 2030, and the phase-out of the use of hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride gases.</p>	<ul style="list-style-type: none"> <li>• The INDC includes four actions: <ul style="list-style-type: none"> <li>○ Development of a national GHG inventory: a baseline and emissions trajectory; and a monitoring, reporting, and verification (MRV) system at the national level</li> <li>○ GHG emissions reductions in the energy sector</li> <li>○ GHG emissions reductions in the transport sector</li> <li>○ Substitutes for ozone depleting substances (ODS)</li> </ul> </li> </ul>
<a href="#"><u>Zambia</u></a>	<p>Unconditional – Reduce emissions by 25% (20,000 Gigagrams) by 2030 compared to 2010 base year emission levels.</p> <p>Conditional – Reduce emissions by 47% (38,000 Gigagrams) compared to 2010 base year emission levels.</p>	<ul style="list-style-type: none"> <li>• Sustainable forest management</li> <li>• Sustainable agriculture</li> <li>• Renewable energy and energy efficiency programs</li> </ul>
<a href="#"><u>Zimbabwe</u></a>	<p>Conditional – Energy emissions per capita by 2030 that are 33% below the projected BAU level.</p>	<ul style="list-style-type: none"> <li>• Energy</li> </ul>

Nearly all countries in the region have a national climate change policy, or a draft that is pending approval or in progress.<sup>17</sup> These are briefly listed below to provide additional context:

- Angola – Republic of Angola. Estratégia de Implementação Nacional para a UNFCCC e do Protocolo de Kyoto (2008) (National Implementation Strategy for the UNFCCC and the Kyoto Protocol (2008))
- Botswana – The Ministry of Environment, Wildlife, and Tourism in co-operation with the United Nations Development Programme is currently developing a Climate Change Policy and Institutional Framework that will be supported by a Strategy and Action Plan. The Policy was expected to be finalized in late 2015.
- Lesotho – formally committed to a process to develop a new National Climate Change Policy and Sustainable Energy Policy
- Madagascar – Repoblikan'i Madagasikara. Ministere de L'Environnement et des Forets. [Politique Nationale de Lutte Contre le Changement Climatique](#) (2010) (National Policy to Combat Climate Change (2010))
- Malawi – Government of Malawi, Environmental Affairs Department, Ministry of Environment and Climate Change Management. The first [National Climate Change Policy](#) is pending Cabinet approval and endorsement
- Mozambique – Republica De Mocambique, Ministerio para a Coordenacao da Accao Ambiental. [Estrategia Nacional de Adaptacao e Mitigacao de Mudancas Climaticas](#). ([National Climate Change Adaptation and Mitigation Strategy](#) (2012))
- Namibia – Republic of Namibia, Ministry of Environment and Tourism. [National Policy on Climate Change for Namibia](#) (2011)
- Seychelles – The Seychelles National Climate Change Committee. [Seychelles National Climate Change Strategy](#) (2009)
- South Africa – The Government of the Republic of South Africa. [National Climate Change Response Policy White Paper](#) (2011)
- Swaziland – National Climate Change Steering Committee. National Climate Change Policy (2015) and National Climate Change Strategy and Action Plan (2014)
- Zambia – Government of the Republic of Zambia, Ministry of Tourism, Environment & Natural Resources. [Zambia's National Climate Change Response Strategy](#) (2010)
- Zimbabwe – Republic of Zimbabwe, Zimbabwe Ministry of Environment, Water, and Climate. Zimbabwe's National Climate Change Response Strategy (2014)

<sup>17</sup> Hyperlinks are provided to facilitate access to the original documents where they are available online.