Center for Climate Strategies

Integrated Modeling System and Toolkit for Low Carbon Development and Energy, Resources, Economic, and Emissions Planning and Implementation

The Center for Climate Strategies (CCS)

Spring 2019

System and Toolkit Evolution

1. Initial construction was built from tools used to support subnational climate change mitigation planning for over 20 states in the US and Mexico (2005-2009)
2. Low Carbon Development (LCD) modeling framework and decisions support toolkit assembled with Chinese partners to support subnational planning in China (2009-2016)
3. Further refinement of the system and toolkit to support Low Emissions Development Strategies (LEDS) planning and capacity-building in Guatemala and Africa (2015-present)

THE CENTER FOR CLIMATE STRATEGIES China LCD Planning Global Environmental Institute

AFRICA LEDS Partnership

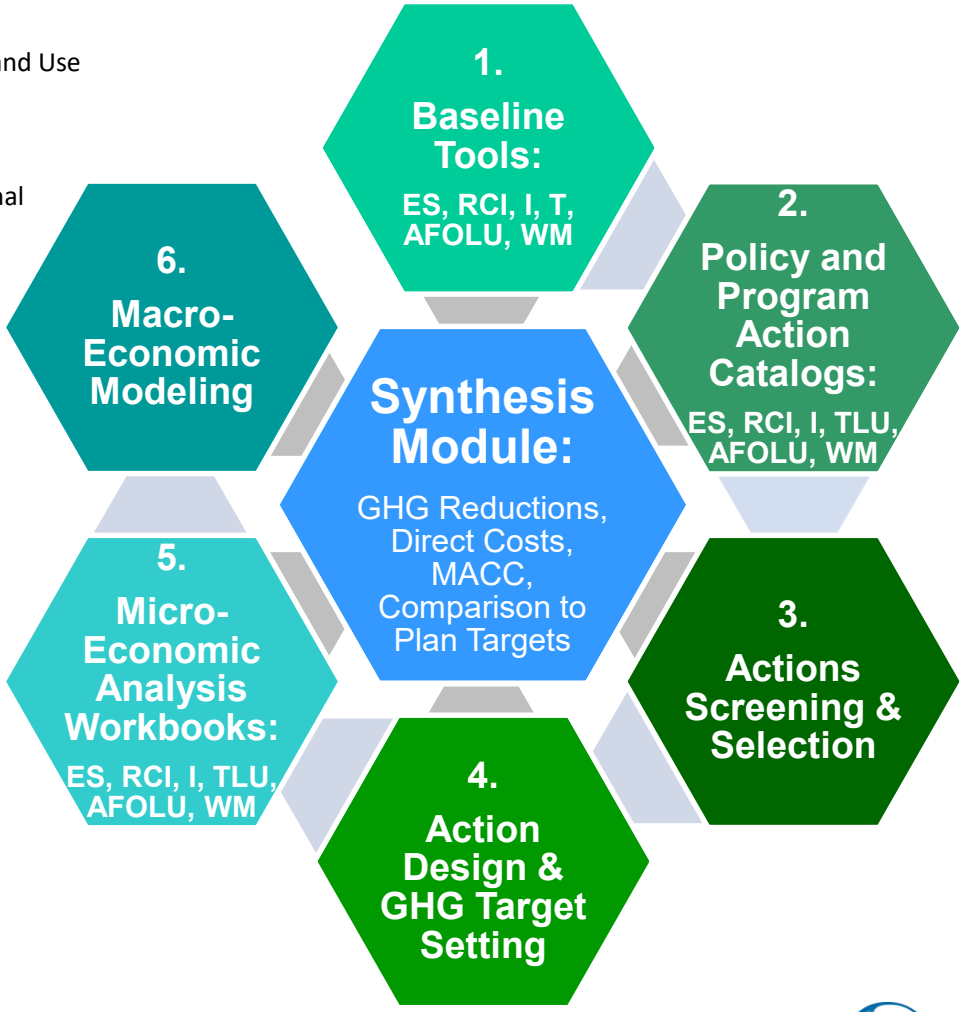
USAID FROM THE AMERICAN PEOPLE Low Emission Development

Decision Support for CCS' Step-Wise Action Planning Process

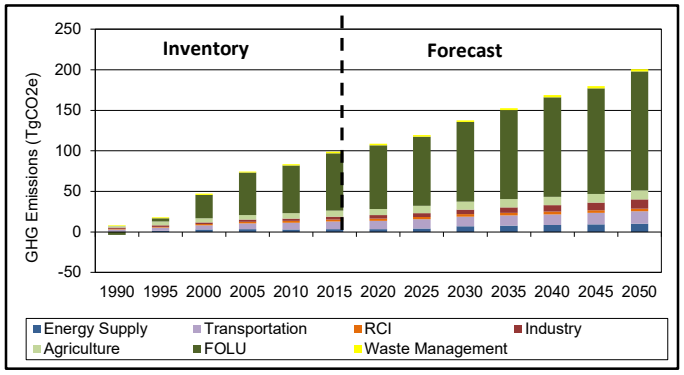
Step 1	Organization and Goals
Step 2	Baseline Development
Step 3	Policy Options Identification
Step 4	Policy Screening & Prioritization
Step 5	Initial Policy Option Design Specifications
Step 6	Direct (Micro) Impacts Assessment
Step 7	Policy Options Integration and Overlap
Step 8	Indirect (Macro) Impacts Assessment
Step 9	Final Recommendations & Report Transmittal
Step 10	Monitoring, Reporting, Evaluation, & Updating

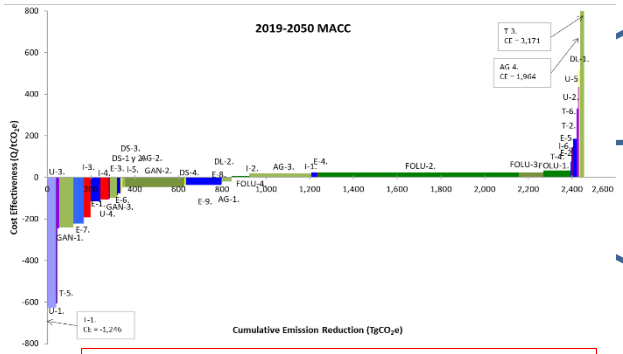
Action Planning System Overview

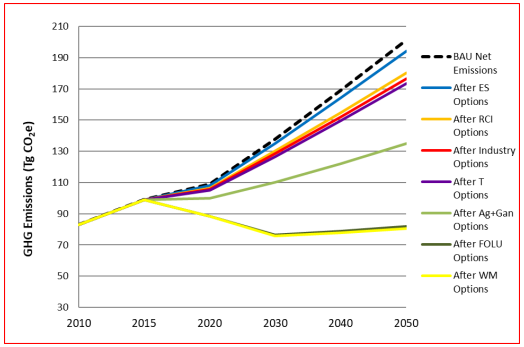
Acronyms:
AFOLU – Agriculture, Forestry & Other Land Use
ES – Energy Supply
GHG – greenhouse gas
I – Industry
RCI – Residential, Commercial, Institutional
T – Transportation
TLU – Transportation & Land Use
WM – Waste Management



Action Planning "Toolkit" System Contents







Energy, Economic & Emissions Baselines

- **Economy-Wide Synthesis Module, plus:**
- Energy Supply Module
- Residential, Commercial & Institutional Module
- Industrial Module
- Transportation Module
- Agriculture, Forestry & Land Use Module
- Waste Management Module

Multi-Criteria Action Catalogs

- **Sector-Specific for Action Screening & Prioritization:**
- Energy Supply
- Residential, Commercial & Institutional
- Industrial
- Transportation & (Urban) Land Use
- Agriculture & Forestry
- Waste Management

Policy Design & Analysis

- Policy Design Templates
- Causal Chain Templates
- Microeconomic Analysis Principles
- Sector-level Microeconomic (Cost Effectiveness) Modeling Tools
- Macroeconomic Screening Tool
- Linkage to Formal Macroeconomic Models (e.g. REMI)
- Financing Mechanisms Guidance
- Cross-Sector Integration Tools in the Synthesis Module (assess progress to targets, develop MAC curves)

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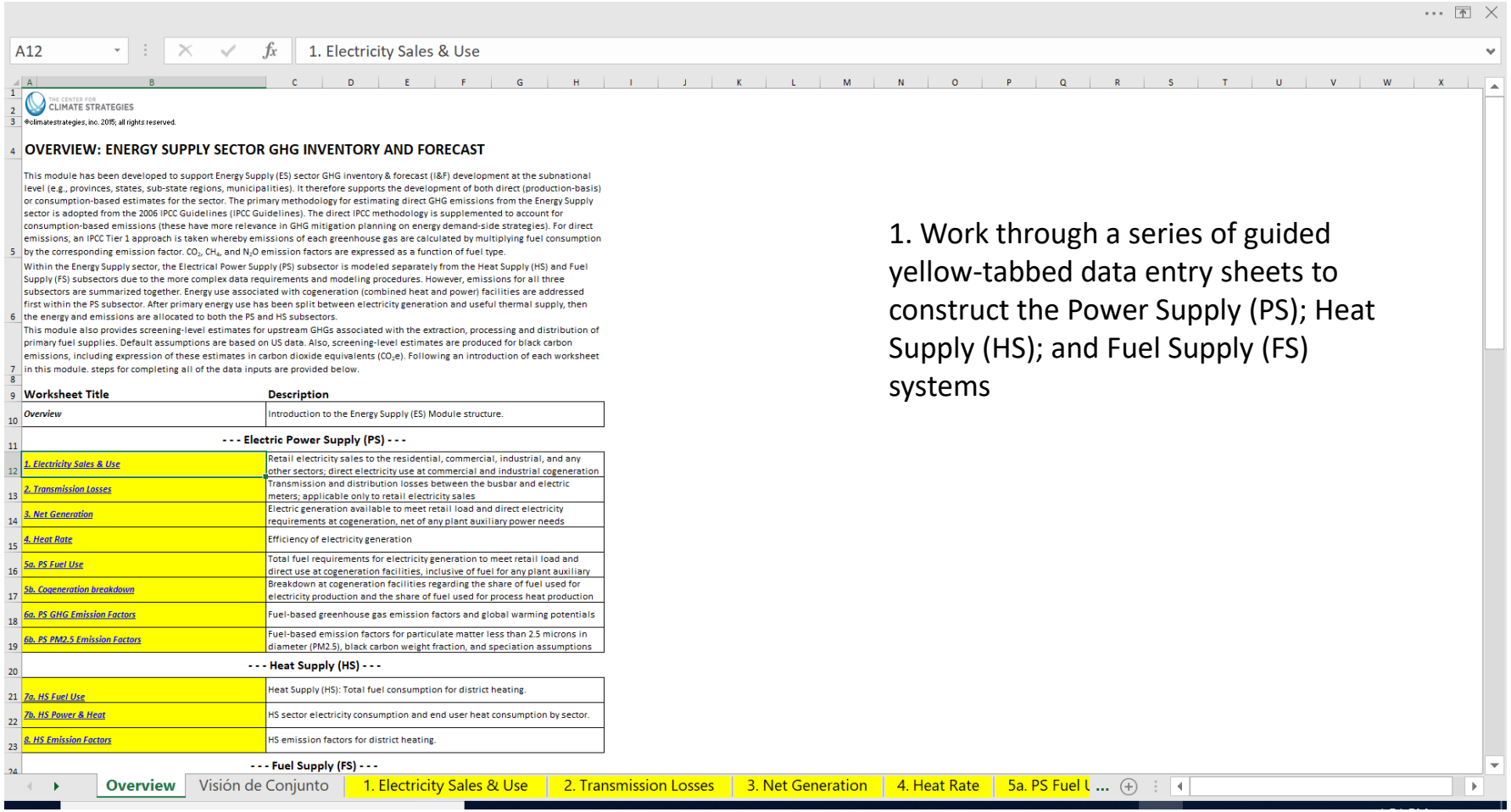
LCD/LEDS Modeling Framework and Tool Examples: Energy Supply and Forestry & Other Land Use Baseline Modules

- Brief overview
- More detailed demonstrations are provided during webinars and workshops

Energy Supply Baseline Module: Application Steps



A12 | 1. Electricity Sales & Use

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OVERVIEW: ENERGY SUPPLY SECTOR GHG INVENTORY AND FORECAST

This module has been developed to support Energy Supply (ES) sector GHG inventory & forecast (I&F) development at the subnational level (e.g., provinces, states, sub-state regions, municipalities). It therefore supports the development of both direct (production-basis) or consumption-based estimates for the sector. The primary methodology for estimating direct GHG emissions from the Energy Supply sector is adopted from the 2006 IPCC Guidelines (IPCC Guidelines). The direct IPCC methodology is supplemented to account for consumption-based emissions (these have more relevance in GHG mitigation planning on energy demand-side strategies). For direct emissions, an IPCC Tier 1 approach is taken whereby emissions of each greenhouse gas are calculated by multiplying fuel consumption by the corresponding emission factor. CO_2, CH_4, and N_2O emission factors are expressed as a function of fuel type.

Within the Energy Supply sector, the Electrical Power Supply (PS) subsector is modeled separately from the Heat Supply (HS) and Fuel Supply (FS) subsectors due to the more complex data requirements and modeling procedures. However, emissions for all three subsectors are summarized together. Energy use associated with cogeneration (combined heat and power) facilities are addressed first within the PS subsector. After primary energy use has been split between electricity generation and useful thermal supply, then the energy and emissions are allocated to both the PS and HS subsectors.

This module also provides screening-level estimates for upstream GHGs associated with the extraction, processing and distribution of primary fuel supplies. Default assumptions are based on US data. Also, screening-level estimates are produced for black carbon emissions, including expression of these estimates in carbon dioxide equivalents (CO_2e). Following an introduction of each worksheet in this module. steps for completing all of the data inputs are provided below.

Worksheet Title	Description
Overview	Introduction to the Energy Supply (ES) Module structure.
- - - Electric Power Supply (PS) - - -	
1. Electricity Sales & Use	Retail electricity sales to the residential, commercial, industrial, and any other sectors; direct electricity use at commercial and industrial cogeneration
2. Transmission Losses	Transmission and distribution losses between the busbar and electric meters; applicable only to retail electricity sales
3. Net Generation	Electric generation available to meet retail load and direct electricity requirements at cogeneration, net of any plant auxiliary power needs
4. Heat Rate	Efficiency of electricity generation
5a. PS Fuel Use	Total fuel requirements for electricity generation to meet retail load and direct use at cogeneration facilities, inclusive of fuel for any plant auxiliary
5b. Cogeneration breakdown	Breakdown at cogeneration facilities regarding the share of fuel used for electricity production and the share of fuel used for process heat production
6a. PS GHG Emission Factors	Fuel-based greenhouse gas emission factors and global warming potentials
6b. PS PM2.5 Emission Factors	Fuel-based emission factors for particulate matter less than 2.5 microns in diameter (PM2.5), black carbon weight fraction, and speciation assumptions
- - - Heat Supply (HS) - - -	
7a. HS Fuel Use	Heat Supply (HS): Total fuel consumption for district heating.
7b. HS Power & Heat	HS sector electricity consumption and end user heat consumption by sector.
8. HS Emission Factors	HS emission factors for district heating.
- - - Fuel Supply (FS) - - -	

Overview | Visión de Conjunto | 1. Electricity Sales & Use | 2. Transmission Losses | 3. Net Generation | 4. Heat Rate | 5a. PS Fuel U ...

1. Work through a series of guided yellow-tabbed data entry sheets to construct the Power Supply (PS); Heat Supply (HS); and Fuel Supply (FS) systems

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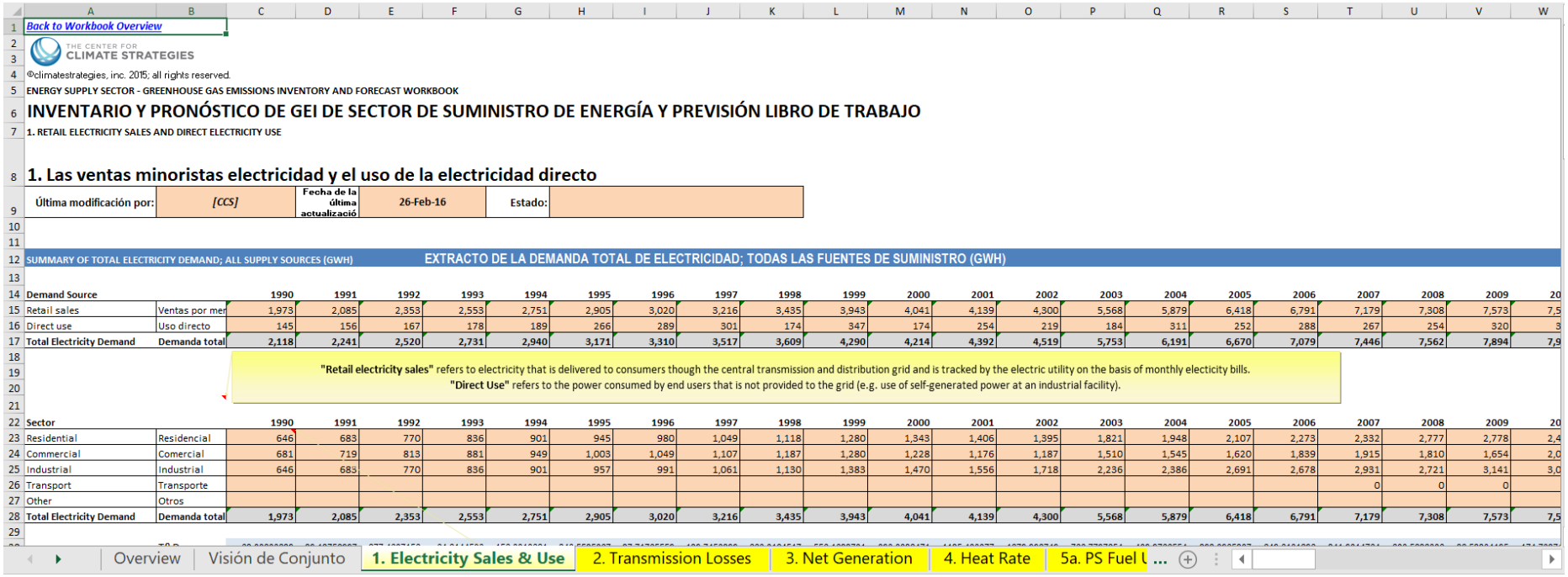
Energy Supply Baseline Module: Application Steps

2. Example Data Entry Sheet for Power Supply Sales and Direct Use



Back to Workbook Overview

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ENERGY SUPPLY SECTOR - GREENHOUSE GAS EMISSIONS INVENTORY AND FORECAST WORKBOOK

INVENTARIO Y PRONÓSTICO DE GEI DE SECTOR DE SUMINISTRO DE ENERGÍA Y PREVISIÓN LIBRO DE TRABAJO

1. RETAIL ELECTRICITY SALES AND DIRECT ELECTRICITY USE

1. Las ventas minoristas electricidad y el uso de la electricidad directo

Última modificación por:	[CCS]	Fecha de la última actualizació	26-Feb-16	Estado:	

SUMMARY OF TOTAL ELECTRICITY DEMAND; ALL SUPPLY SOURCES (GWH) — EXTRACTO DE LA DEMANDA TOTAL DE ELECTRICIDAD; TODAS LAS FUENTES DE SUMINISTRO (GWH)

Demand Source		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	20
Retail sales	Ventas por mer	1,973	2,085	2,353	2,553	2,751	2,905	3,020	3,216	3,435	3,943	4,041	4,139	4,300	5,568	5,879	6,418	6,791	7,179	7,308	7,573	7,5
Direct use	Uso directo	145	156	167	178	189	266	289	301	174	347	174	254	219	184	311	252	288	267	254	320	3
Total Electricity Demand	**Demanda total**	**2,118**	**2,241**	**2,520**	**2,731**	**2,940**	**3,171**	**3,310**	**3,517**	**3,609**	**4,290**	**4,214**	**4,392**	**4,519**	**5,753**	**6,191**	**6,670**	**7,079**	**7,446**	**7,562**	**7,894**	**7,9**

"Retail electricity sales" refers to electricity that is delivered to consumers though the central transmission and distribution grid and is tracked by the electric utility on the basis of monthly electicity bills.
"Direct Use" refers to the power consumed by end users that is not provided to the grid (e.g. use of self-generated power at an industrial facility).

Sector		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	20
Residential	Residencial	646	683	770	836	901	945	980	1,049	1,118	1,280	1,343	1,406	1,395	1,821	1,948	2,107	2,273	2,332	2,777	2,778	2,4
Commercial	Comercial	681	719	813	881	949	1,003	1,049	1,107	1,187	1,280	1,228	1,176	1,187	1,510	1,545	1,620	1,839	1,915	1,810	1,654	2,0
Industrial	Industrial	646	683	770	836	901	957	991	1,061	1,130	1,383	1,470	1,556	1,718	2,236	2,386	2,691	2,678	2,931	2,721	3,141	3,0
Transport	Transporte																		0	0	0	
Other	Otros																					
Total Electricity Demand	**Demanda total**	**1,973**	**2,085**	**2,353**	**2,553**	**2,751**	**2,905**	**3,020**	**3,216**	**3,435**	**3,943**	**4,041**	**4,139**	**4,300**	**5,568**	**5,879**	**6,418**	**6,791**	**7,179**	**7,308**	**7,573**	**7,5**

Overview | Visión de Conjunto | 1. Electricity Sales & Use | 2. Transmission Losses | 3. Net Generation | 4. Heat Rate | 5a. PS Fuel ...

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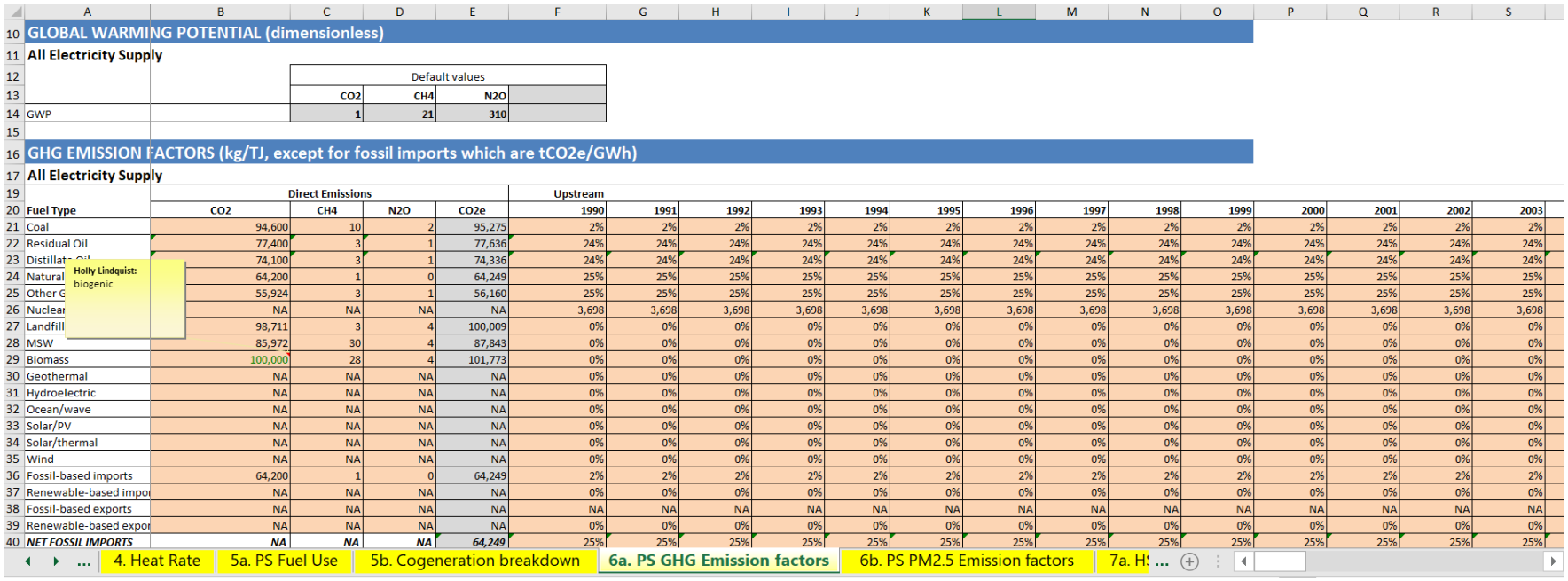
Energy Supply Baseline Module: Application Steps

3. Review and Revise Pre-Populated Data such as GHG emission factors.



GLOBAL WARMING POTENTIAL (dimensionless)

All Electricity Supply

	Default values		
	CO2	CH4	N2O
GWP	1	21	310

GHG EMISSION FACTORS (kg/TJ, except for fossil imports which are tCO2e/GWh)

All Electricity Supply

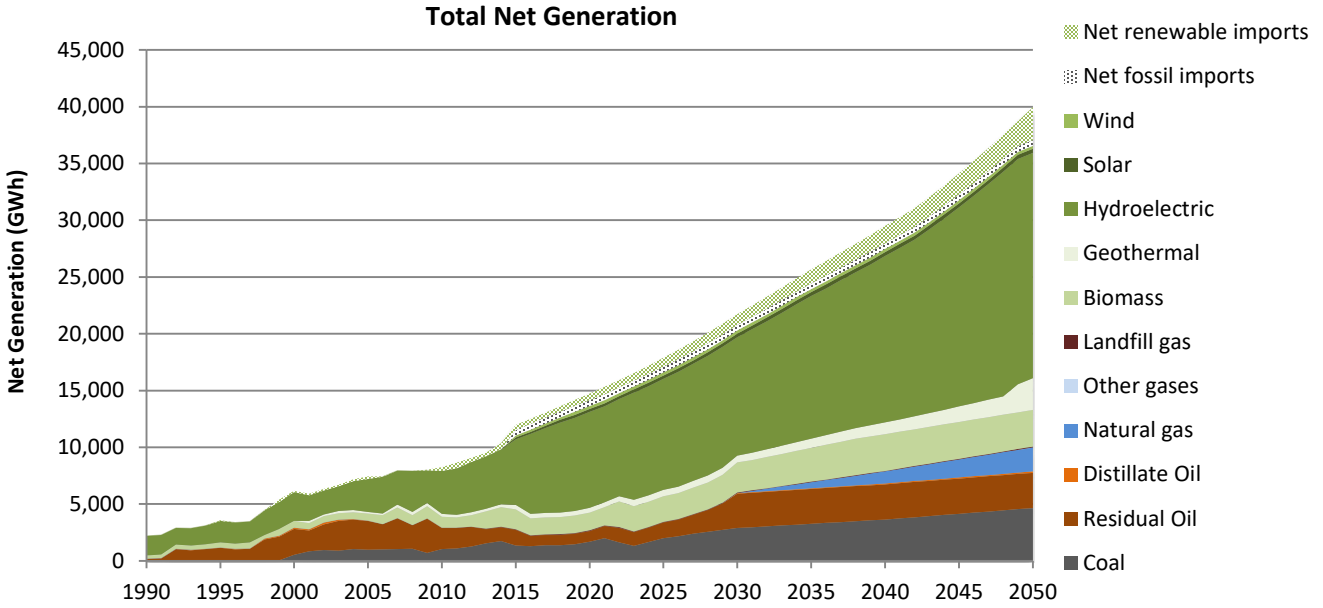
	Direct Emissions				Upstream													
Fuel Type	CO2	CH4	N2O	CO2e	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Coal	94,600	10	2	95,275	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Residual Oil	77,400	3	1	77,636	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%
Distillat- Oil	74,100	3	1	74,336	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%
Natural	64,200	1	0	64,249	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Other G	55,924	3	1	56,160	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Nuclear	NA	NA	NA	NA	3,698	3,698	3,698	3,698	3,698	3,698	3,698	3,698	3,698	3,698	3,698	3,698	3,698	3,698
Landfill	98,711	3	4	100,009	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
MSW	85,972	30	4	87,843	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biomass	100,000	28	4	101,773	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Geothermal	NA	NA	NA	NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hydroelectric	NA	NA	NA	NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Ocean/wave	NA	NA	NA	NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Solar/PV	NA	NA	NA	NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Solar/thermal	NA	NA	NA	NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wind	NA	NA	NA	NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fossil-based imports	64,200	1	0	64,249	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Renewable-based impo	NA	NA	NA	NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fossil-based exports	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Renewable-based expo	NA	NA	NA	NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
NET FOSSIL IMPORTS	*NA*	*NA*	*NA*	*64,249*	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%

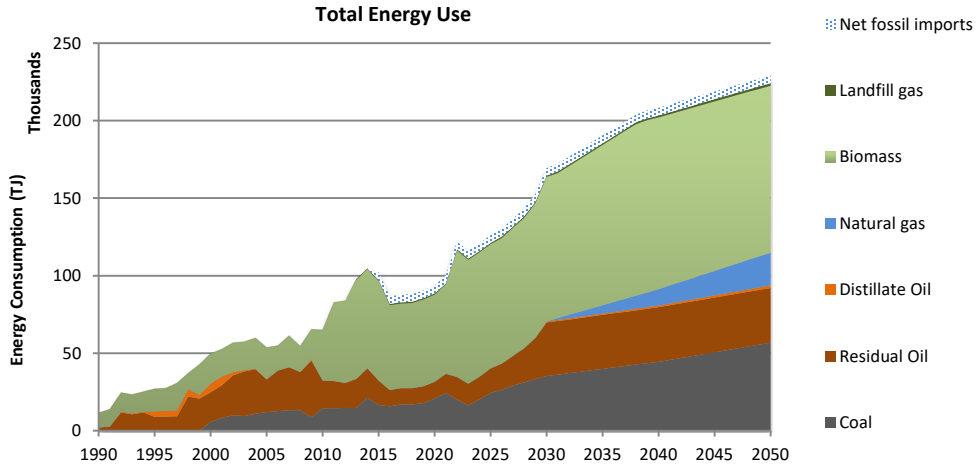
Holly Lindquist: biogenic

... 4. Heat Rate | 5a. PS Fuel Use | 5b. Cogeneration breakdown | 6a. PS GHG Emission factors | 6b. PS PM2.5 Emission factors | 7a. H ...

Energy Supply Baseline Module: Application Steps

4. Review Summary Results for Emissions Drivers.





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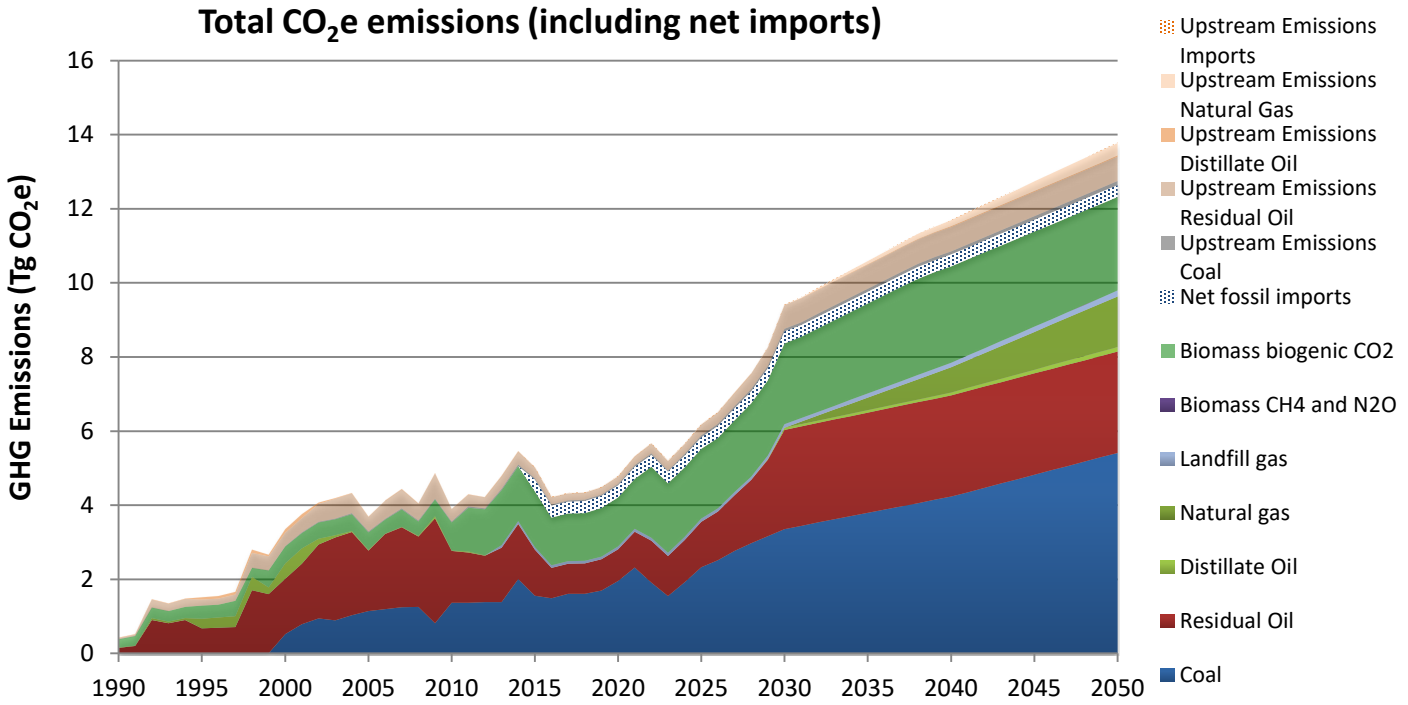
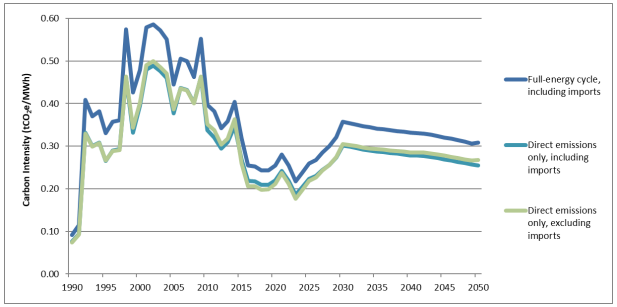
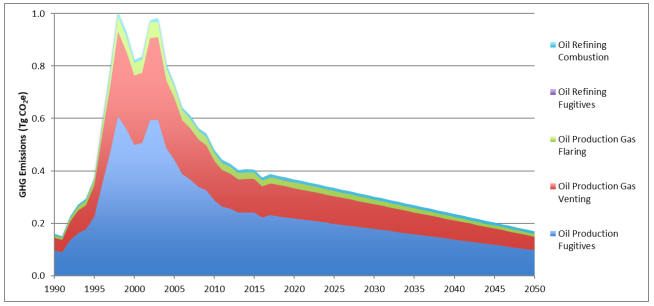
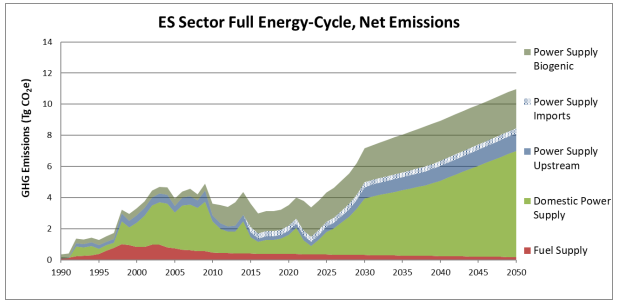
Energy Supply Baseline Module: Application Steps

5. Review Summary Results for Emissions.





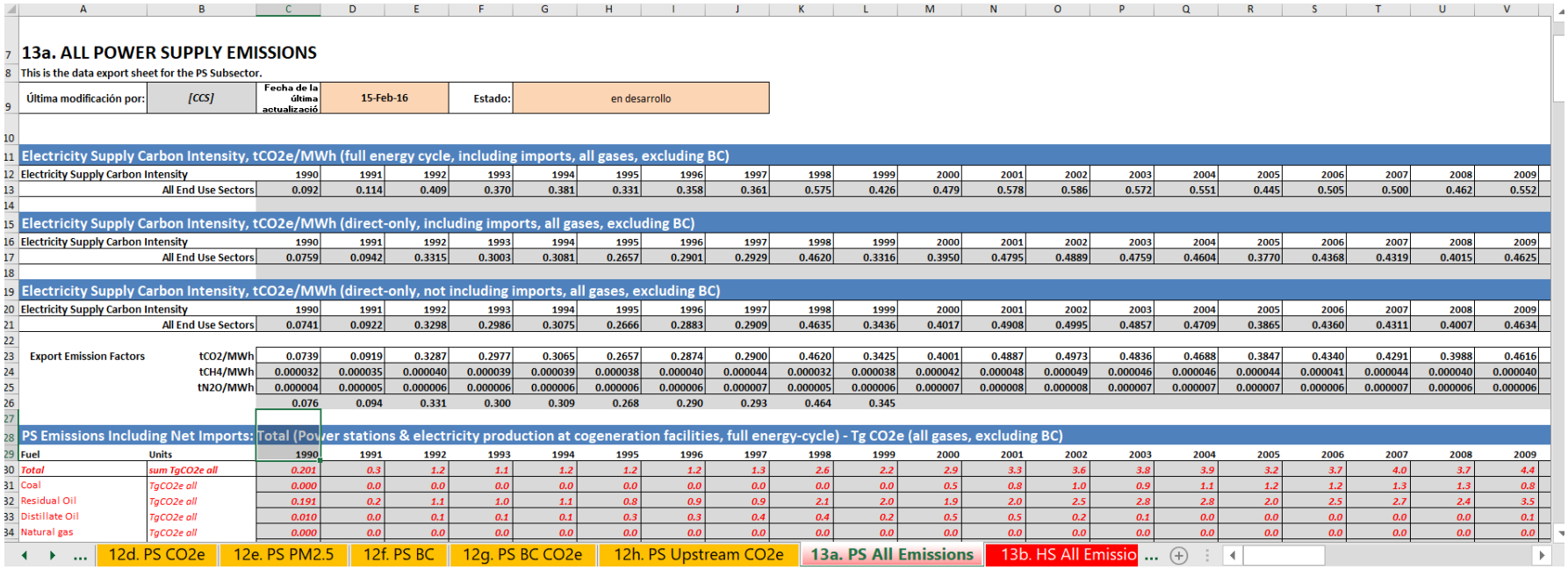




Energy Supply Baseline Module: Application Steps

6. Review Detailed Results.

7. Export these to the Excel-based Synthesis Module for the economy-wide baseline construction.



13a. ALL POWER SUPPLY EMISSIONS

This is the data export sheet for the PS Subsector.

Última modificación por:	[CCS]	Fecha de la última actualización	15-Feb-16	Estado:	en desarrollo

Electricity Supply Carbon Intensity, tCO2e/MWh (full energy cycle, including imports, all gases, excluding BC)

Electricity Supply Carbon Intensity	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
All End Use Sectors	0.092	0.114	0.409	0.370	0.381	0.331	0.358	0.361	0.575	0.426	0.479	0.578	0.586	0.572	0.551	0.445	0.505	0.500	0.462	0.552

Electricity Supply Carbon Intensity, tCO2e/MWh (direct-only, including imports, all gases, excluding BC)

Electricity Supply Carbon Intensity	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
All End Use Sectors	0.0759	0.0942	0.3315	0.3003	0.3081	0.2657	0.2901	0.2929	0.4620	0.3316	0.3950	0.4795	0.4889	0.4759	0.4604	0.3770	0.4368	0.4319	0.4015	0.4625

Electricity Supply Carbon Intensity, tCO2e/MWh (direct-only, not including imports, all gases, excluding BC)

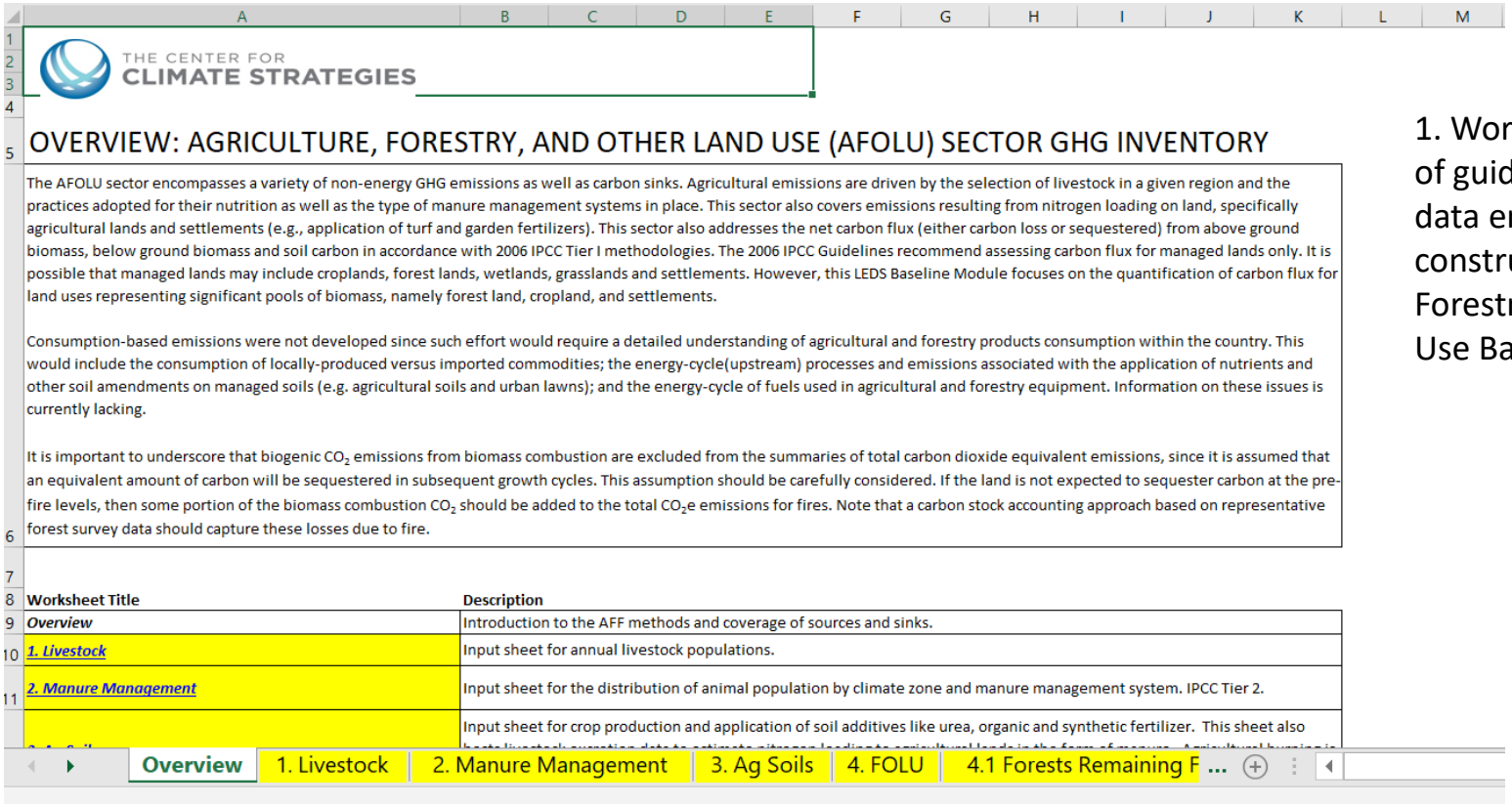
Electricity Supply Carbon Intensity	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
All End Use Sectors	0.0741	0.0922	0.3298	0.2986	0.3075	0.2666	0.2883	0.2909	0.4635	0.3436	0.4017	0.4908	0.4995	0.4857	0.4709	0.3865	0.4360	0.4311	0.4007	0.4634

Export Emission Factors																				
tCO2/MWh	0.0739	0.0919	0.3287	0.2977	0.3065	0.2657	0.2874	0.2900	0.4620	0.3425	0.4001	0.4887	0.4973	0.4836	0.4688	0.3847	0.4340	0.4291	0.3988	0.4616
tCH4/MWh	0.000032	0.000035	0.000040	0.000039	0.000039	0.000038	0.000040	0.000044	0.000032	0.000038	0.000042	0.000048	0.000049	0.000046	0.000046	0.000044	0.000041	0.000044	0.000040	0.000040
tN2O/MWh	0.000004	0.000005	0.000006	0.000006	0.000006	0.000006	0.000006	0.000007	0.000005	0.000006	0.000007	0.000008	0.000008	0.000007	0.000007	0.000007	0.000006	0.000007	0.000006	0.000006
	0.076	0.094	0.331	0.300	0.309	0.268	0.290	0.293	0.464	0.345										

PS Emissions Including Net Imports: Total (Power stations & electricity production at cogeneration facilities, full energy-cycle) - Tg CO2e (all gases, excluding BC)

Fuel	Units	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	*sum TgCO2e all*	*0.201*	*0.3*	*1.2*	*1.1*	*1.2*	*1.2*	*1.2*	*1.3*	*2.6*	*2.2*	*2.9*	*3.3*	*3.6*	*3.8*	*3.9*	*3.2*	*3.7*	*4.0*	*3.7*	*4.4*
Coal	*TgCO2e all*	*0.000*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.5*	*0.8*	*1.0*	*0.9*	*1.1*	*1.2*	*1.2*	*1.3*	*1.3*	*0.8*
Residual Oil	*TgCO2e all*	*0.191*	*0.2*	*1.1*	*1.0*	*1.1*	*0.8*	*0.9*	*0.9*	*2.1*	*2.0*	*1.9*	*2.0*	*2.5*	*2.8*	*2.8*	*2.0*	*2.5*	*2.7*	*2.4*	*3.5*
Distillate Oil	*TgCO2e all*	*0.010*	*0.0*	*0.1*	*0.1*	*0.1*	*0.3*	*0.3*	*0.4*	*0.4*	*0.2*	*0.5*	*0.5*	*0.2*	*0.1*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*
Natural gas	*TgCO2e all*	*0.000*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*

Agriculture, Forestry & Other Land Use (AFOLU) Baseline Module: Application Steps for FOLU



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OVERVIEW: AGRICULTURE, FORESTRY, AND OTHER LAND USE (AFOLU) SECTOR GHG INVENTORY

The AFOLU sector encompasses a variety of non-energy GHG emissions as well as carbon sinks. Agricultural emissions are driven by the selection of livestock in a given region and the practices adopted for their nutrition as well as the type of manure management systems in place. This sector also covers emissions resulting from nitrogen loading on land, specifically agricultural lands and settlements (e.g., application of turf and garden fertilizers). This sector also addresses the net carbon flux (either carbon loss or sequestered) from above ground biomass, below ground biomass and soil carbon in accordance with 2006 IPCC Tier I methodologies. The 2006 IPCC Guidelines recommend assessing carbon flux for managed lands only. It is possible that managed lands may include croplands, forest lands, wetlands, grasslands and settlements. However, this LEDS Baseline Module focuses on the quantification of carbon flux for land uses representing significant pools of biomass, namely forest land, cropland, and settlements.

Consumption-based emissions were not developed since such effort would require a detailed understanding of agricultural and forestry products consumption within the country. This would include the consumption of locally-produced versus imported commodities; the energy-cycle(upstream) processes and emissions associated with the application of nutrients and other soil amendments on managed soils (e.g. agricultural soils and urban lawns); and the energy-cycle of fuels used in agricultural and forestry equipment. Information on these issues is currently lacking.

It is important to underscore that biogenic CO_2 emissions from biomass combustion are excluded from the summaries of total carbon dioxide equivalent emissions, since it is assumed that an equivalent amount of carbon will be sequestered in subsequent growth cycles. This assumption should be carefully considered. If the land is not expected to sequester carbon at the pre-fire levels, then some portion of the biomass combustion CO_2 should be added to the total CO_2e emissions for fires. Note that a carbon stock accounting approach based on representative forest survey data should capture these losses due to fire.

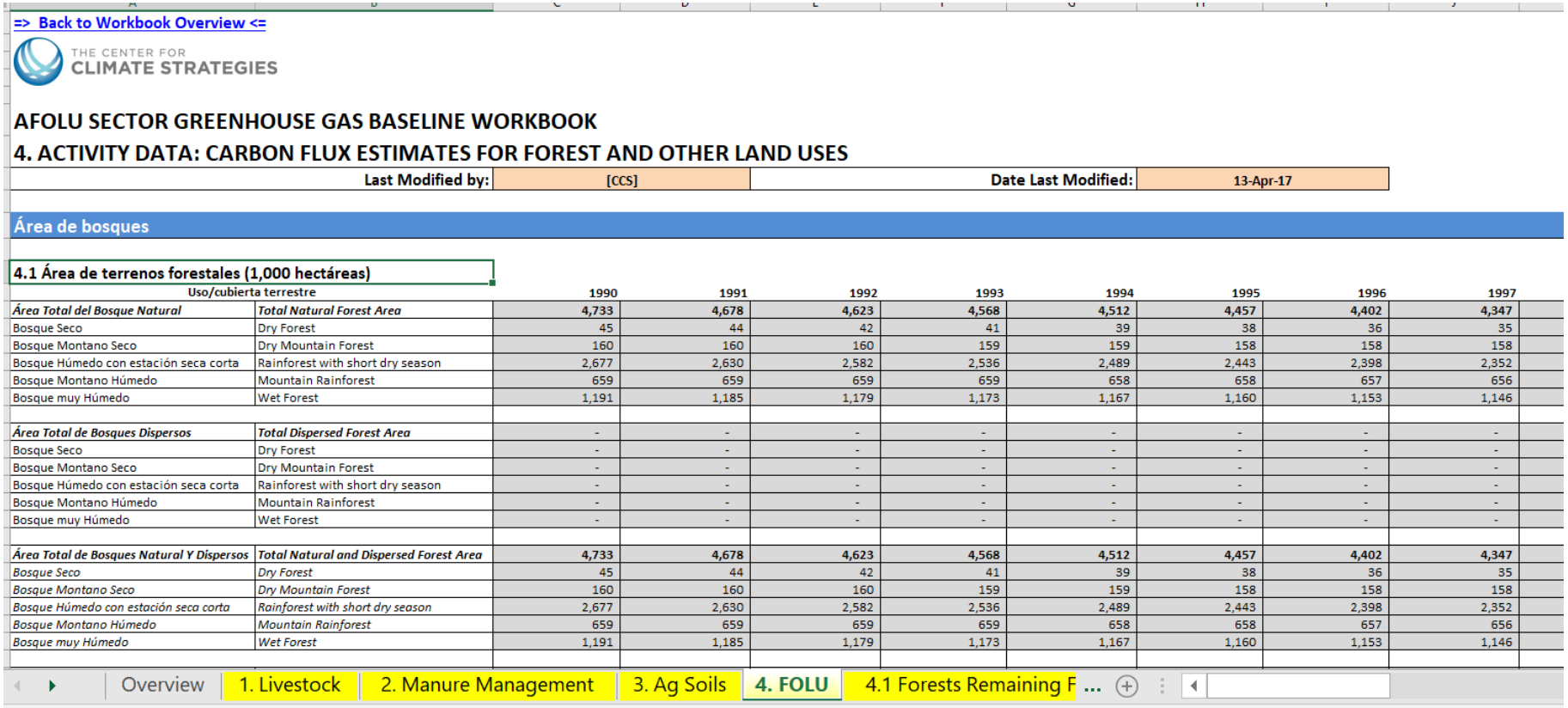
Worksheet Title	Description
Overview	Introduction to the AFF methods and coverage of sources and sinks.
1. Livestock	Input sheet for annual livestock populations.
2. Manure Management	Input sheet for the distribution of animal population by climate zone and manure management system. IPCC Tier 2.
	Input sheet for crop production and application of soil additives like urea, organic and synthetic fertilizer. This sheet also

Overview | 1. Livestock | 2. Manure Management | 3. Ag Soils | 4. FOLU | 4.1 Forests Remaining F ...

1. Work through a series of guided yellow-tabbed data entry sheets to construct the Agriculture, Forestry & Other Land Use Baseline

Agriculture, Forestry & Other Land Use (AFOLU) Baseline Module: Application Steps for FOLU

2. Example data entry sheet for historic and forecasted forest land use



=> Back to Workbook Overview <=

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AFOLU SECTOR GREENHOUSE GAS BASELINE WORKBOOK

4. ACTIVITY DATA: CARBON FLUX ESTIMATES FOR FOREST AND OTHER LAND USES

Last Modified by:	[CCS]	Date Last Modified:	13-Apr-17

Área de bosques

4.1 Área de terrenos forestales (1,000 hectáreas)

Uso/cubierta terrestre		1990	1991	1992	1993	1994	1995	1996	1997
Área Total del Bosque Natural	***Total Natural Forest Area***	**4,733**	**4,678**	**4,623**	**4,568**	**4,512**	**4,457**	**4,402**	**4,347**
Bosque Seco	Dry Forest	45	44	42	41	39	38	36	35
Bosque Montano Seco	Dry Mountain Forest	160	160	160	159	159	158	158	158
Bosque Húmedo con estación seca corta	Rainforest with short dry season	2,677	2,630	2,582	2,536	2,489	2,443	2,398	2,352
Bosque Montano Húmedo	Mountain Rainforest	659	659	659	659	658	658	657	656
Bosque muy Húmedo	Wet Forest	1,191	1,185	1,179	1,173	1,167	1,160	1,153	1,146
Área Total de Bosques Dispersos	***Total Dispersed Forest Area***	-	-	-	-	-	-	-	-
Bosque Seco	Dry Forest	-	-	-	-	-	-	-	-
Bosque Montano Seco	Dry Mountain Forest	-	-	-	-	-	-	-	-
Bosque Húmedo con estación seca corta	Rainforest with short dry season	-	-	-	-	-	-	-	-
Bosque Montano Húmedo	Mountain Rainforest	-	-	-	-	-	-	-	-
Bosque muy Húmedo	Wet Forest	-	-	-	-	-	-	-	-
Área Total de Bosques Natural Y Dispersos	***Total Natural and Dispersed Forest Area***	**4,733**	**4,678**	**4,623**	**4,568**	**4,512**	**4,457**	**4,402**	**4,347**
Bosque Seco	*Dry Forest*	45	44	42	41	39	38	36	35
Bosque Montano Seco	*Dry Mountain Forest*	160	160	160	159	159	158	158	158
Bosque Húmedo con estación seca corta	*Rainforest with short dry season*	2,677	2,630	2,582	2,536	2,489	2,443	2,398	2,352
Bosque Montano Húmedo	*Mountain Rainforest*	659	659	659	659	658	658	657	656
Bosque muy Húmedo	*Wet Forest*	1,191	1,185	1,179	1,173	1,167	1,160	1,153	1,146

Overview | 1. Livestock | 2. Manure Management | 3. Ag Soils | 4. FOLU | 4.1 Forests Remaining F ...

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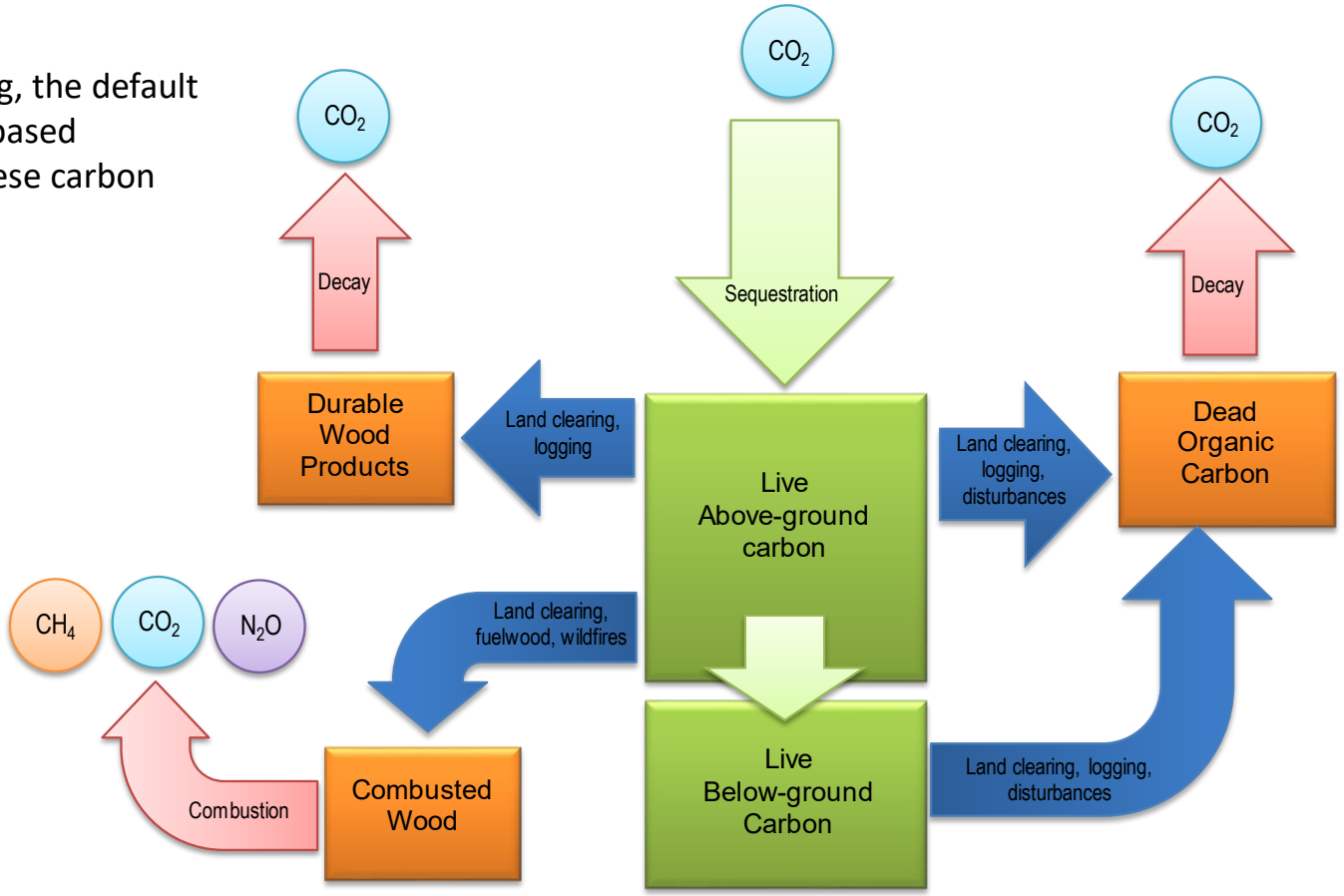
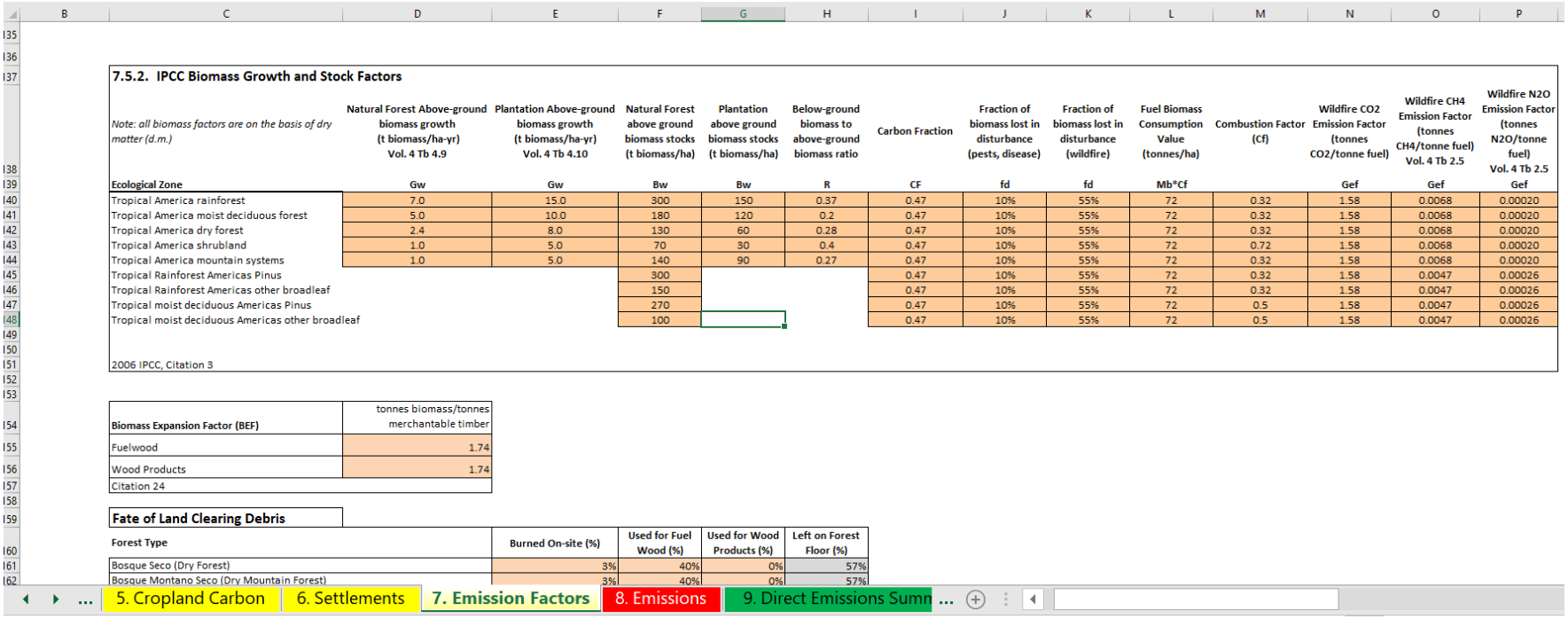
Agriculture, Forestry & Other Land Use (AFOLU) Baseline Module: Application Steps for FOLU

For forest carbon accounting, the default methodology follows IPCC-based methods, as shown with these carbon flows.



Agriculture, Forestry & Other Land Use (AFOLU) Baseline Module: Application Steps for FOLU

3. Review pre-populated emission factors and other input variables required for estimating GHG emissions and sinks.



7.5.2. IPCC Biomass Growth and Stock Factors

Note: all biomass factors are on the basis of dry matter (d.m.)	Natural Forest Above-ground biomass growth (t biomass/ha-yr) Vol. 4 Tb 4.9	Plantation Above-ground biomass growth (t biomass/ha-yr) Vol. 4 Tb 4.10	Natural Forest above ground biomass stocks (t biomass/ha)	Plantation above ground biomass stocks (t biomass/ha)	Below-ground biomass to above-ground biomass ratio	Carbon Fraction	Fraction of biomass lost in disturbance (pests, disease)	Fraction of biomass lost in disturbance (wildfire)	Fuel Biomass Consumption Value (tonnes/ha)	Combustion Factor (Cf)	Wildfire CO2 Emission Factor (tonnes CO2/tonne fuel)	Wildfire CH4 Emission Factor (tonnes CH4/tonne fuel) Vol. 4 Tb 2.5	Wildfire N2O Emission Factor (tonnes N2O/tonne fuel) Vol. 4 Tb 2.5
Ecological Zone	Gw	Gw	Bw	Bw	R	CF	fd	fd	Mb*Cf		Gef	Gef	Gef
Tropical America rainforest	7.0	15.0	300	150	0.37	0.47	10%	55%	72	0.32	1.58	0.0068	0.00020
Tropical America moist deciduous forest	5.0	10.0	180	120	0.2	0.47	10%	55%	72	0.32	1.58	0.0068	0.00020
Tropical America dry forest	2.4	8.0	130	60	0.28	0.47	10%	55%	72	0.32	1.58	0.0068	0.00020
Tropical America shrubland	1.0	5.0	70	30	0.4	0.47	10%	55%	72	0.72	1.58	0.0068	0.00020
Tropical America mountain systems	1.0	5.0	140	90	0.27	0.47	10%	55%	72	0.32	1.58	0.0068	0.00020
Tropical Rainforest Americas Pinus			300			0.47	10%	55%	72	0.32	1.58	0.0047	0.00026
Tropical Rainforest Americas other broadleaf			150			0.47	10%	55%	72	0.32	1.58	0.0047	0.00026
Tropical moist deciduous Americas Pinus			270			0.47	10%	55%	72	0.5	1.58	0.0047	0.00026
Tropical moist deciduous Americas other broadleaf			100			0.47	10%	55%	72	0.5	1.58	0.0047	0.00026

2006 IPCC, Citation 3

Biomass Expansion Factor (BEF)	tonnes biomass/tonnes merchantable timber
Fuelwood	1.74
Wood Products	1.74
Citation 24	

Fate of Land Clearing Debris

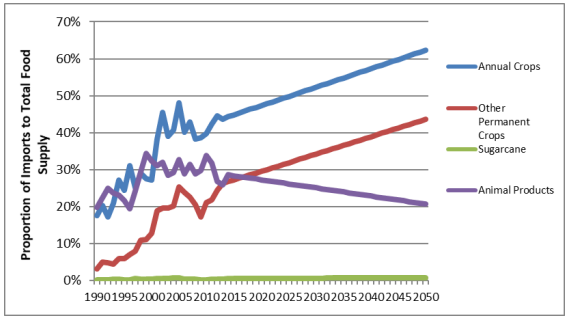
Forest Type	Burned On-site (%)	Used for Fuel Wood (%)	Used for Wood Products (%)	Left on Forest Floor (%)
Bosque Seco (Dry Forest)	3%	40%	0%	57%
Bosque Montano Seco (Dry Mountain Forest)	3%	40%	0%	57%

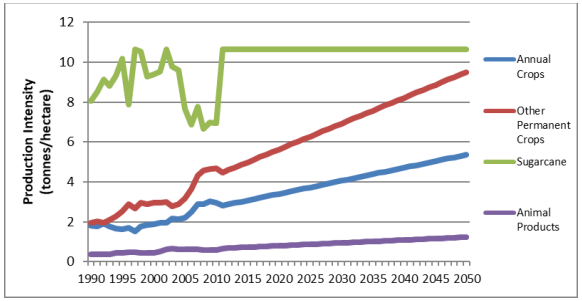
5. Cropland Carbon | 6. Settlements | 7. Emission Factors | 8. Emissions | 9. Direct Emissions Sumn ...

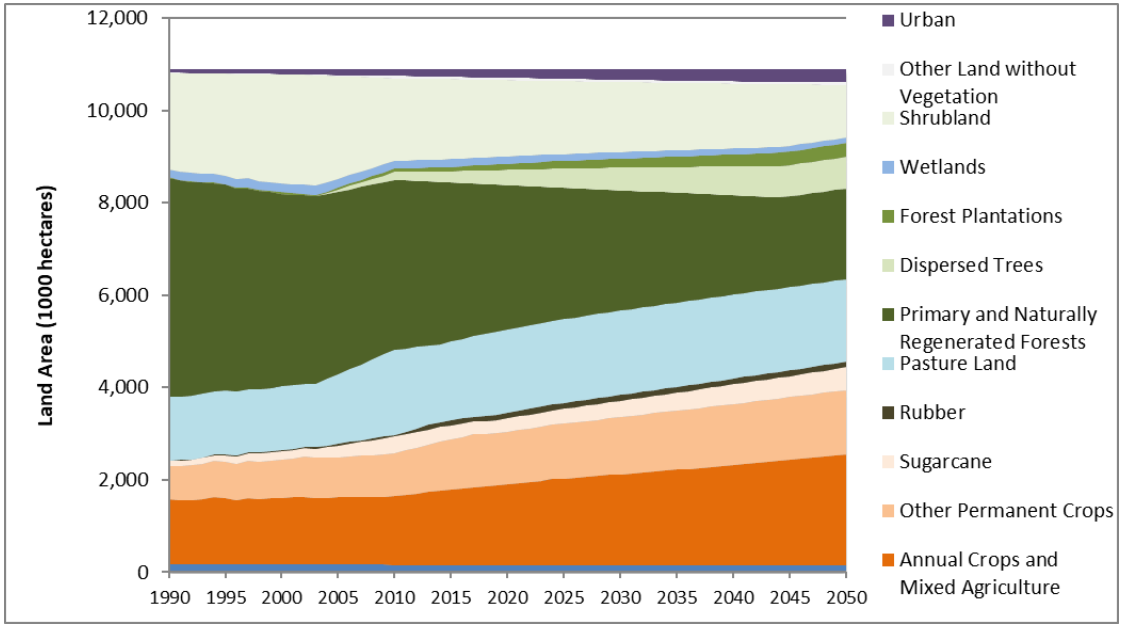
Agriculture, Forestry & Other Land Use (AFOLU) Baseline Module: Application Steps for FOLU

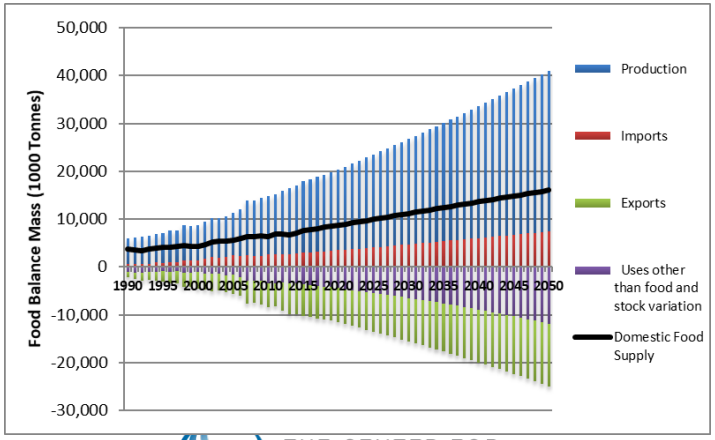
4. Review summaries of activity data that drive land use change and emissions.

	2003	2010	2020	2030	2040	2050
People/1000 ha	Historic Data		Forecasted Values			
	47.5	49.5	52.4	55.9	59.9	64.5









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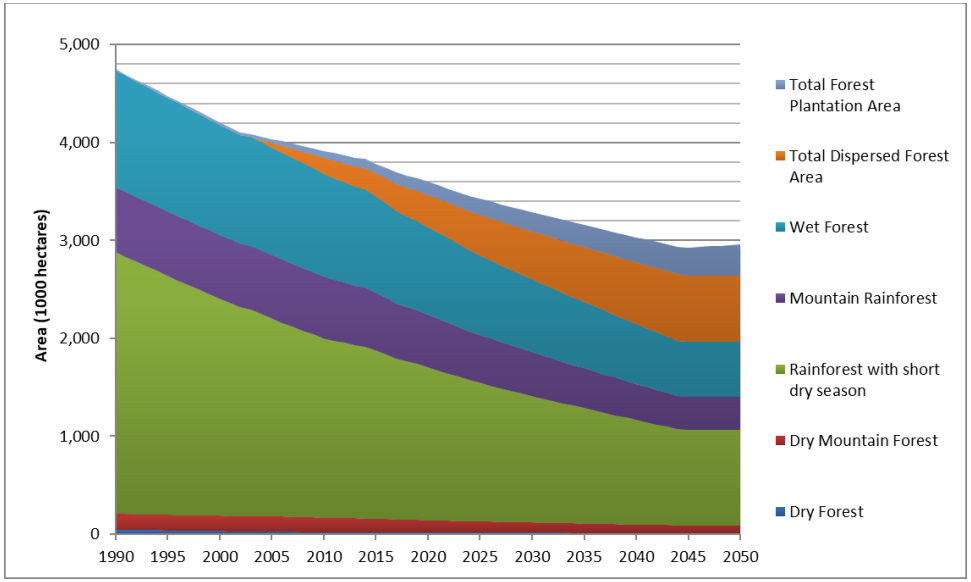
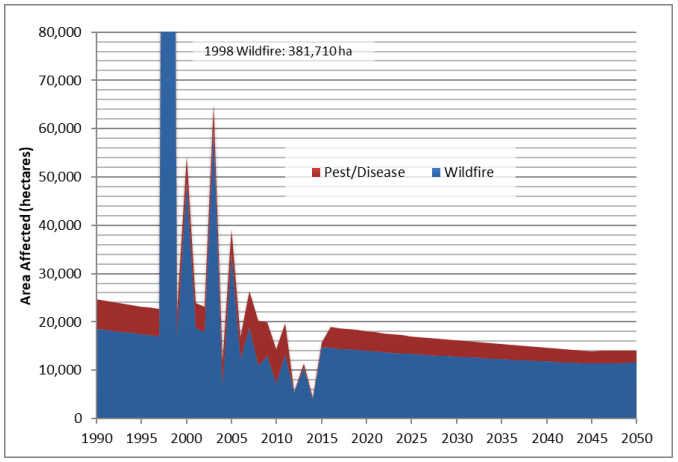
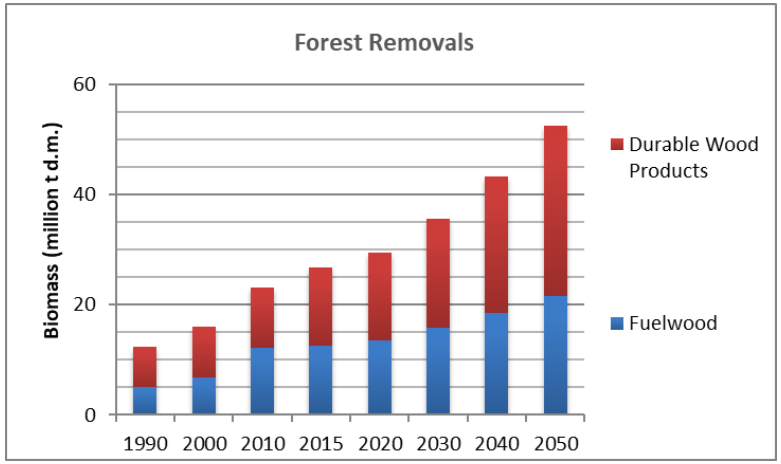
Agriculture, Forestry & Other Land Use (AFOLU) Baseline Module: Application Steps for FOLU

4 (continued). Review summaries of activity data that drive land use change, forest degradation, and emissions.

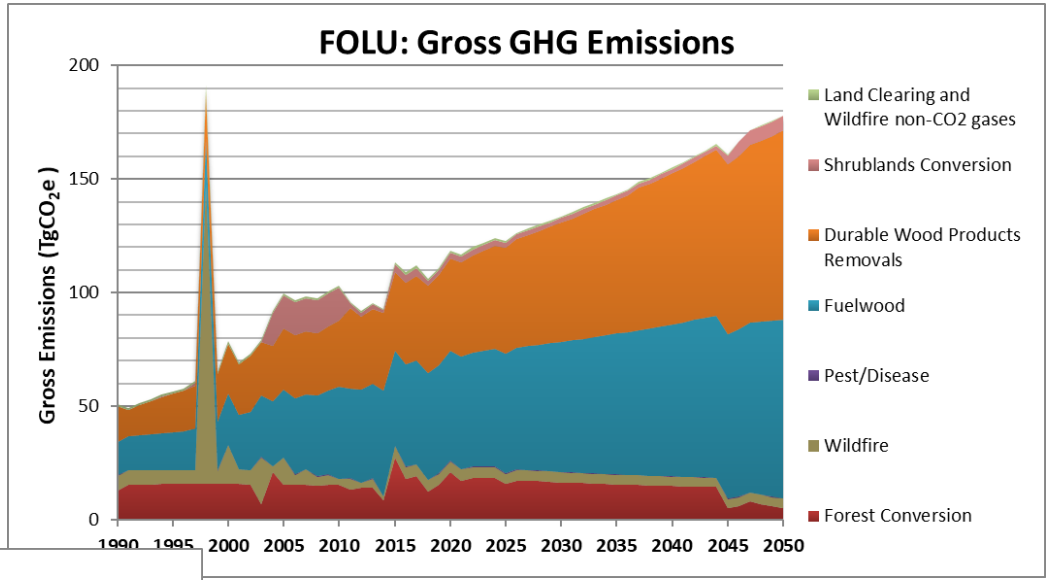


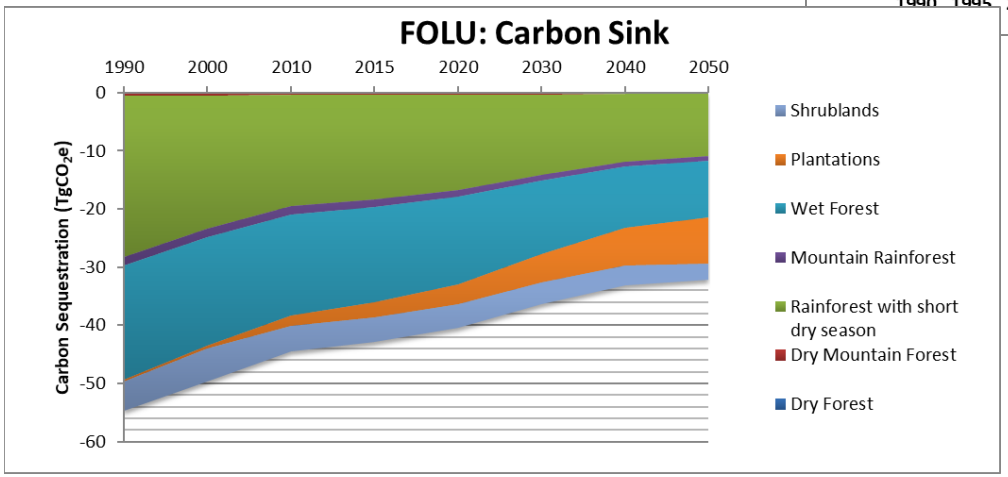




Agriculture, Forestry & Other Land Use (AFOLU) Baseline Module: Application Steps for FOLU

5. Review summaries of FOLU sector GHG emissions and sinks.





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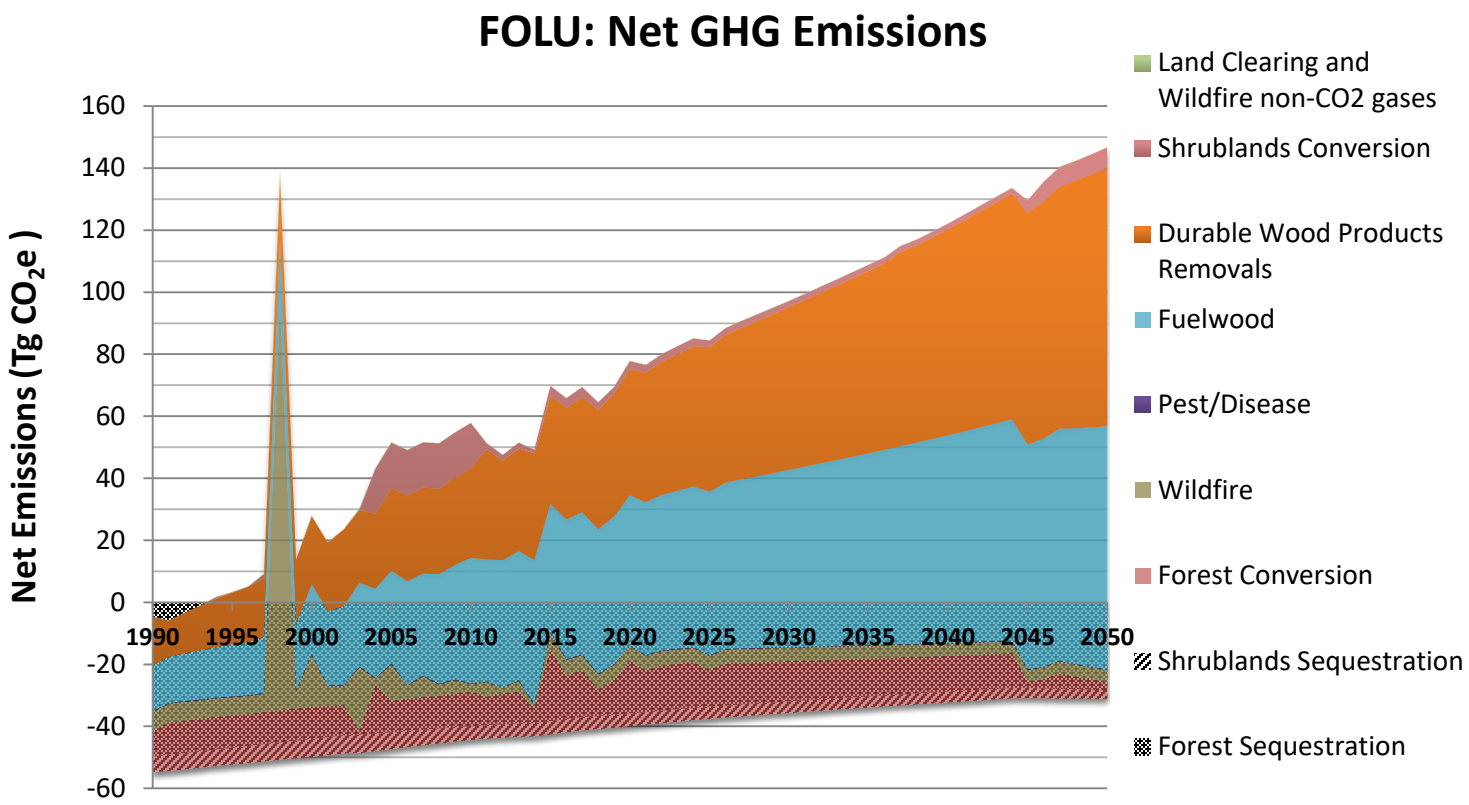
Agriculture, Forestry & Other Land Use (AFOLU) Baseline Module: Application Steps for FOLU

6. Review net summary of FOLU sector emissions (i.e. sources plus sinks).



Agriculture, Forestry & Other Land Use (AFOLU) Baseline Module: Application Steps for FOLU

7. Review the detailed emissions summary.
8. Export these data to the Synthesis Module for construction of the economy-wide baseline.

	A	B	C	D	E	F	G
144							
145	**8.4.2. Forest Land Use Change**	**Units**	**1990**	**1991**	**1992**	**1993**	**1994**
146	**Forest Conversion Total**	***sum tCO2 biogenic***	***13,012,547***	***15,427,966***	***15,515,288***	***15,560,809***	***15,601,580***
147	**Land Clearing Burning**	***sum tCO2 biogenic***	***6,776,541***	***6,776,541***	***6,769,509***	***6,762,631***	***6,755,752***
148	Bosque Seco (Dry Forest)	*tCO2 biogenic*	*10,311*	*10,311*	*10,151*	*9,992*	*9,832*
149	Bosque Montano Seco (Dry Mountain Forest)	*tCO2 biogenic*	*1,910*	*1,910*	*2,184*	*2,459*	*2,733*
150	Bosque Húmedo con estación seca corta (Rainforest with short dry season)	*tCO2 biogenic*	*5,602,955*	*5,602,955*	*5,557,593*	*5,512,230*	*5,466,868*
151	Bosque Montano Húmedo (Mountain Rainforest)	*tCO2 biogenic*	*-*	*-*	*1,165*	*2,483*	*3,802*
152	Bosque muy Húmedo (Wet Forest)	*tCO2 biogenic*	*1,161,365*	*1,161,365*	*1,198,416*	*1,235,467*	*1,272,518*
153	Plantations	*tCO2 biogenic*	*-*	*-*	*-*	*-*	*-*
154	***Dead Organic Carbon Decay***	***tCO2 biogenic***	***6,236,006***	***8,651,425***	***8,745,779***	***8,798,178***	***8,845,828***
155							
156	***Land Clearing Burning Emissions - tonnes CH4***	**Units**	**1990**	**1991**	**1992**	**1993**	**1994**
157	***Total CH4***	***sum tCH4***	**26739**	**26739**	**26711**	**26684**	**26657**
158	Bosque Seco (Dry Forest)	tCH4	40.7	40.7	40.1	39.4	38.8
159	Bosque Montano Seco (Dry Mountain Forest)	tCH4	7.5	7.5	8.6	9.7	10.8
160	Bosque Húmedo con estación seca corta (Rainforest with short dry season)	tCH4	22108.4	22108.4	21929.4	21750.4	21571.4
161	Bosque Montano Húmedo (Mountain Rainforest)	tCH4	0.0	0.0	4.6	9.8	15.0
162	Bosque muy Húmedo (Wet Forest)	tCH4	4582.6	4582.6	4728.8	4875.0	5021.2
163	*Total Forest Plantations*	tCH4	0.0	0.0	0.0	0.0	0.0
164							
165	***Land Clearing Burning Emissions - tonnes N2O***	**Units**	**1990**	**1991**	**1992**	**1993**	**1994**
166	**Total N2O**	***sum tN2O***	**826.88**	**826.88**	**827.39**	**827.93**	**828.47**
167	Bosque Seco (Dry Forest)	tN2O	1.20	1.20	1.18	1.16	1.14
168	Bosque Montano Seco (Dry Mountain Forest)	tN2O	0.22	0.22	0.25	0.29	0.32
169	Bosque Húmedo con estación seca corta (Rainforest with short dry season)	tN2O	650.25	650.25	644.98	639.72	634.45
170	Bosque Montano Húmedo (Mountain Rainforest)	tN2O	0.00	0.00	0.18	0.37	0.57

... 6. Settlements | 7. Emission Factors | 8. Emissions | 9. Direct Emissions Summary | 10. Consumpt ...

LCD/LEDS Tool Example: Synthesis Module

- Brief overview
- More detailed demonstrations can be scheduled via webinar or during workshops

Synthesis Module: Assembly of Economy-Wide Emissions Summaries

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LOW EMISSIONS DEVELOPMENT PLANNING SYSTEM: SYNTHESIS MODULE

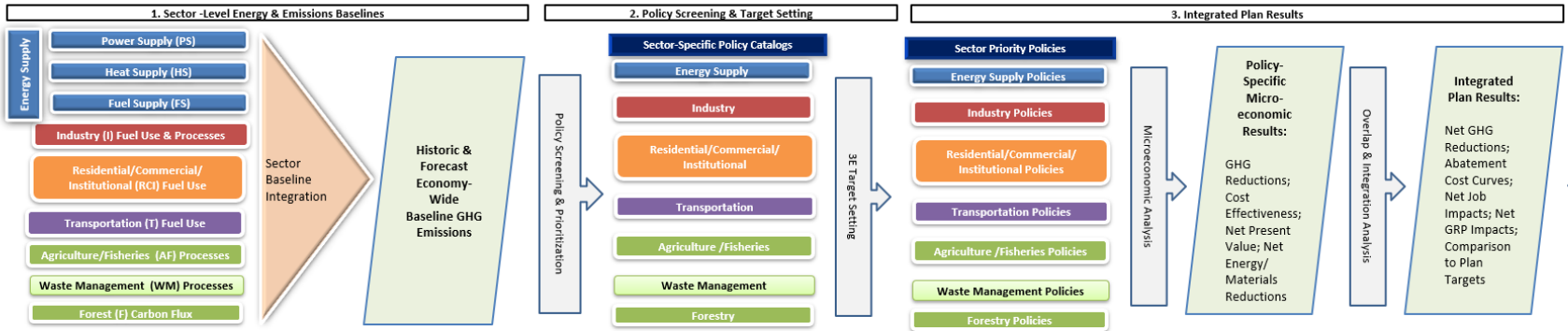
This module serves multiple purposes for low carbon development planning, including baseline integration and summarization, emission reduction target setting, and integration of microeconomic analysis results for low carbon development plan policies. There are 3 components in the "Synthesis Module":

- **Component 1. Energy & Emissions Baseline:** here the module aggregates, summarizes and reports baseline historical and forecasted greenhouse gas (GHG) emissions from all source/sink sectors and seven GHGs. Nine emissions input sheets (E1-E10) are provided by the respective sector I&F modules for use in constructing the integrated baseline emissions. Results are shown in sheets B1-B11. The summary shown in sheet B1 (IPCC Time Series Table) provides the baseline using the inventory structure for national reporting under the United Nations Framework Convention on Climate Change (UNFCCC) requirements as developed by the Intergovernmental Panel on Climate Change (IPCC). It is used here as a basis for comparison to national inventory reports. Sheet B2 (Sector Time Series Table) provides the integrated baseline in a format more useful for LEDS planning (e.g. energy consumption and emissions are allocated more clearly to each sector of the economy). This subnational planning structure is used throughout the rest of the planning system. Subsequent sheets (B3-B11) provide additional data summaries and comparisons for reporting and analysis purposes. Additional baseline data (economic, population, land use, renewable energy, etc.) are provided in the I2. Common Forecast Data sheet (this sheet is also used in subsequent phases of LEDS planning, including direct and indirect impacts assessments of LEDS policies).

- **Component 2. Policy Screening & Target Setting:** In the second section (currently under development), the module compares baseline emissions against possible future emissions targets and provides screening-level assessments for GHG reductions and economic impacts for policies chosen for further detailed analysis. This component uses the baseline data from Component 1 and the sector catalogs of low carbon development actions to conduct screening-level assessments of GHG reductions and potential costs/cost savings. These screening-level assessments provide an initial sense of whether selected policies are sufficient to meet a pre-defined GHG reduction goal (or what type of goals could be considered) and whether the suite of selected policies trends towards combined costs that are high, neutral, or negative (cost savings).

- **Component 3. Integrated Plan Results:** The third section (currently under development) aggregates the micro-economic analysis results of planned low carbon development policies and compares these to the selected future targets. Marginal GHG abatement cost curves are also produced for the selected and quantified low carbon development policies.

The Citations sheet provides references and weblinks to all data sources utilized by the Synthesis Module. A Look-Up Data sheet provides common conversion factors and other supporting data for use by the module (e.g. global warming potentials, provincial renewable energy potential, etc).



Worksheet Title	Description
Overview	Introduction to this Module.
Section 1. Baseline Data	
I1. Comparison Emissions Data	Global or regional GHG emissions data used to develop comparisons to Guatemala.

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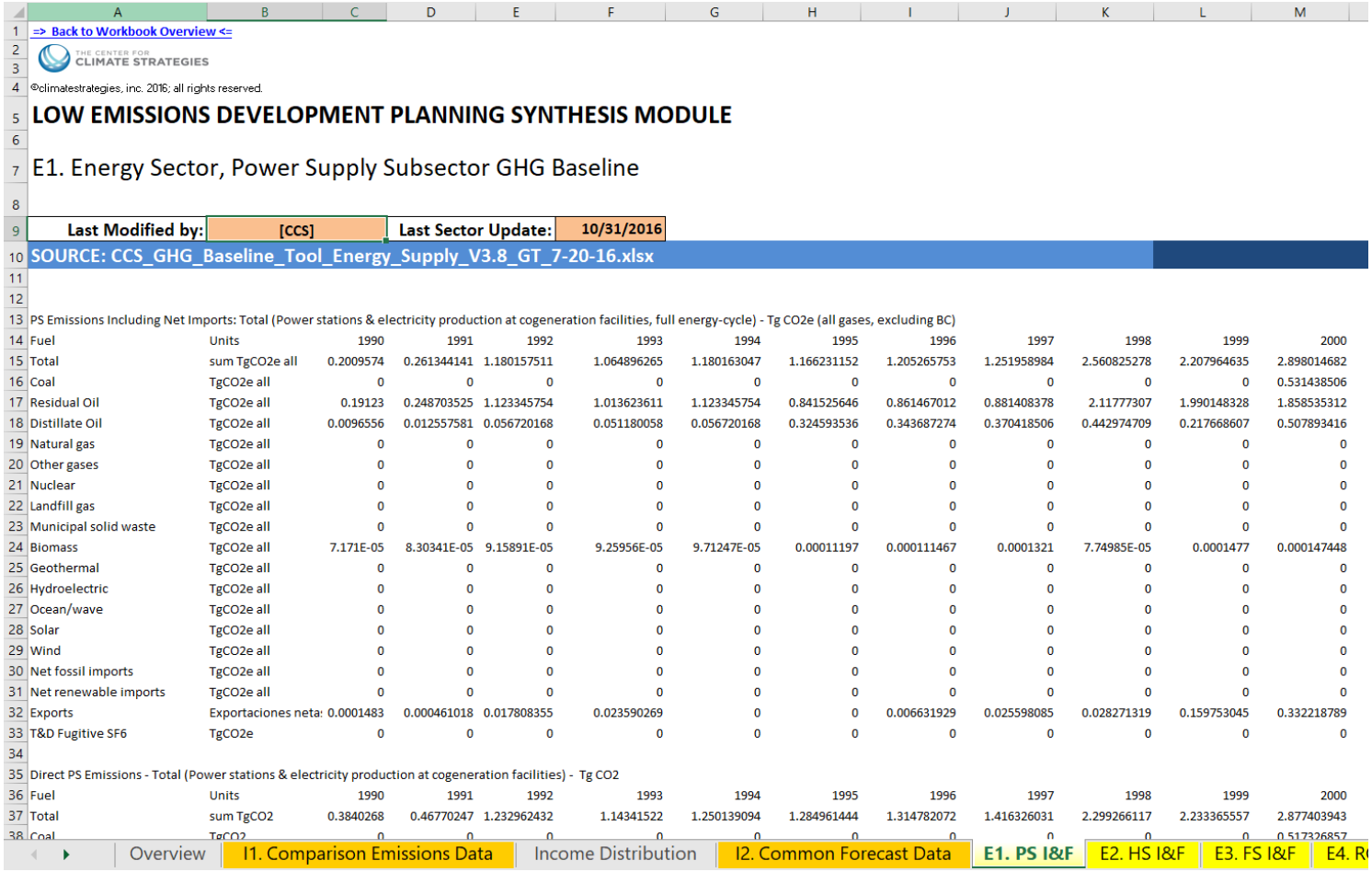
Synthesis Module: Assembly of Economy-Wide Emissions Summaries



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LOW EMISSIONS DEVELOPMENT PLANNING SYNTHESIS MODULE

E1. Energy Sector, Power Supply Subsector GHG Baseline

Last Modified by:	[CCS]	Last Sector Update:	10/31/2016

SOURCE: CCS_GHG_Baseline_Tool_Energy_Supply_V3.8_GT_7-20-16.xlsx

PS Emissions Including Net Imports: Total (Power stations & electricity production at cogeneration facilities, full energy-cycle) - Tg CO2e (all gases, excluding BC)

Fuel	Units	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total	sum TgCO2e all	0.2009574	0.261344141	1.180157511	1.064896265	1.180163047	1.166231152	1.205265753	1.251958984	2.560825278	2.207964635	2.898014682
Coal	TgCO2e all	0	0	0	0	0	0	0	0	0	0	0.531438506
Residual Oil	TgCO2e all	0.19123	0.248703525	1.123345754	1.013623611	1.123345754	0.841525646	0.861467012	0.881408378	2.11777307	1.990148328	1.858535312
Distillate Oil	TgCO2e all	0.0096556	0.012557581	0.056720168	0.051180058	0.056720168	0.324593536	0.343687274	0.370418506	0.442974709	0.217668607	0.507893416
Natural gas	TgCO2e all	0	0	0	0	0	0	0	0	0	0	0
Other gases	TgCO2e all	0	0	0	0	0	0	0	0	0	0	0
Nuclear	TgCO2e all	0	0	0	0	0	0	0	0	0	0	0
Landfill gas	TgCO2e all	0	0	0	0	0	0	0	0	0	0	0
Municipal solid waste	TgCO2e all	0	0	0	0	0	0	0	0	0	0	0
Biomass	TgCO2e all	7.171E-05	8.30341E-05	9.15891E-05	9.25956E-05	9.71247E-05	0.00011197	0.000111467	0.0001321	7.74985E-05	0.0001477	0.000147448
Geothermal	TgCO2e all	0	0	0	0	0	0	0	0	0	0	0
Hydroelectric	TgCO2e all	0	0	0	0	0	0	0	0	0	0	0
Ocean/wave	TgCO2e all	0	0	0	0	0	0	0	0	0	0	0
Solar	TgCO2e all	0	0	0	0	0	0	0	0	0	0	0
Wind	TgCO2e all	0	0	0	0	0	0	0	0	0	0	0
Net fossil imports	TgCO2e all	0	0	0	0	0	0	0	0	0	0	0
Net renewable imports	TgCO2e all	0	0	0	0	0	0	0	0	0	0	0
Exports	Exportaciones neta:	0.0001483	0.000461018	0.017808355	0.023590269	0	0	0.006631929	0.025598085	0.028271319	0.159753045	0.332218789
T&D Fugitive SF6	TgCO2e	0	0	0	0	0	0	0	0	0	0	0

Direct PS Emissions - Total (Power stations & electricity production at cogeneration facilities) - Tg CO2

Fuel	Units	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total	sum TgCO2	0.3840268	0.46770247	1.232962432	1.14341522	1.250139094	1.284961444	1.314782072	1.416326031	2.299266117	2.233365557	2.877403943
Coal	TgCO2	0	0	0	0	0	0	0	0	0	0	0.517326857

Overview | I1. Comparison Emissions Data | Income Distribution | I2. Common Forecast Data | E1. PS I&F | E2. HS I&F | E3. FS I&F | E4. R

1. Input the detailed results from each sector baseline module into the yellow-tabbed entry sheets of the Synthesis Module.

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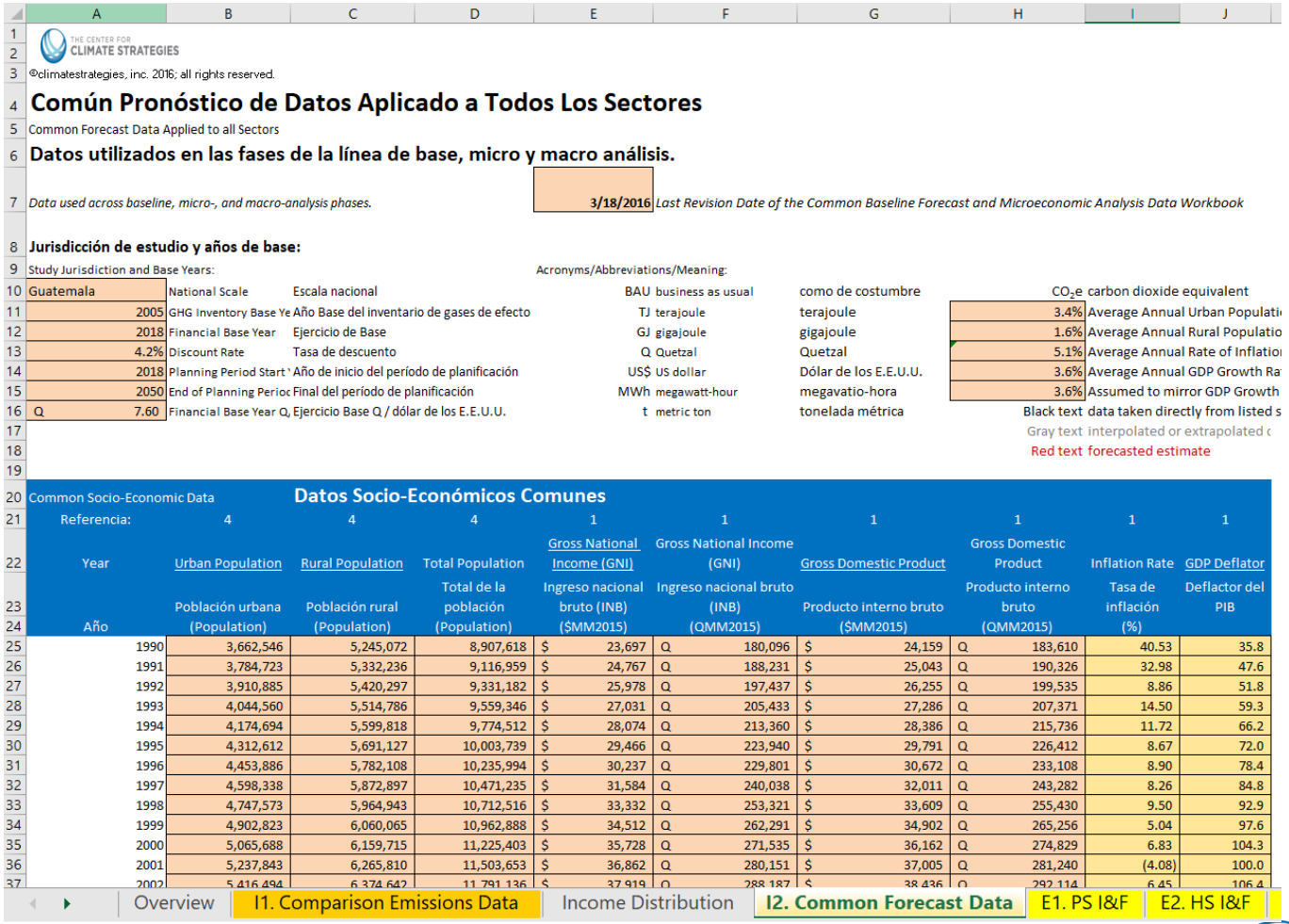
Synthesis Module: Assembly of Economy-Wide Emissions Summaries



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Común Pronóstico de Datos Aplicado a Todos Los Sectores

Common Forecast Data Applied to all Sectors

Datos utilizados en las fases de la línea de base, micro y macro análisis.

Data used across baseline, micro-, and macro-analysis phases. 3/18/2016 *Last Revision Date of the Common Baseline Forecast and Microeconomic Analysis Data Workbook*

Jurisdicción de estudio y años de base:

Study Jurisdiction and Base Years:

Guatemala	National Scale	Escala nacional	
2005	GHG Inventory Base Ye	Año Base del inventario de gases de efecto	
2018	Financial Base Year	Ejercicio de Base	
4.2%	Discount Rate	Tasa de descuento	
2018	Planning Period Start '	Año de inicio del período de planificación	
2050	End of Planning Perioc	Final del período de planificación	
Q 7.60	Financial Base Year Q,	Ejercicio Base Q / dólar de los E.E.U.U.	

Acronyms/Abbreviations/Meaning:

BAU	business as usual	como de costumbre
TJ	terajoule	terajoule
GJ	gigajoule	gigajoule
Q	Quetzal	Quetzal
US$	US dollar	Dólar de los E.E.U.U.
MWh	megawatt-hour	megavatio-hora
t	metric ton	tonelada métrica

CO_2e	carbon dioxide equivalent
3.4%	Average Annual Urban Populati
1.6%	Average Annual Rural Populatio
5.1%	Average Annual Rate of Inflatio
3.6%	Average Annual GDP Growth Ra
3.6%	Assumed to mirror GDP Growth
Black text	data taken directly from listed s
Gray text	interpolated or extrapolated c
Red text	forecasted estimate

Common Socio-Economic Data — **Datos Socio-Económicos Comunes**

Referencia:	4	4	4	1	1	1	1	1	1
Year / Año	Urban Population / Población urbana (Population)	Rural Population / Población rural (Population)	Total Population / Total de la población (Population)	Gross National Income (GNI) / Ingreso nacional bruto (INB) ($MM2015)	Gross National Income (GNI) / Ingreso nacional bruto (INB) (QMM2015)	Gross Domestic Product / Producto interno bruto ($MM2015)	Gross Domestic Product / Producto interno bruto (QMM2015)	Inflation Rate / Tasa de inflación (%)	GDP Deflator / Deflactor del PIB
1990	3,662,546	5,245,072	8,907,618	$ 23,697	Q 180,096	$ 24,159	Q 183,610	40.53	35.8
1991	3,784,723	5,332,236	9,116,959	$ 24,767	Q 188,231	$ 25,043	Q 190,326	32.98	47.6
1992	3,910,885	5,420,297	9,331,182	$ 25,978	Q 197,437	$ 26,255	Q 199,535	8.86	51.8
1993	4,044,560	5,514,786	9,559,346	$ 27,031	Q 205,433	$ 27,286	Q 207,371	14.50	59.3
1994	4,174,694	5,599,818	9,774,512	$ 28,074	Q 213,360	$ 28,386	Q 215,736	11.72	66.2
1995	4,312,612	5,691,127	10,003,739	$ 29,466	Q 223,940	$ 29,791	Q 226,412	8.67	72.0
1996	4,453,886	5,782,108	10,235,994	$ 30,237	Q 229,801	$ 30,672	Q 233,108	8.90	78.4
1997	4,598,338	5,872,897	10,471,235	$ 31,584	Q 240,038	$ 32,011	Q 243,282	8.26	84.8
1998	4,747,573	5,964,943	10,712,516	$ 33,332	Q 253,321	$ 33,609	Q 255,430	9.50	92.9
1999	4,902,823	6,060,065	10,962,888	$ 34,512	Q 262,291	$ 34,902	Q 265,256	5.04	97.6
2000	5,065,688	6,159,715	11,225,403	$ 35,728	Q 271,535	$ 36,162	Q 274,829	6.83	104.3
2001	5,237,843	6,265,810	11,503,653	$ 36,862	Q 280,151	$ 37,005	Q 281,240	(4.08)	100.0
2002	5,416,494	6,374,642	11,791,136	$ 37,919	Q 288,187	$ 38,436	Q 292,114	6.45	106.4

Overview | I1. Comparison Emissions Data | Income Distribution | I2. Common Forecast Data | E1. PS I&F | E2. HS I&F

2. Assemble and input socio-economic data for developing baseline carbon intensity metrics.

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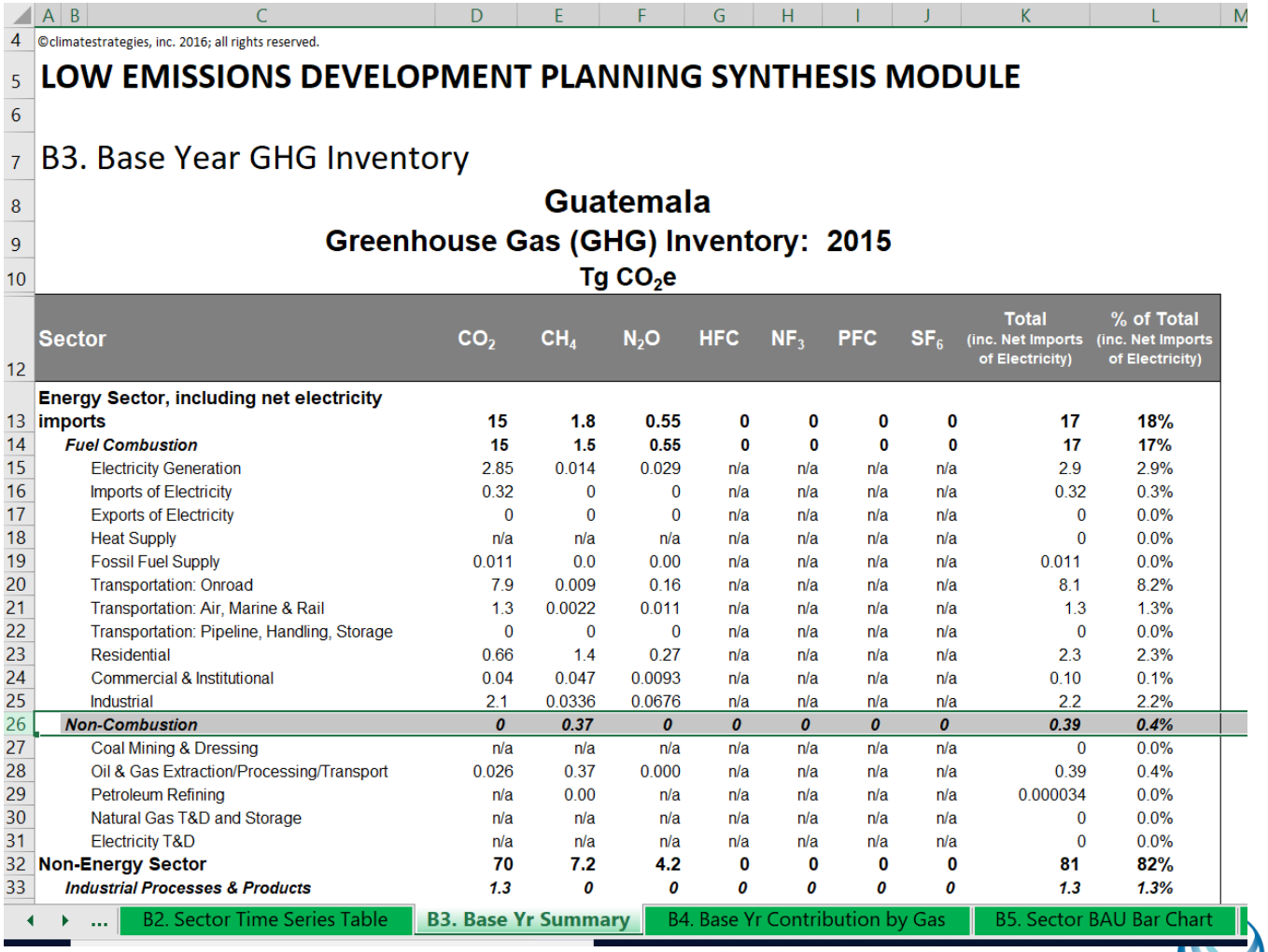


LOW EMISSIONS DEVELOPMENT PLANNING SYNTHESIS MODULE

B3. Base Year GHG Inventory

Guatemala

Greenhouse Gas (GHG) Inventory: 2015

Tg CO_2e

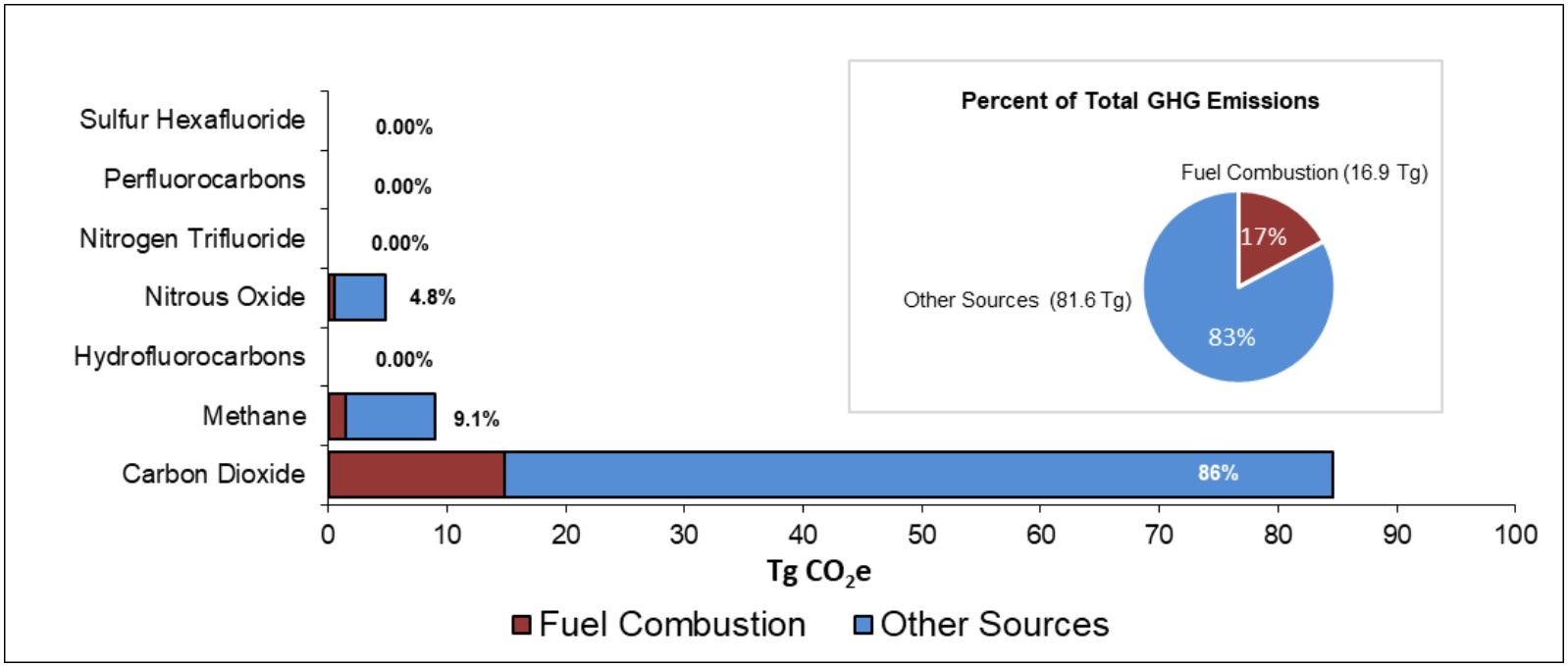
Sector	CO_2	CH_4	N_2O	HFC	NF_3	PFC	SF_6	Total (inc. Net Imports of Electricity)	% of Total (inc. Net Imports of Electricity)
Energy Sector, including net electricity imports	**15**	**1.8**	**0.55**	**0**	**0**	**0**	**0**	**17**	**18%**
Fuel Combustion	**15**	**1.5**	**0.55**	**0**	**0**	**0**	**0**	**17**	**17%**
Electricity Generation	2.85	0.014	0.029	n/a	n/a	n/a	n/a	2.9	2.9%
Imports of Electricity	0.32	0	0	n/a	n/a	n/a	n/a	0.32	0.3%
Exports of Electricity	0	0	0	n/a	n/a	n/a	n/a	0	0.0%
Heat Supply	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	0.0%
Fossil Fuel Supply	0.011	0.0	0.00	n/a	n/a	n/a	n/a	0.011	0.0%
Transportation: Onroad	7.9	0.009	0.16	n/a	n/a	n/a	n/a	8.1	8.2%
Transportation: Air, Marine & Rail	1.3	0.0022	0.011	n/a	n/a	n/a	n/a	1.3	1.3%
Transportation: Pipeline, Handling, Storage	0	0	0	n/a	n/a	n/a	n/a	0	0.0%
Residential	0.66	1.4	0.27	n/a	n/a	n/a	n/a	2.3	2.3%
Commercial & Institutional	0.04	0.047	0.0093	n/a	n/a	n/a	n/a	0.10	0.1%
Industrial	2.1	0.0336	0.0676	n/a	n/a	n/a	n/a	2.2	2.2%
Non-Combustion	***0***	***0.37***	***0***	***0***	***0***	***0***	***0***	***0.39***	***0.4%***
Coal Mining & Dressing	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	0.0%
Oil & Gas Extraction/Processing/Transport	0.026	0.37	0.000	n/a	n/a	n/a	n/a	0.39	0.4%
Petroleum Refining	n/a	0.00	n/a	n/a	n/a	n/a	n/a	0.000034	0.0%
Natural Gas T&D and Storage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	0.0%
Electricity T&D	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	0.0%
Non-Energy Sector	**70**	**7.2**	**4.2**	**0**	**0**	**0**	**0**	**81**	**82%**
Industrial Processes & Products	***1.3***	***0***	***0***	***0***	***0***	***0***	***0***	***1.3***	***1.3%***

... | B2. Sector Time Series Table | B3. Base Yr Summary | B4. Base Yr Contribution by Gas | B5. Sector BAU Bar Chart

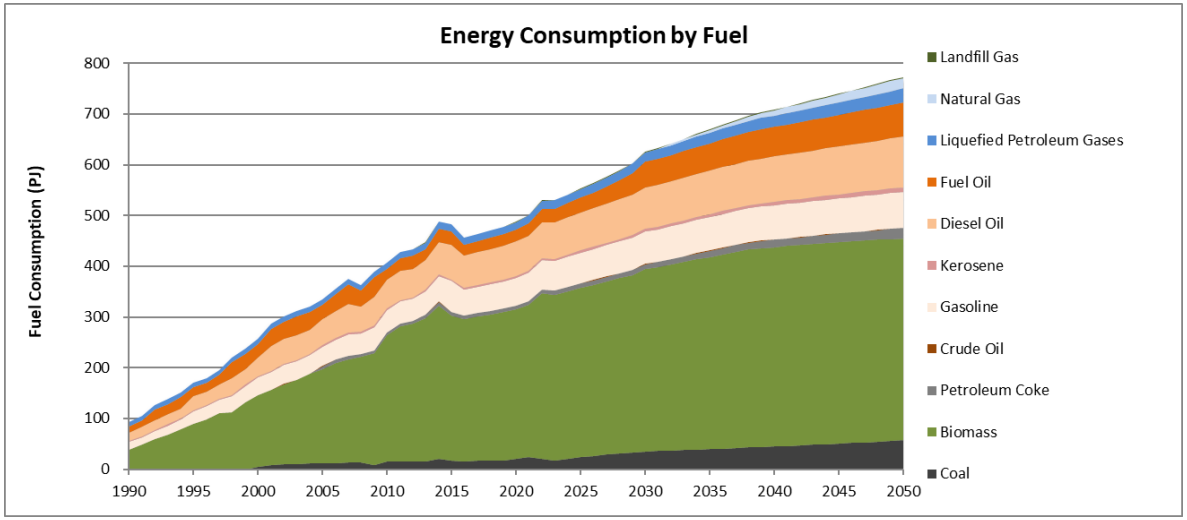
3. Review the economy-wide base year inventory

Synthesis Module: Assembly of Economy-Wide Emissions Summaries

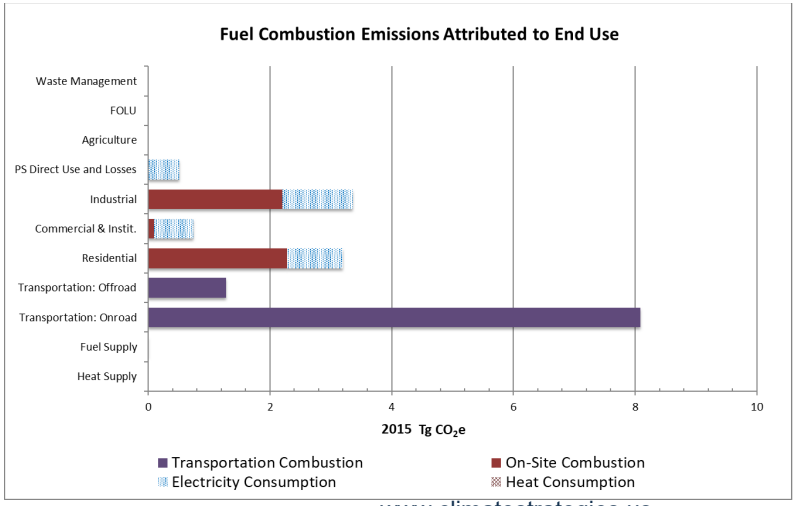
3 (continued). Review the economy-wide base year inventory

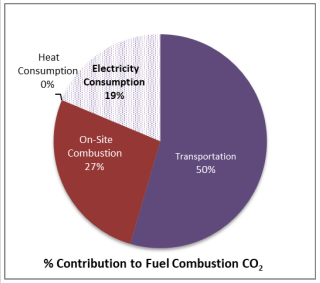


Synthesis Module: Assembly of Economy-Wide Emissions Summaries

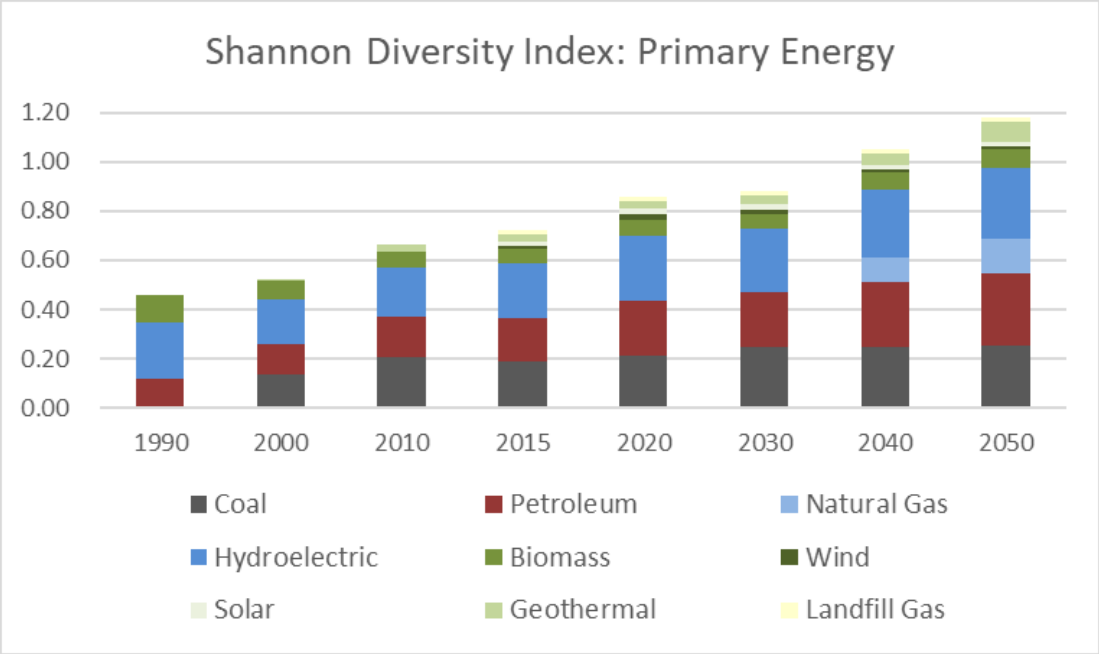


4. Review the other graphical summaries of the economy-wide energy and emissions baselines.



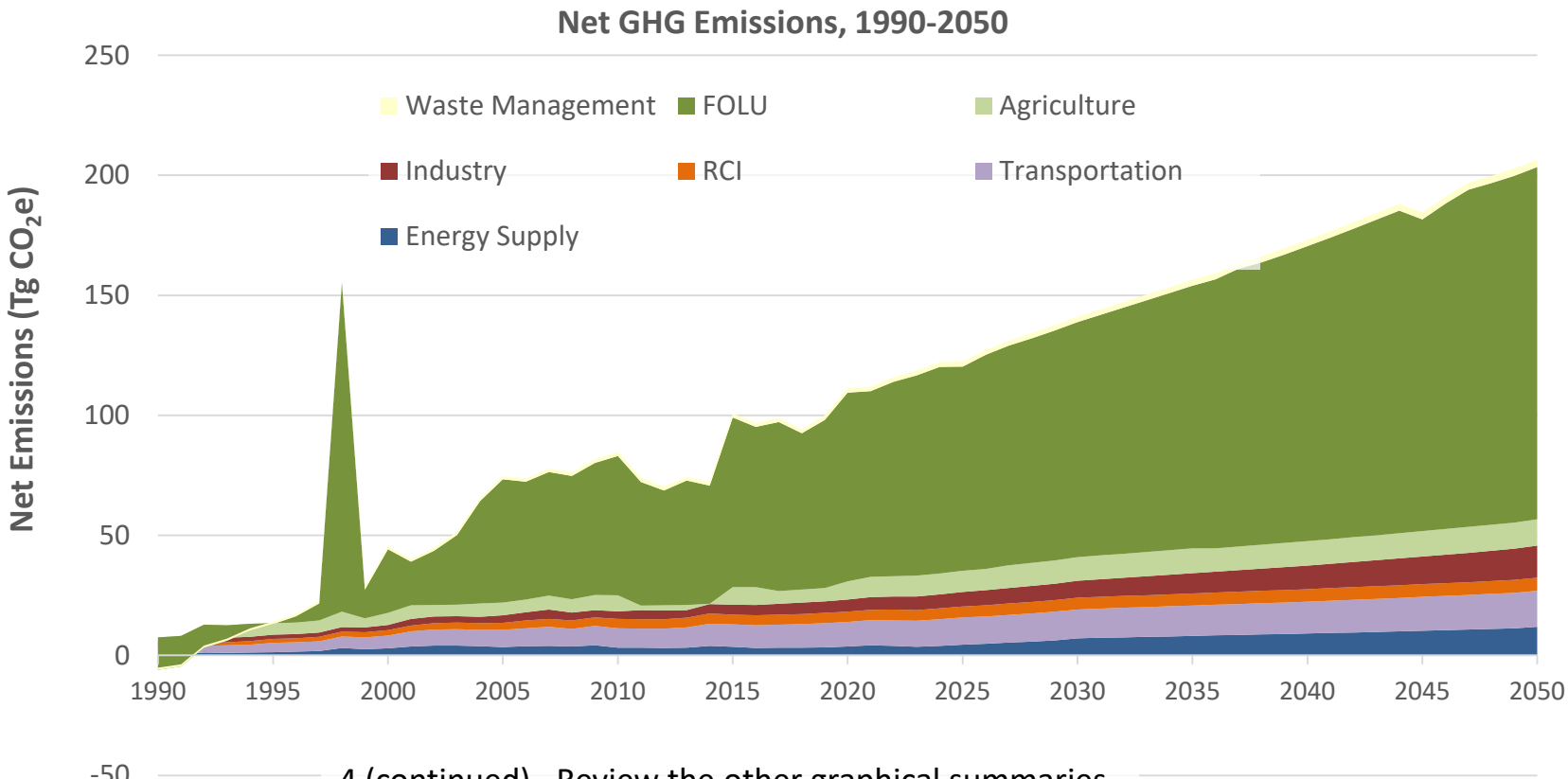


Sample Results:
Economy-Wide Baseline, Synthesis Module



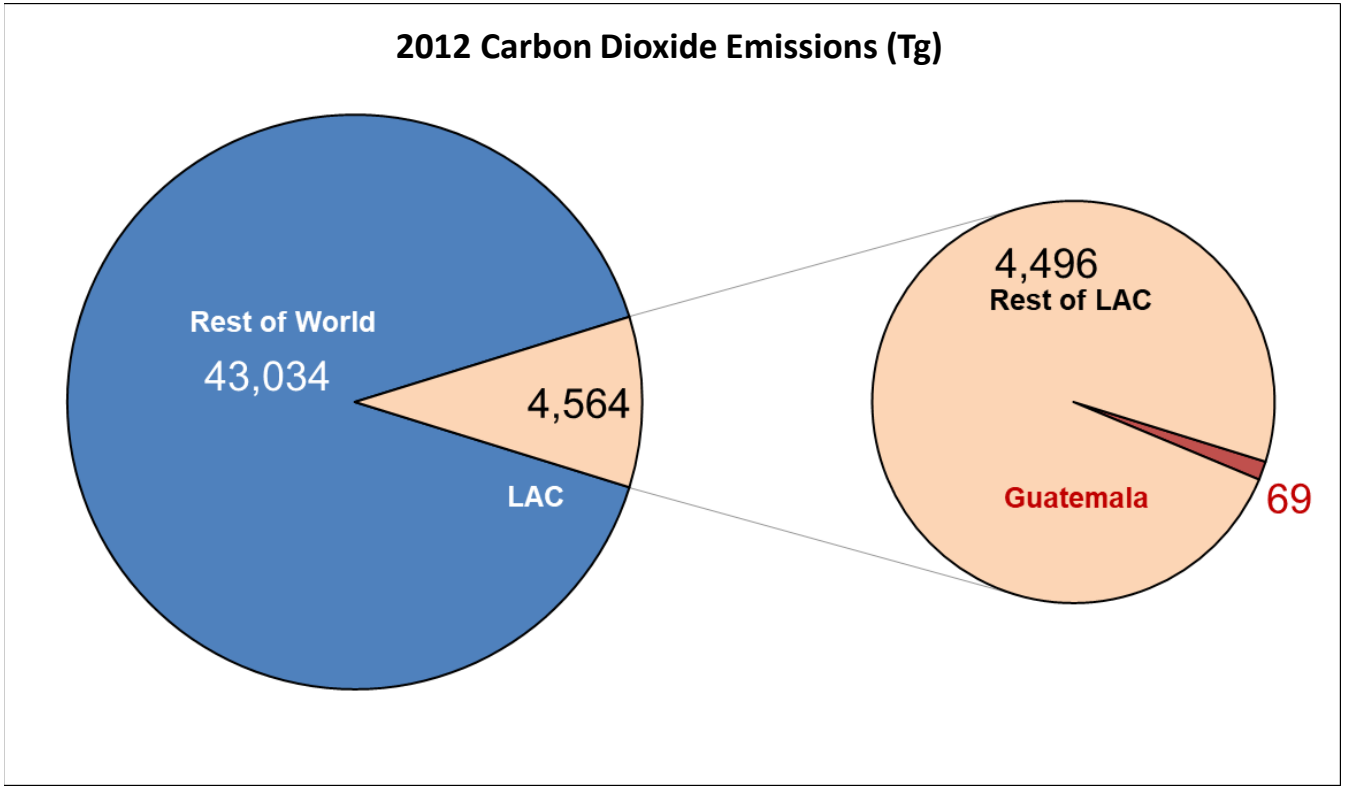
4 (continued). Review the other graphical summaries of the economy-wide energy and emissions baselines. Energy diversity shown here is a metric tied to energy security.

Sample Results:
Economy-Wide Baseline, Synthesis Module



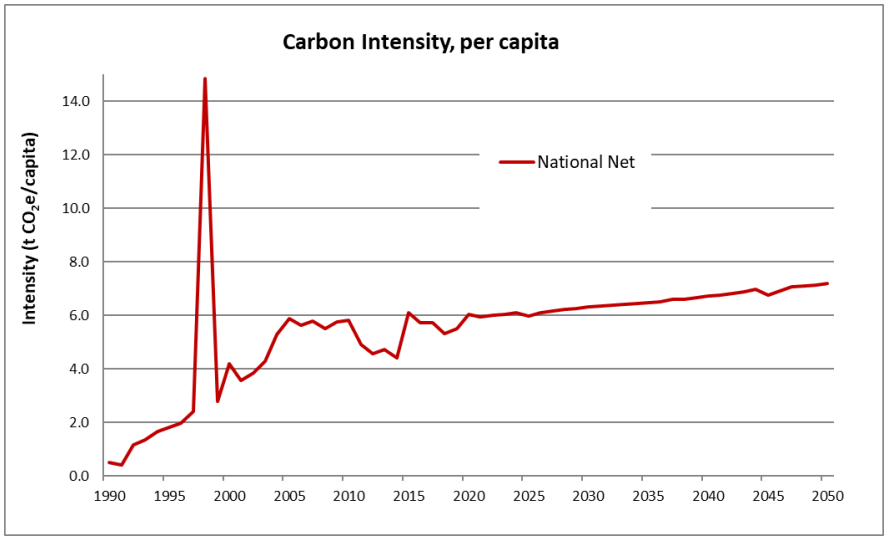
4 (continued). Review the other graphical summaries of the economy-wide energy and emissions baselines.

Sample Results: Economy-Wide Baseline, Synthesis Module

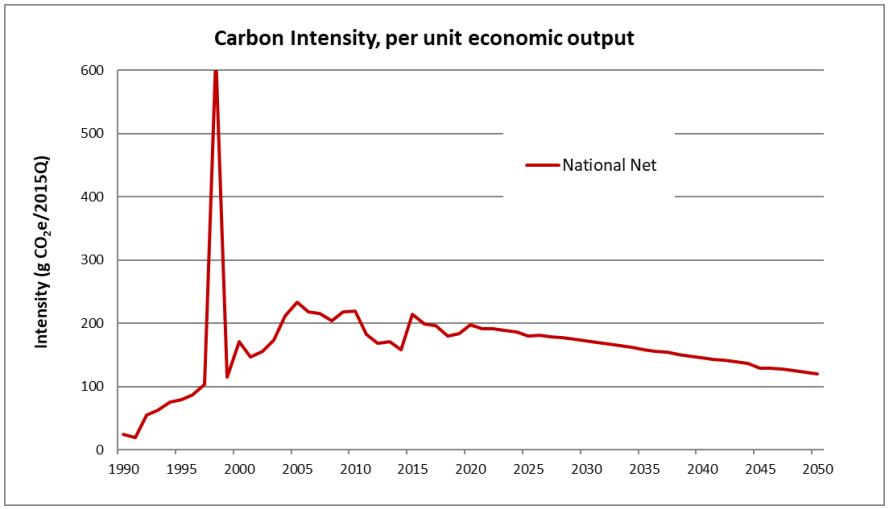


4 (continued). Review the other graphical summaries of the economy-wide energy and emissions baselines.

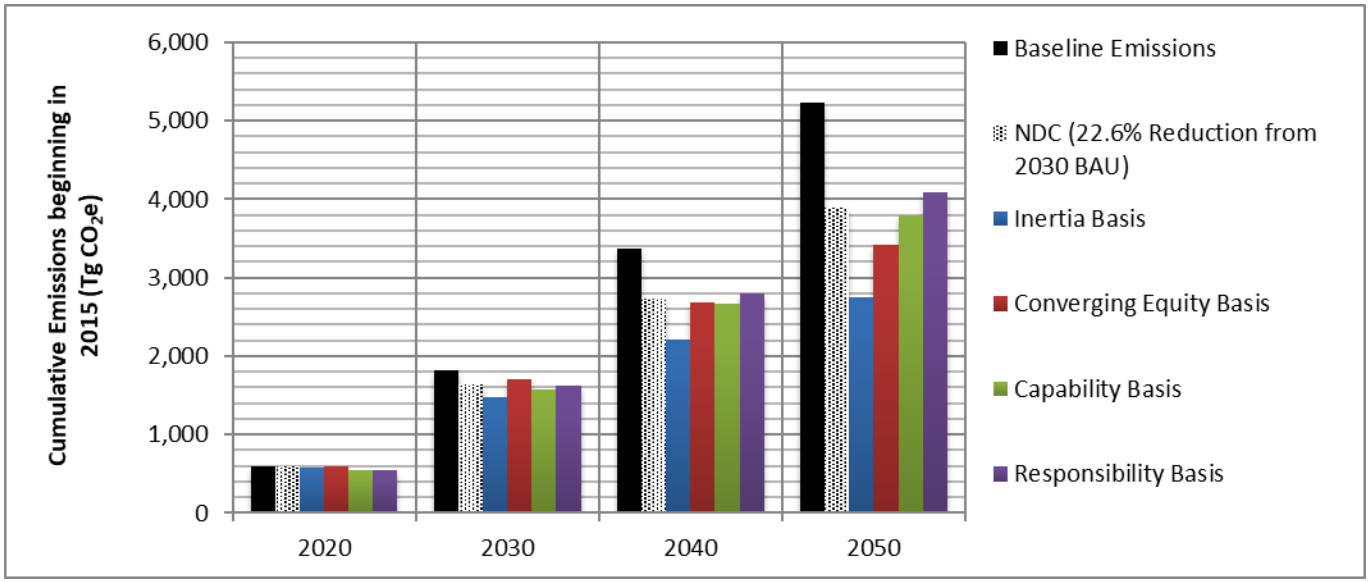
Sample Results:
Economy-Wide Baseline, Synthesis Module



5. Review and report out the previous summaries as well as those indicating emissions intensity for the jurisdiction.



Sample Results:
Economy-Wide Baseline, Synthesis Module



6. Review and compare baseline emissions to other targets, such as a Nationally-Determined Contribution (NDC), or to possible global emissions budget allocations for the jurisdiction. This example indicates that the current NDC is unlikely to meet most global allocation schemes by 2040 or earlier.

Inertia basis also known as "grandfathering", allocates the carbon budget based on the current share of world emissions;
Equity-basis allocates global budget based on population;
Capability-basis allocates global budget based on income of population above threshold income level;
Responsibility-basis allocates global budget based on past cumulative emissions.

LCD/LEDS Tool Example: Micro-Economic (Direct) Impacts

- Brief overview of Sector-Level Tools: a recent Spanish language application is featured in much of this example.
- More detailed demonstrations can be scheduled via webinars or workshops

LCD/LEDS Modeling System Tool Example: Direct Impacts of Ag Sector Policies

Sample summary table showing direct impact metrics for 5 Agricultural policies. These results are shown on a "stand-alone" basis meaning that they have not been adjusted for interactions/overlaps with other policies.

Agriculture Sector - Summary of Benefits and Costs
(2015 - 2030)

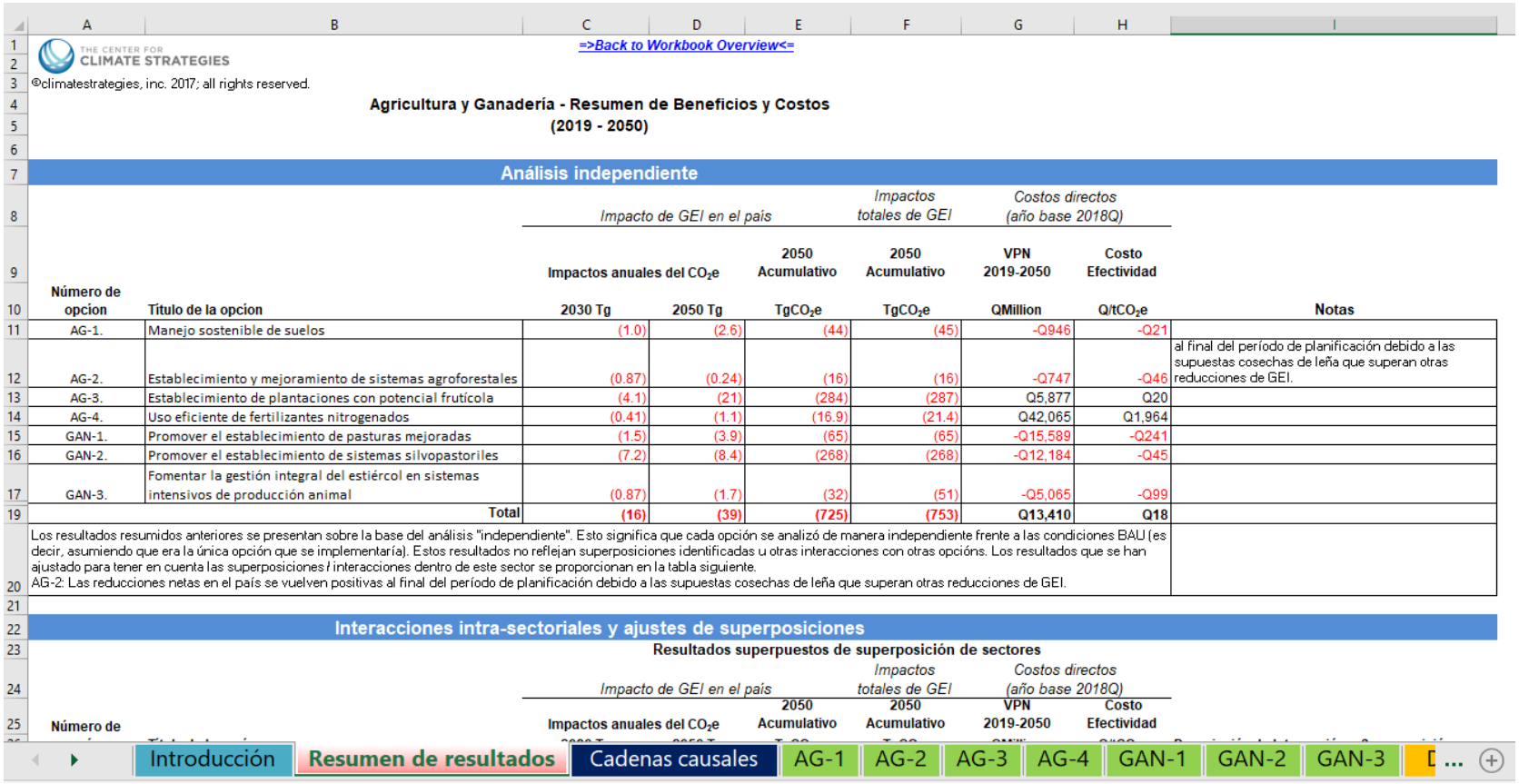
"Stand-Alone" Analysis

		In-State Reductions			*Total*	*Base Year 2014$*		
		Annual CO_2e Reductions		**2030 Cumulative**	**2030 Cumulative**	**NPV 2015-2030**	**Cost Effectiveness**	
Policy ID	**Policy Title**	**2020 Tg**	**2030 Tg**	**$TgCO_2e$**	**$TgCO_2e$**	**$Million**	**$/tCO_2e$**	**Notes**
A-1	Nutrient Management in Agriculture	0.036	0.14	1.1	2.8	($131)	($46)	
A-2	Soil Carbon Management: Increased Use of Cover Crops	0.059	0.49	3.1	3.6	($1,346)	($377)	
A-3	Soil Carbon Management: Increased Conversion of Row Crops to Perennial Crops	0.62	1.6	14	14	($2,104)	($153)	
A-4	Advanced Biofuels Production	*Not Applicable*						Results of this supply-side policy are combined with those from A-5 (demand-side policy)
A-5	Existing Biofuel Statute	0.12	0.17	1.8	3.5	$462	$133	Contains the total net impacts of the A-4/A-5 Biofuels Package.
	Totals	**0.83**	**2.4**	**19**	**24**	**($3,119)**	**($132)**	

Notes: Cost Effectiveness values include full energy-cycle GHG reductions, including those occurring out of State.

Example: Direct Impacts of Ag Policies

Screenshot from the Ag sector microeconomic analysis workbook (Spanish version). This shows the direct impacts for 7 agricultural sector policies (not yet adjusted for policy interactions/overlaps. Analysis of individual options is conducted within each of the light-green tabbed sheets.



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=>Back to Workbook Overview<=

Agricultura y Ganadería - Resumen de Beneficios y Costos (2019 - 2050)

Análisis independiente

		Impacto de GEI en el país			*Impactos totales de GEI*	*Costos directos (año base 2018Q)*		
		Impactos anuales del CO_2e		**2050 Acumulativo**	**2050 Acumulativo**	**VPN 2019-2050**	**Costo Efectividad**	
Número de opción	**Título de la opción**	**2030 Tg**	**2050 Tg**	**$TgCO_2e$**	**$TgCO_2e$**	**QMillion**	**Q/tCO_2e**	**Notas**
AG-1.	Manejo sostenible de suelos	(1.0)	(2.6)	(44)	(45)	-Q946	-Q21	
AG-2.	Establecimiento y mejoramiento de sistemas agroforestales	(0.87)	(0.24)	(16)	(16)	-Q747	-Q46	al final del período de planificación debido a las supuestas cosechas de leña que superan otras reducciones de GEI.
AG-3.	Establecimiento de plantaciones con potencial frutícola	(4.1)	(21)	(284)	(287)	Q5,877	Q20	
AG-4.	Uso eficiente de fertilizantes nitrogenados	(0.41)	(1.1)	(16.9)	(21.4)	Q42,065	Q1,964	
GAN-1.	Promover el establecimiento de pasturas mejoradas	(1.5)	(3.9)	(65)	(65)	-Q15,589	-Q241	
GAN-2.	Promover el establecimiento de sistemas silvopastoriles	(7.2)	(8.4)	(268)	(268)	-Q12,184	-Q45	
GAN-3.	Fomentar la gestión integral del estiércol en sistemas intensivos de producción animal	(0.87)	(1.7)	(32)	(51)	-Q5,065	-Q99	
	Total	**(16)**	**(39)**	**(725)**	**(753)**	**Q13,410**	**Q18**	

Los resultados resumidos anteriores se presentan sobre la base del análisis "independiente". Esto significa que cada opción se analizó de manera independiente frente a las condiciones BAU (es decir, asumiendo que era la única opción que se implementaría). Estos resultados no reflejan superposiciones identificadas u otras interacciones con otras opciónes. Los resultados que se han ajustado para tener en cuenta las superposiciones / interacciones dentro de este sector se proporcionan en la tabla siguiente.
AG-2: Las reducciones netas en el país se vuelven positivas al final del período de planificación debido a las supuestas cosechas de leña que superan otras reducciones de GEI.

Interacciones intra-sectoriales y ajustes de superposiciones

Resultados superpuestos de superposición de sectores

	Impacto de GEI en el país			*Impactos totales de GEI*	*Costos directos (año base 2018Q)*		
	Impactos anuales del CO_2e		**2050 Acumulativo**	**2050 Acumulativo**	**VPN 2019-2050**	**Costo Efectividad**	
Número de							

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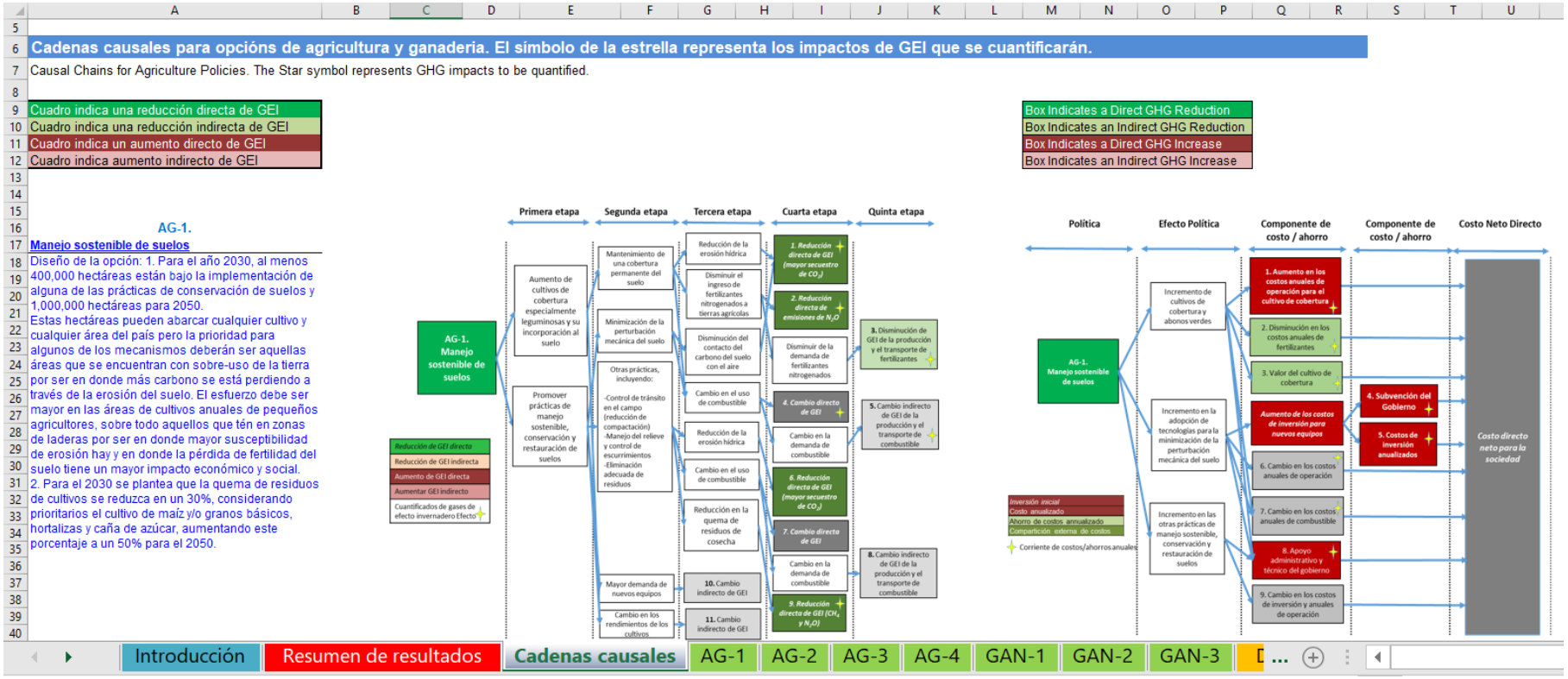
Example: Direct Impacts of Ag Policies

1. Causal chains of GHG emissions and net societal costs are derived from the design of each policy. Policy design templates are additional tools in the CCS Planning Toolkit. The causal chains map out each GHG impact and cost component to be included in the direct impacts analysis.



Example: Direct Impacts of Ag Policies

2. Identify the key inputs required to calculate each stream of direct impacts and costs identified in the causal chains for the policy. These are often provided for input, review and revision by local experts and stakeholders to best match local conditions.

	A	B	C	D
231	**Datos de soporte, supuestos y cálculos**			
232	**Entradas de Energía, Recursos y Emisiones**			
233	**Parámetro**	**Valor**	**Unidades**	**Notas/Citas**
234	Meta 2030	130,000	Ha	Diseño de opción
235	Meta 2050	330,000	Ha	Diseño de opción
236	Tasa de secuestro del C: pasto - BAU	(1,063)	kg CO2/Ha-año	Tasa de flujo de carbono en suelos de pastos y biomasa. Fuente del dato: Juan Fernando Naranjo, César Augusto Cuartas, Enrique Murgueitio, Julián Cha
237	Tasa de secuestro del C: pasto - escenario de la opción	(3,337)	kg CO2/Ha-año	Tasa de flujo de carbono en suelos de pastos y biomasa.Fuente del dato: Juan Fernando Naranjo, César Augusto Cuartas, Enrique Murgueitio, Julián Char
238	Escenario de la opción: nivel de almacenamiento de ganado lechero	0.9	UA/Ha	Unidades de animales (UA) por hectárea para las lecherías. Fuente del dato: Consulta con expertos. El valor corresponde a un promedio en el área objeti
239	Escenario de la opción: nivel de almacenamiento de ganado lechero	2.5	UA/Ha	UA por hectárea para las lecherías. Fuente de dato: Consulta con expertos. El valor corresponde a un promedio del área intervenida con la opción (330,0
240	Nivel de almacenamiento de ganado vacuno: BAU	0.9	UA/Ha	UA por hectárea para producción de carne. Fuente del dato: Consulta con expertos. El valor corresponde a un promedio en el área objetivo de la opción c
241	Escenario de la opción: nivel de almacenamiento de ganado vacuno	2.5	UA/Ha	UA por hectárea para producción de carne. Fuente de dato: Consulta con expertos. El valor corresponde a un promedio del área intervenida con la opció
242	Fracción de área para ganado lechero	0.55	sin unidades	Ficticio; fracción del área objetivo de opción para el ganado lechero. Estimación realizada con base en la proporción que representan las UA dentro del
243	Fracción de área para ganado vacuno	0.45	sin unidades	Ficticio; fracción del área de meta de opción para el ganado de carne. Estimación realizada con base en la proporción que representan las UA dentro del
244	Ganado lechero: entérico CH4 EF	1.32	tCO2e/UA	GLEDS Línea de base; Estos EFs de CH4 entéricos pueden o no ser utilizados. No está claro si existe la expectativa de que una mejor disponibilidad de alin
245	Ganado vacuno: entérico CH4 EF	1.18	tCO2e/UA	GLEDS Línea de base; Estos EFs de CH4 entéricos pueden o no ser utilizados. No está claro si existe la expectativa de que una mejor disponibilidad de alin
246	Ganado lechero EF: estiércol de pasto	0.013	tCO2e/UA	GLEDS Línea de base; representa solo la fracción de CH4 emitido desde el pastar / potrero / rango; 36% del estiércol depositado aquí frente a operaciones
247	Ganado vacuno EF: estiércol de pasto	0.023	tCO2e/UA	GLEDS Línea de base; representa solo la fracción de CH4 emitido desde el pastar / potrero / rango; 99% del estiércol depositado aquí frente a operaciones
248	Ganado vacuno: años para alcanzar la madurez del mercado	2.5	año	Cálculos propios (rango)
249	Tasa media de secuestro de C forestal nacional	(10.3)	tCO2/ha-año	GLEDS Línea de base; Bosque natural (América tropical húmedo caducifolio); biomasa por encima y por debajo del suelo; sin carbono en el suelo (no abo
250	Productividad láctea: BAU	630	L/UA-año	Cálculos propios realizados a partir de la proyección del número de vacas ordeñadas por año 0, la producción diaria de leche por vaca en año 0, y la du
251	Productividad láctea: escenario de la opción	1,500	L/UA-año	Cálculos propios realizados a partir de la proyección del número de vacas ordeñadas por año, la producción diaria de leche por vaca y la duración de l
	Peso del ganado vacuno en la			

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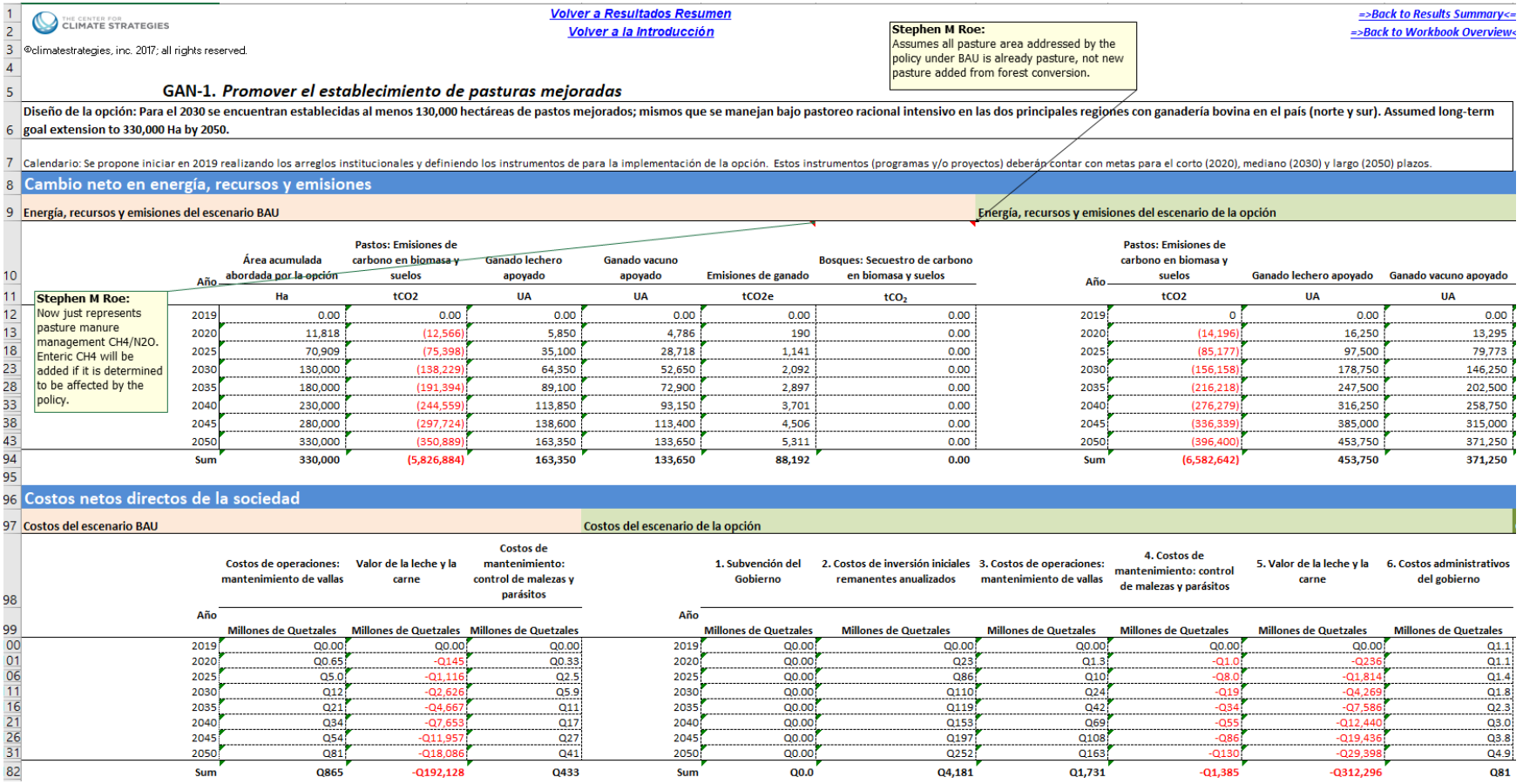
Example: Direct Impacts of Ag Policies

3. Calculate and review the streams of direct energy, resources, and emissions impacts under a business as usual (BAU) scenario and a policy scenario. Do the same for BAU and policy scenario direct costs.



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Volver a Resultados Resumen
Volver a la Introducción

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Stephen M Roe:
Assumes all pasture area addressed by the policy under BAU is already pasture, not new pasture added from forest conversion.

GAN-1. *Promover el establecimiento de pasturas mejoradas*

Diseño de la opción: Para el 2030 se encuentran establecidas al menos 130,000 hectáreas de pastos mejorados; mismos que se manejan bajo pastoreo racional intensivo en las dos principales regiones con ganadería bovina en el país (norte y sur). Assumed long-term goal extension to 330,000 Ha by 2050.

Calendario: Se propone iniciar en 2019 realizando los arreglos institucionales y definiendo los instrumentos de para la implementación de la opción. Estos instrumentos (programas y/o proyectos) deberán contar con metas para el corto (2020), mediano (2030) y largo (2050) plazos.

Cambio neto en energía, recursos y emisiones

Energía, recursos y emisiones del escenario BAU

Año	Área acumulada abordada por la opción	Pastos: Emisiones de carbono en biomasa y suelos	Ganado lechero apoyado	Ganado vacuno apoyado	Emisiones de ganado	Bosques: Secuestro de carbono en biomasa y suelos
	Ha	tCO2	UA	UA	tCO2e	tCO_2
2019	0.00	0.00	0.00	0.00	0.00	0.00
2020	11,818	(12,566)	5,850	4,786	190	0.00
2025	70,909	(75,398)	35,100	28,718	1,141	0.00
2030	130,000	(138,229)	64,350	52,650	2,092	0.00
2035	180,000	(191,394)	89,100	72,900	2,897	0.00
2040	230,000	(244,559)	113,850	93,150	3,701	0.00
2045	280,000	(297,724)	138,600	113,400	4,506	0.00
2050	330,000	(350,889)	163,350	133,650	5,311	0.00
Sum	330,000	(5,826,884)	163,350	133,650	88,192	0.00

Stephen M Roe:
Now just represents pasture manure management CH4/N2O. Enteric CH4 will be added if it is determined to be affected by the policy.

Energía, recursos y emisiones del escenario de la opción

Año	Pastos: Emisiones de carbono en biomasa y suelos	Ganado lechero apoyado	Ganado vacuno apoyado
	tCO2	UA	UA
2019	0	0.00	0.00
2020	(14,196)	16,250	13,295
2025	(85,177)	97,500	79,773
2030	(156,158)	178,750	146,250
2035	(216,218)	247,500	202,500
2040	(276,279)	316,250	258,750
2045	(336,339)	385,000	315,000
2050	(396,400)	453,750	371,250
Sum	(6,582,642)	453,750	371,250

Costos netos directos de la sociedad

Costos del escenario BAU

Año	Costos de operaciones: mantenimiento de vallas	Valor de la leche y la carne	Costos de mantenimiento: control de malezas y parásitos
	Millones de Quetzales	Millones de Quetzales	Millones de Quetzales
2019	Q0.00	Q0.00	Q0.00
2020	Q0.65	-Q145	Q0.33
2025	Q5.0	-Q1,116	Q2.5
2030	Q12	-Q2,626	Q5.9
2035	Q21	-Q4,667	Q11
2040	Q34	-Q7,653	Q17
2045	Q54	-Q11,957	Q27
2050	Q81	-Q18,086	Q41
Sum	Q865	-Q192,128	Q433

Costos del escenario de la opción

Año	1. Subvención del Gobierno	2. Costos de inversión iniciales remanentes anualizados	3. Costos de operaciones: mantenimiento de vallas	4. Costos de mantenimiento: control de malezas y parásitos	5. Valor de la leche y la carne	6. Costos administrativos del gobierno
	Millones de Quetzales	Millones de Quetzales	Millones de Quetzales	Millones de Quetzales	Millones de Quetzales	Millones de Quetzales
2019	Q0.00	Q0.00	Q0.00	Q0.00	Q0.00	Q1.1
2020	Q0.00	Q23	Q1.3	-Q1.0	-Q236	Q1.1
2025	Q0.00	Q86	Q10	-Q8.0	-Q1,814	Q1.4
2030	Q0.00	Q110	Q24	-Q19	-Q4,269	Q1.8
2035	Q0.00	Q119	Q42	-Q34	-Q7,586	Q2.3
2040	Q0.00	Q153	Q69	-Q55	-Q12,440	Q3.0
2045	Q0.00	Q197	Q108	-Q86	-Q19,436	Q3.8
2050	Q0.00	Q252	Q163	-Q130	-Q29,398	Q4.9
Sum	Q0.0	Q4,181	Q1,731	-Q1,385	-Q312,296	Q81

THE CENTER FOR CLIMATE STRATEGIES

Example: Direct Impacts of Ag Policies

4. Review the streams of net change in energy, resources, and emissions, as well as the net direct costs or savings for the policy (negative values indicate a savings to society).
5. Identify intra-sector interactions and overlaps among policies in each sector and adjust these streams of results to correct for those.

Cambio en energía, recursos y emisiones

Año	1. Pastos: secuestro de carbono en biomasa y suelos	2. Emisiones evitadas a través de una producción más eficiente	3. Bosques: Secuestro de carbono en biomasa y suelos	Impactos netos de GEI en la jurisdicción	Impactos netos de GEI fuera de la jurisdicción	Impactos Totales
	tCO2	tCO2e	tCO2e	TgCO2e	TgCO2e	TgCO2e
2019	0.00	0	0.00	0.000	0.00	0.00
2020	(1,630)	(59,709)	(77,905)	(0.14)	0.00	(0.14)
2025	(9,779)	(358,253)	(467,433)	(0.84)	0.00	(0.84)
2030	(17,929)	(656,797)	(856,960)	(1.5)	0.00	(1.5)
2035	(24,824)	(909,411)	(1,186,560)	(2.1)	0.00	(2.1)
2040	(31,720)	(1,162,026)	(1,516,160)	(2.7)	0.00	(2.7)
2045	(38,615)	(1,414,640)	(1,845,760)	(3.3)	0.00	(3.3)
2050	(45,511)	(1,667,254)	(2,175,360)	(3.9)	0.00	(3.9)
Sum	**(755,758)**	**(27,686,522)**	**(36,124,160)**	**(65)**	**0.00**	**(65)**

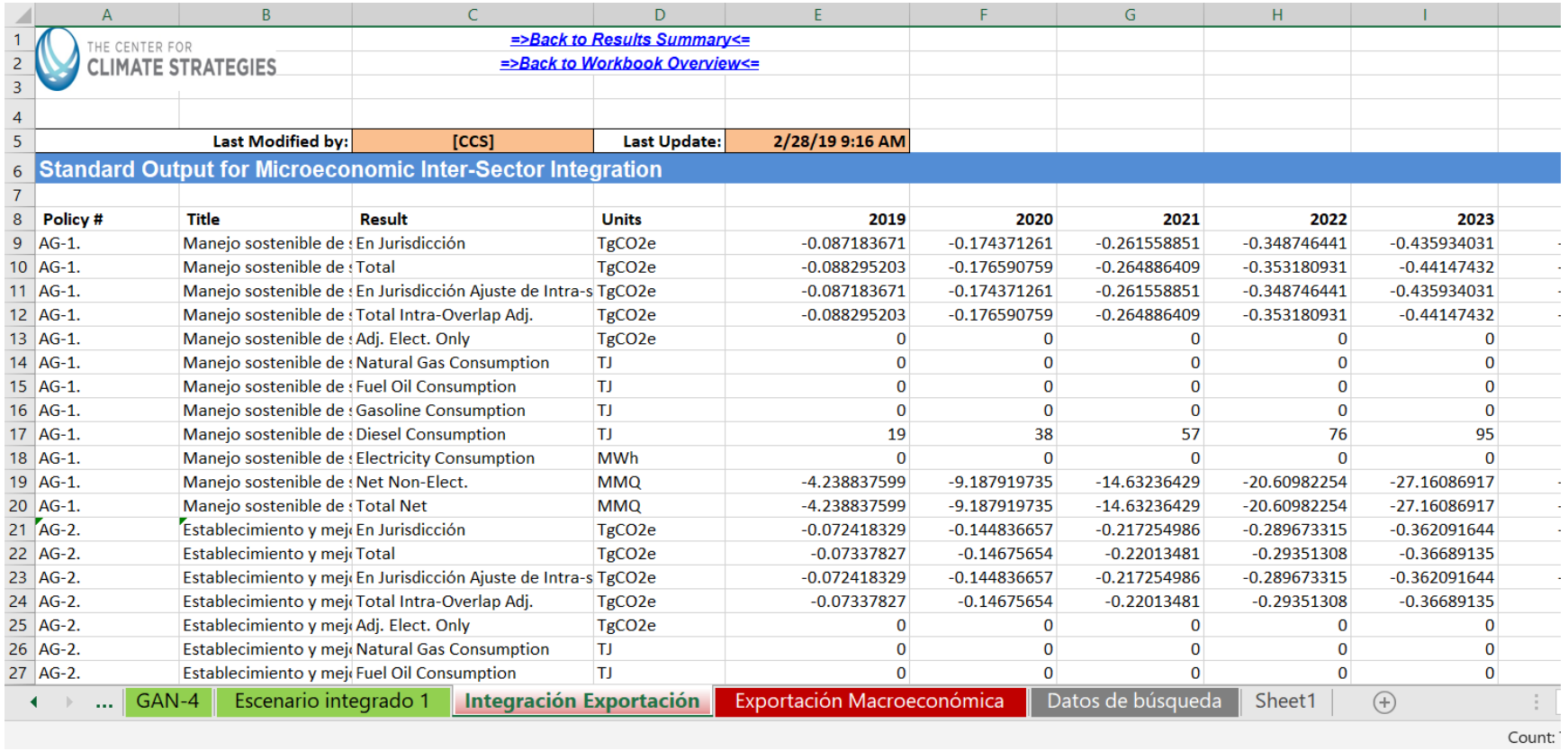
Costos netos

Año	Total de los costos	Total de costos descontados	Costo efectividad
	Millones de Quetzales	Millones de Quetzales 2018	Q2018/tCO2e
2019	Q1.1	Q1.0	
2020	-Q67	-Q56	
2025	-Q617	-Q326	
2030	-Q1,544	-Q518	
2035	-Q2,820	-Q600	
2040	-Q4,668	-Q630	
2045	-Q7,337	-Q628	
2050	-Q11,144	-Q605	
Sum	**-Q116,858**	**-Q15,589**	**-Q241**

THE CENTER FOR CLIMATE STRATEGIES

Example: Direct Impacts of Ag Policies

6. Export the sector integrated results for assessment of economy-wide impacts within the Synthesis Module.



THE CENTER FOR CLIMATE STRATEGIES

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		Last Modified by:	[CCS]	Last Update:	2/28/19 9:16 AM				
Standard Output for Microeconomic Inter-Sector Integration									
Policy #	**Title**	**Result**	**Units**	**2019**	**2020**	**2021**	**2022**	**2023**	
AG-1.	Manejo sostenible de s	En Jurisdicción	TgCO2e	-0.087183671	-0.174371261	-0.261558851	-0.348746441	-0.435934031	
AG-1.	Manejo sostenible de s	Total	TgCO2e	-0.088295203	-0.176590759	-0.264886409	-0.353180931	-0.44147432	
AG-1.	Manejo sostenible de s	En Jurisdicción Ajuste de Intra-s	TgCO2e	-0.087183671	-0.174371261	-0.261558851	-0.348746441	-0.435934031	
AG-1.	Manejo sostenible de s	Total Intra-Overlap Adj.	TgCO2e	-0.088295203	-0.176590759	-0.264886409	-0.353180931	-0.44147432	
AG-1.	Manejo sostenible de s	Adj. Elect. Only	TgCO2e	0	0	0	0	0	
AG-1.	Manejo sostenible de s	Natural Gas Consumption	TJ	0	0	0	0	0	
AG-1.	Manejo sostenible de s	Fuel Oil Consumption	TJ	0	0	0	0	0	
AG-1.	Manejo sostenible de s	Gasoline Consumption	TJ	0	0	0	0	0	
AG-1.	Manejo sostenible de s	Diesel Consumption	TJ	19	38	57	76	95	
AG-1.	Manejo sostenible de s	Electricity Consumption	MWh	0	0	0	0	0	
AG-1.	Manejo sostenible de s	Net Non-Elect.	MMQ	-4.238837599	-9.187919735	-14.63236429	-20.60982254	-27.16086917	
AG-1.	Manejo sostenible de s	Total Net	MMQ	-4.238837599	-9.187919735	-14.63236429	-20.60982254	-27.16086917	
AG-2.	Establecimiento y mej	En Jurisdicción	TgCO2e	-0.072418329	-0.144836657	-0.217254986	-0.289673315	-0.362091644	
AG-2.	Establecimiento y mej	Total	TgCO2e	-0.07337827	-0.14675654	-0.22013481	-0.29351308	-0.36689135	
AG-2.	Establecimiento y mej	En Jurisdicción Ajuste de Intra-s	TgCO2e	-0.072418329	-0.144836657	-0.217254986	-0.289673315	-0.362091644	
AG-2.	Establecimiento y mej	Total Intra-Overlap Adj.	TgCO2e	-0.07337827	-0.14675654	-0.22013481	-0.29351308	-0.36689135	
AG-2.	Establecimiento y mej	Adj. Elect. Only	TgCO2e	0	0	0	0	0	
AG-2.	Establecimiento y mej	Natural Gas Consumption	TJ	0	0	0	0	0	
AG-2.	Establecimiento y mej	Fuel Oil Consumption	TJ	0	0	0	0	0	

... GAN-4 | Escenario integrado 1 | Integración Exportación | Exportación Macroeconómica | Datos de búsqueda | Sheet1

Count:

LCD/LEDS Tool Example: Economy-Wide (Direct) Impacts

- Results at the Sector Level are then aggregated within the Synthesis Module
  - Includes adjustments for inter-sector interactions and overlaps: e.g. between electricity supply and demand
- More detailed demonstrations, including methods for inter-sector interaction/overlap adjustment, can be scheduled during webinars and workshops

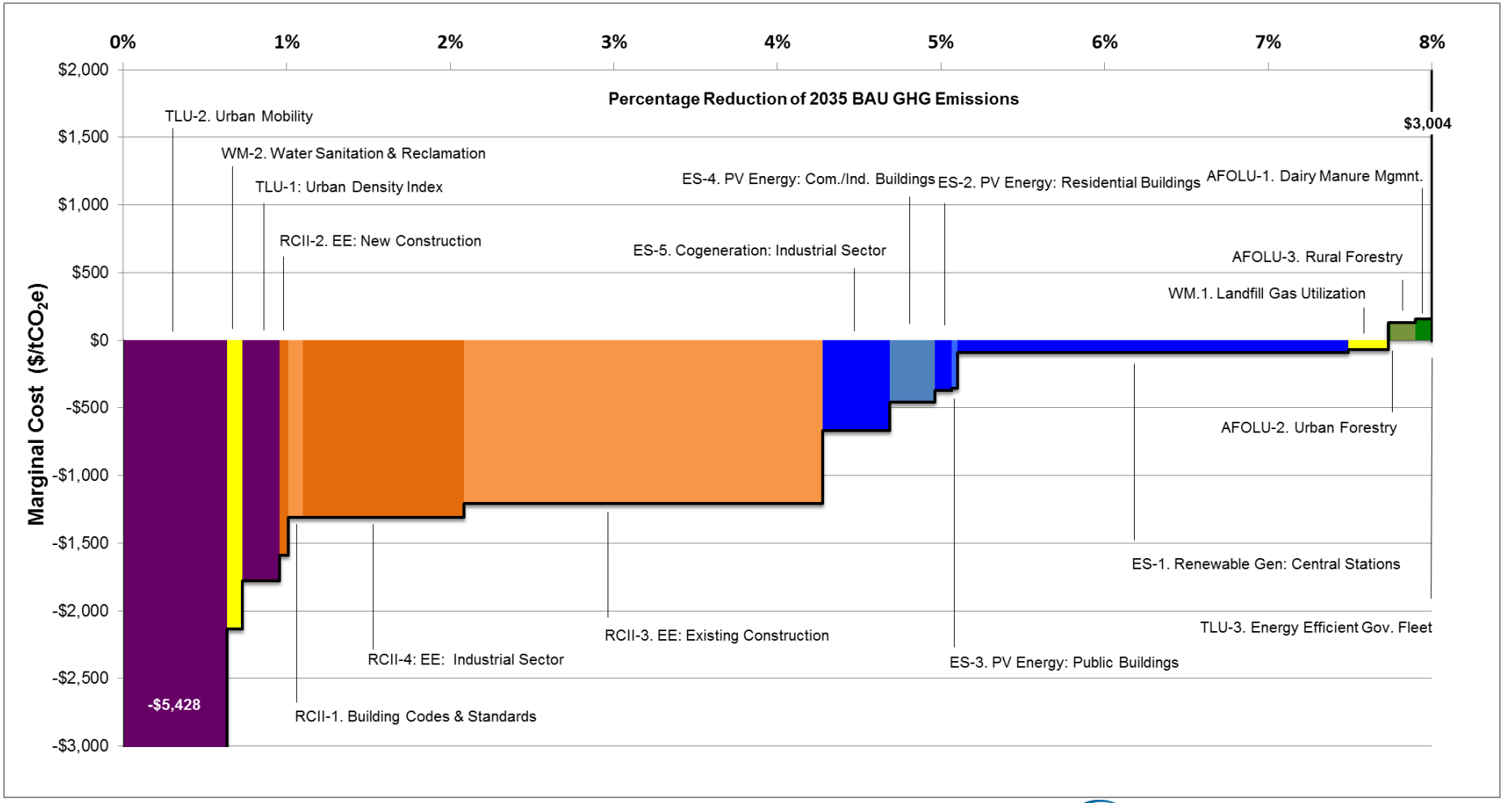
Policy ID	Policy Name	2020 Annual Reductions (Tg CO_2e)	2030 Annual Reductions (Tg CO_2e)	Cumulative 2016-2030 (Tg CO_2e)	NPV Costs/ Savings 2016-2030 ($2012MM)	Cost Effectiveness ($2012/t CO_2e)
ES-1	Micro-Hydro Renewable Energy Generation	0.047	0.065	0.78	$231	$294
ES-2	Energy Supply Diversification	0.94	1.3	16	$6,814	$425
ES-3	Distributed Energy Supply for Building	0.013	0.019	0.22	$6.9	$31
ES-4	Photovoltaic Panel Electricity Generation	0.018	0.025	0.30	$150	$505
Energy Supply Sector Totals		**1.0**	**1.5**	**17**	**$7,201**	**$415.17**
RCII-1	Energy Efficiency: Residential Shell Improvement	0.019	0.019	0.26	($309)	($1,172)
RCII-2	Energy Efficiency: New Housing Appliances	0.016	0.016	0.43	($290)	($675)
RCII-3	Energy Efficiency: Existing Buildings	0.58	0.58	8.2	($10,952)	($1,342)
RCII-4	Finance Incentives for Machinery Energy Efficiency	0.27	0.73	6.1	($11,771)	($1,915)
RCII-5	Solar Water Heaters on Housing	0.44	0.44	6.1	($8,800)	($1,435)
RCII-6	Flow Water Heaters for Residential Sector	0.14	0.14	2.0	($3,095)	($1,559)
Residential, Commercial, Industrial & Institutional Sector Totals		**1.5**	**1.9**	**23**	**($35,217)**	**($1,523)**
TLU-1	Black Carbon Control Measures	0.046	0.000	0.30	$60	$196
TLU-2	Alternative Fuels	0.034	0.078	0.77	($188)	($242)
TLU-3	Onroad Fleet Efficiency	0.0033	0.0079	0.070	($81)	($1,150)
TLU-4	Increase efficiency in urban mobility	Dropped from final CAP results.				
TLU-5	Smart Growth Planning	0.011	0.036	0.28	($480)	($1,716)
TLU-6	Energy Efficient Government Fleet	0.000084	0.00011	0.0015	$2.3	$1,609
Transportation & Land Use Sector Totals		**0.10**	**0.12**	**1.4**	**($686)**	**($480)**
AFOLU-1	Manure Management: Non-Dairy Livestock	0.00037	0.00037	0.0048	$3.4	$714
AFOLU-2	Manure Management: Dairies	0.020	0.021	0.27	$31	$117
AFOLU-3	Utilization of Wheat Straw	N/A; GHG reductions and costs are reported with the ES-2 policy totals.				
AFOLU-4	Bioethanol Production from Sweet Sorghum	N/A; GHG reductions and costs are reported with the TLU-2 policy totals.				
AFOLU-5	Livestock Grazing Management	0.069	0.12	1.31	$1,117	$855
AFOLU-6	Urban Forestry	0.00005	0.0006	0.0034	$17	$5,514
Agriculture, Forestry and Other Land Use Sector Totals		**0.090**	**0.14**	**1.6**	**$1,169**	**$739**
WM-1	Landfill Gas Management	0.27	0.32	3.9	$258	$67
WM-2	Indirect Potable Water Re-Use	0.025	0.035	0.43	($226)	($532)
WM-3	Water Reclamation	0.041	0.071	0.76	($415)	($545)
WM-4	Biodiesel Production	N/A; GHG reductions and costs are reported with the TLU-2 policy totals.				
Waste Management Sector Totals		0.34	0.43	5.1	($383)	($76)
Total Integrated Plan Results		**3.0**	**4.1**	**49**	**($27,916)**	**($575)**

Sample Micro-Economic Analysis Results: Baja California Action Plan

Note: $ = Mexican peso

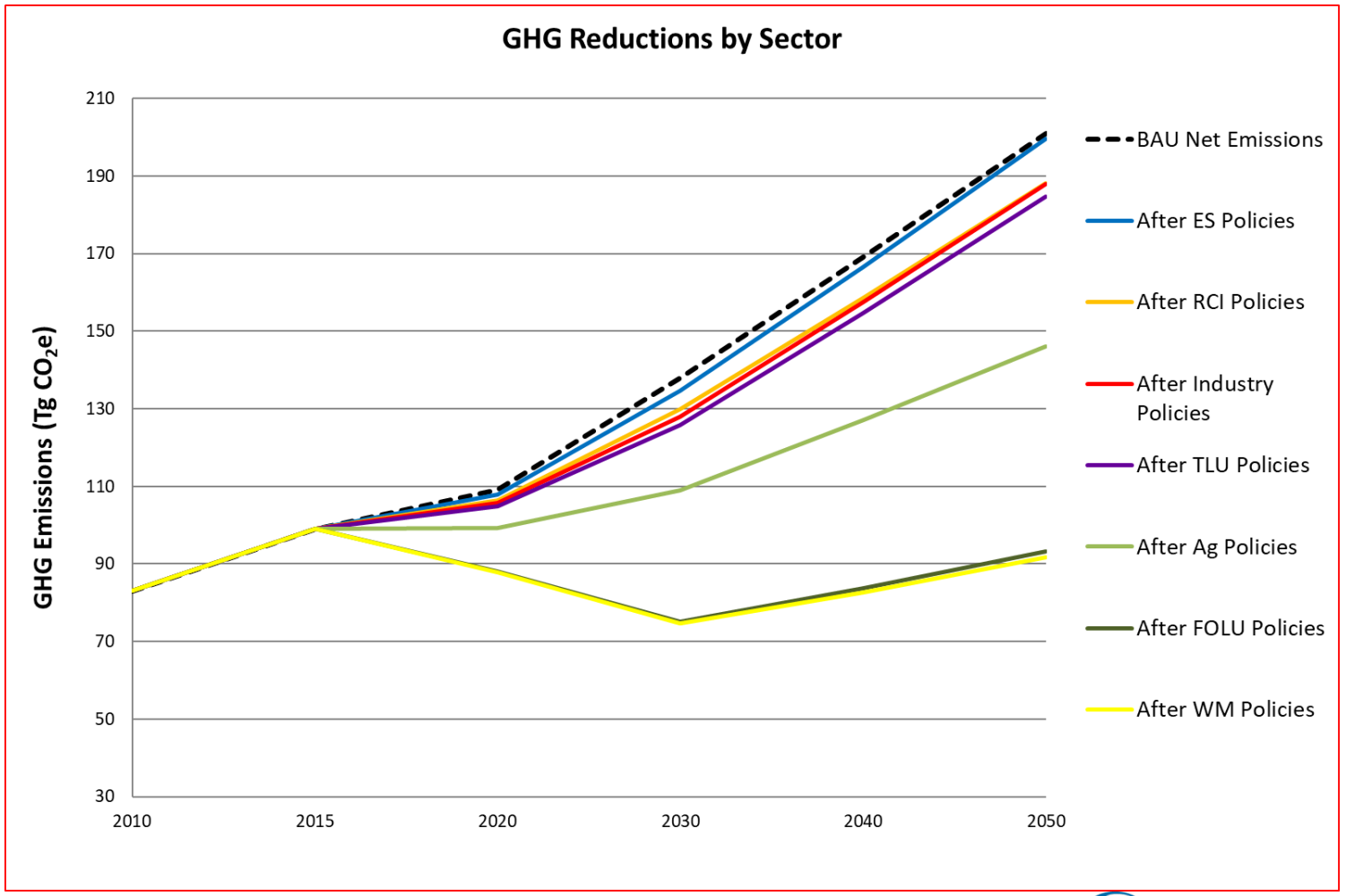
Marginal Abatement Cost Curve

2016 Coahuila, Mexico Action Plan



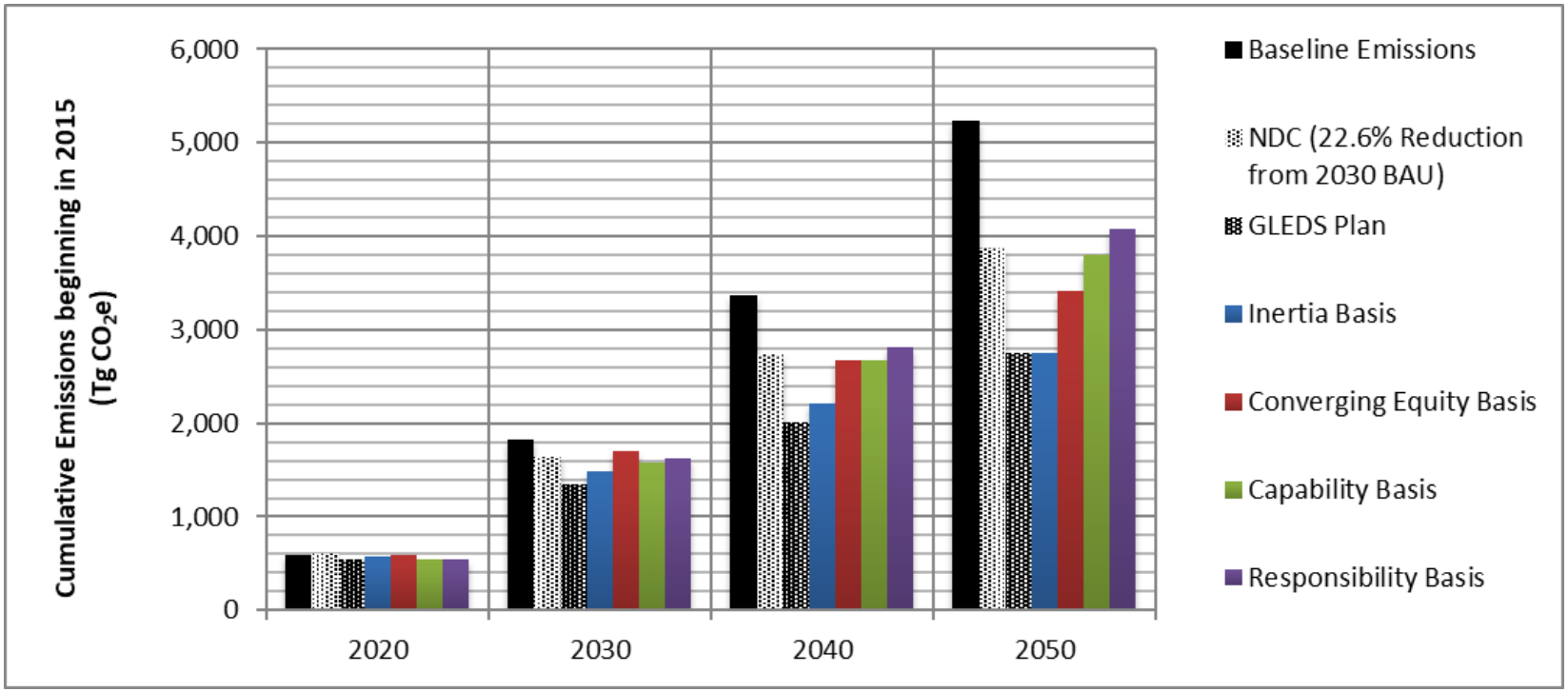
Economy-Wide Plan Results:

Guatemala Low Emissions Development Strategy



Economy-Wide Plan Results:
Guatemala Low Emissions Development Strategy

Final results indicate that full implementation of GLEDS would keep Guatemala's emissions within any of the possible global budget allocation schemes implemented to maintain global temperature rise to less than 2 degrees Celsius.



Macro-economic Assessment Indicator and Methodology

Topics

- Overall objective of the macro assessment
- Indicator methodology
  - Objective and Scope
  - Source
  - Factors
  - Process
  - Examples of results
- Macro assessment example walkthrough

Objectives of Macro Assessment

- To identify/estimate the *indirect* effects of option-induced changes on the economy as a whole – GDP, Jobs, Income, etc.
- Outputs of macroeconomic assessment can also offer insights on the impacts on competitiveness of each individual option and design features that can be modified to improve policy performance.

Micro and Macro Assessments

Micro-economic Assessment

- Cost per unit of GHG reduction
- Cumulative reductions
- Total cost

Macro-economic Assessment

- Jobs
- Income
- Price
- GDP

Scope and Objectives

- The macroeconomic assessment is based on six key factors (indicators) that have a significant effect on estimated GDP growth and employment.
- The potential influence of the factors and the impact that the option on the economy is illustrated.

Methodology - Source

- The Process and Methodology of the Macroeconomic evaluation is based on the study "Summary of Key Factors Contributing to Macroeconomic Impacts of GHG Mitigation Options," by Dan Wei, Adam Rose and Noah Dormandy of the USC Sol Price School of Public Policy.

Six Macroeconomic Factors

- Overall Net Policy Cost vs. BAU
- Avoided Energy Spending
- Shift in Local Energy Sources
- Shift in Local Supply Chains
- Shift in Job Creation
- Shift in Imports Exports

Six Macroeconomic Factors

Overall Net Policy Cost vs. BAU

- the option's total collection of costs and savings outperforms the expected net cost of the business-as-usual scenario without the policy in place

Avoided Energy Spending

- shift to net efficiency, or higher energy savings than use

Six Macroeconomic Factors

Shift in Local Energy Sources

- shifting from imported to local energy sources and production

Shift in Local Supply Chains

- expands activity in sectors that buy inputs to production from other local sectors

Six Macroeconomic Factors

Shift in Job Creation

- shifting to more labor intense activities compared to baseline

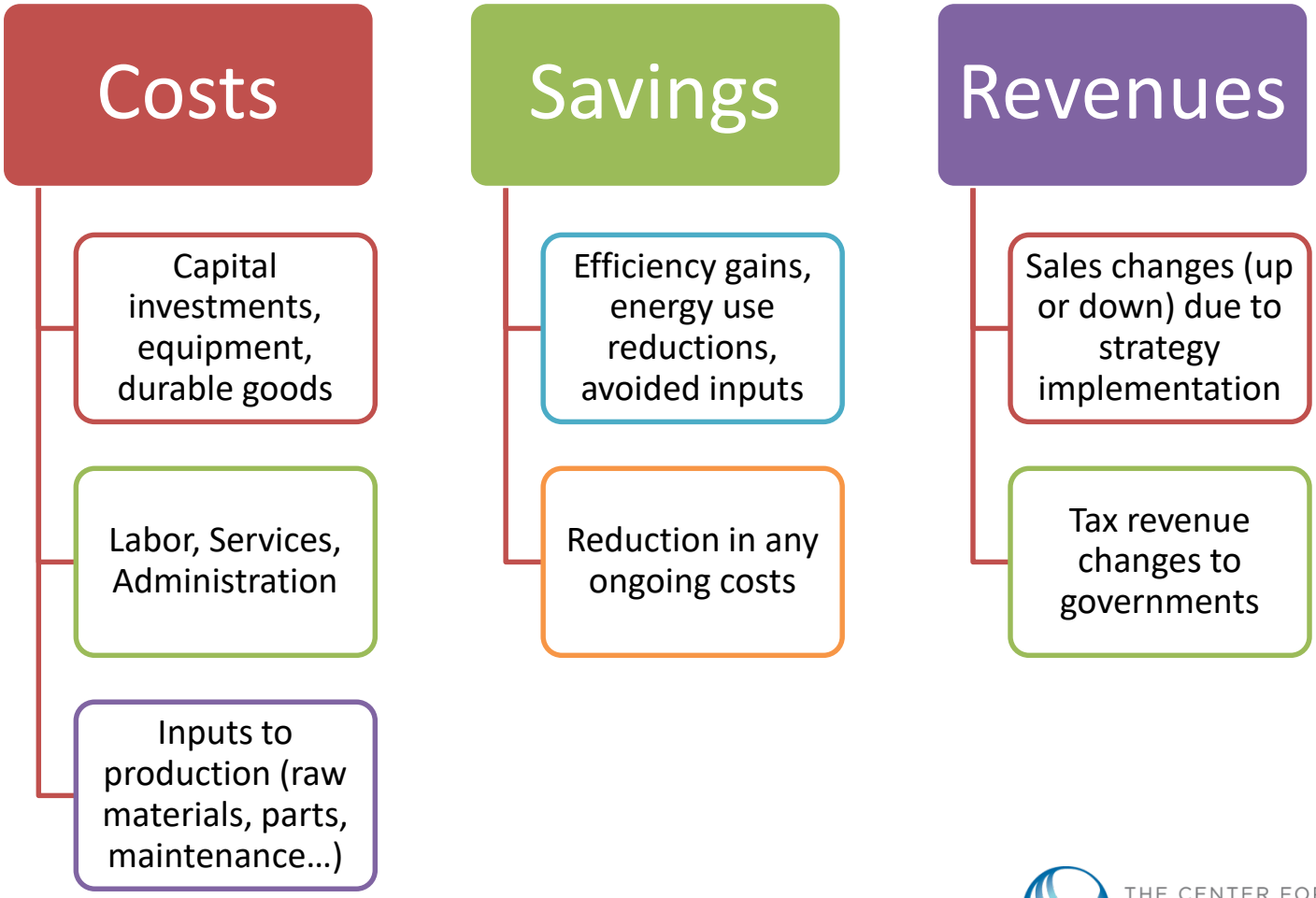
Shift in Imports Exports

- Net reduction in imports

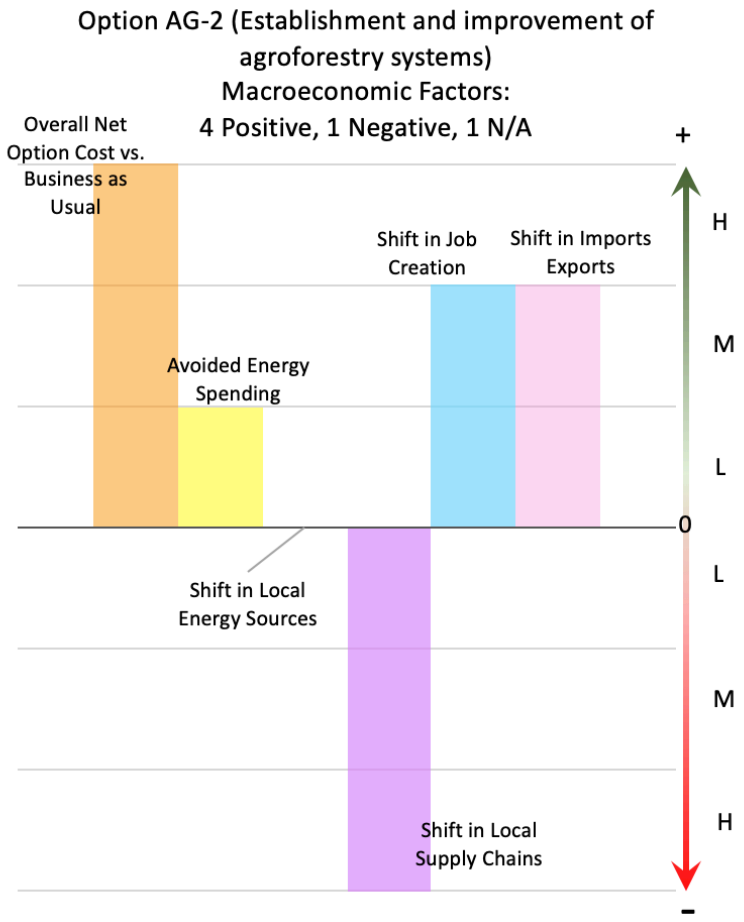
Macroeconomic Assessment Process

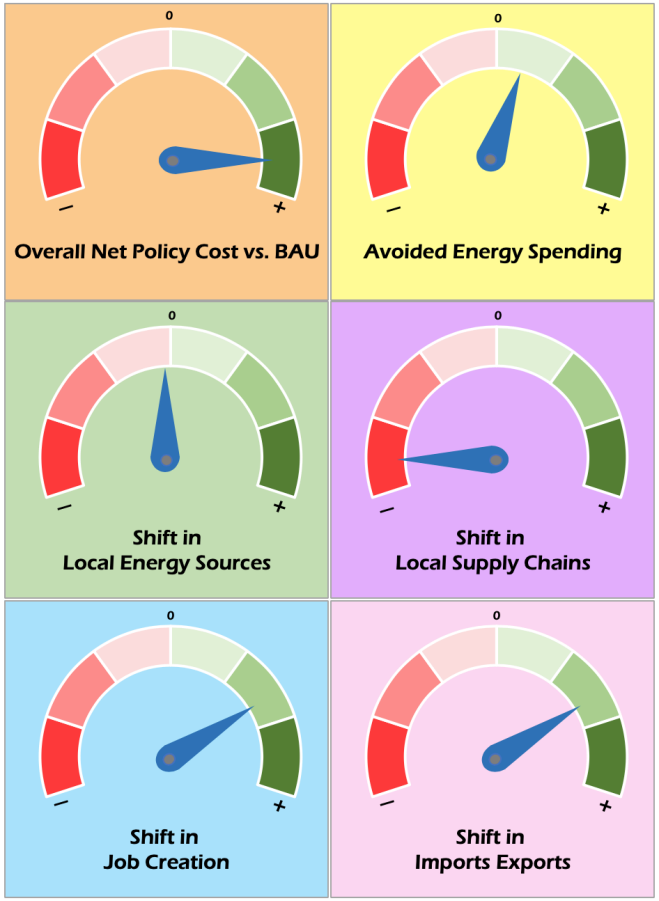
- Review of the financial flows from microeconomic assessment for macroeconomic factors mapping.
- Determine whether the factor has a positive or negative effect depending on the unique design and the circumstances of the option.
- A scale is established based on the scale of the affected financial flow.
- Identify the potential influence of all the factors to illustrate the impact that the option could have on the economy of assessment region.

Examples of Financial Flows

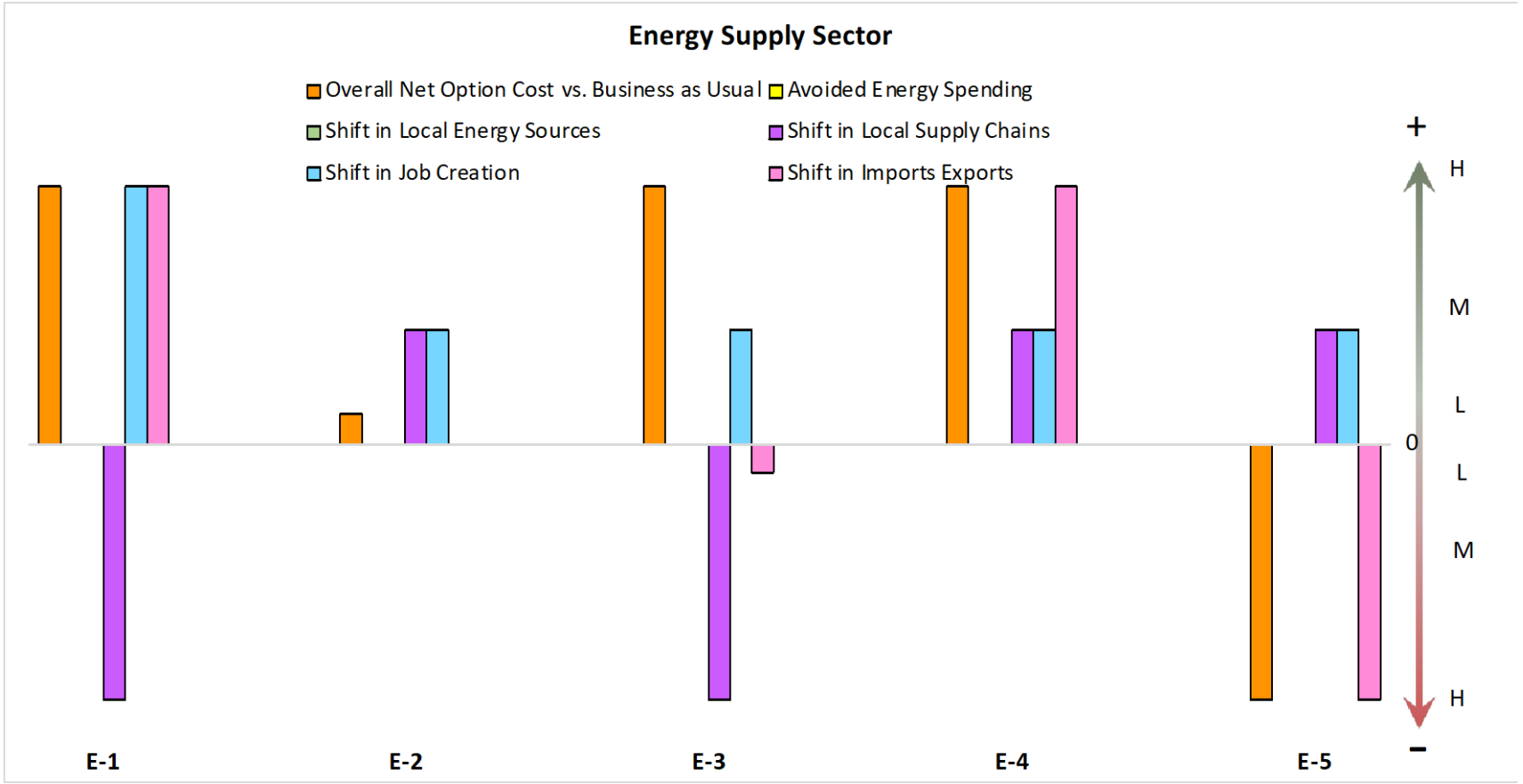


Individual Policy Example





Sector level (comparing 5 options)



Macroeconomic Assessment Process

- This factor-based rating process develops a strategic, multi-faceted evaluation of each option's likely unique impact on the economy for design and implementation decisions.
- It does not, however, quantify the net level of change in GDP, jobs, income, imports or exports induced or lost as a result of option implementation in absolute terms.

Walkthrough – Energy Example

- Example Policy : Use of high efficient wood cooking stoves
  - Policy Description
  - Financial flows analyzed
  - Macroeconomic factors rating
  - Results

High-Efficiency Wood Stoves

- Policy goal: Increase distribution and use of high-efficiency wood cookstoves in rural households in Guatemala
- Target:
  - 100,000 stoves installed in 10 years
  - 600,000 stoves (25% of rural households) by 2050

Financial Flows

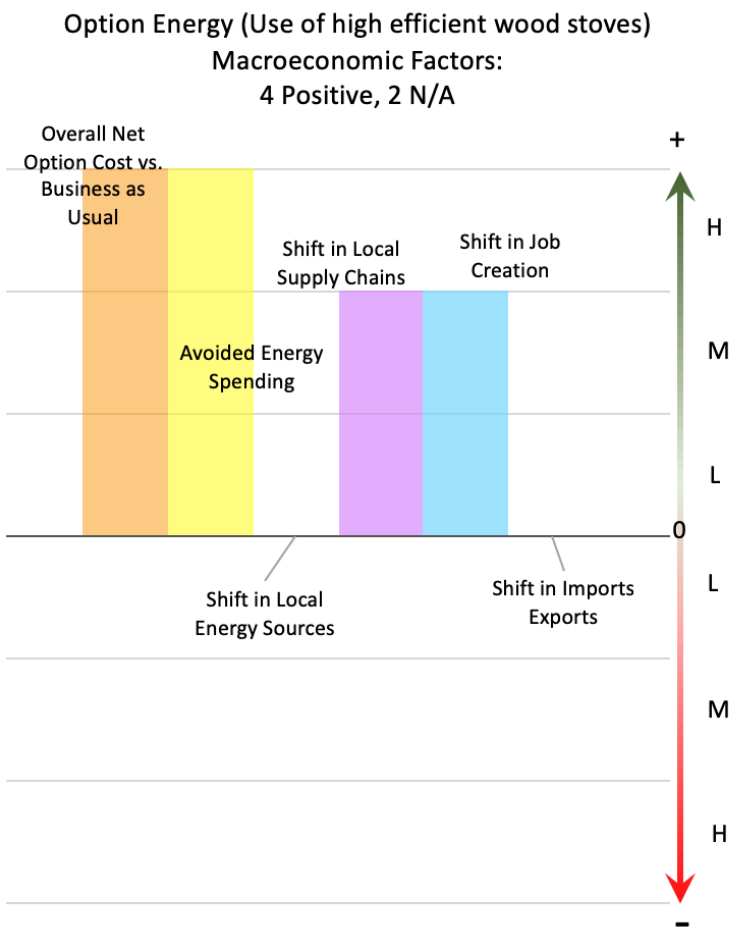
Financial Flows from Microeconomic Analysis:

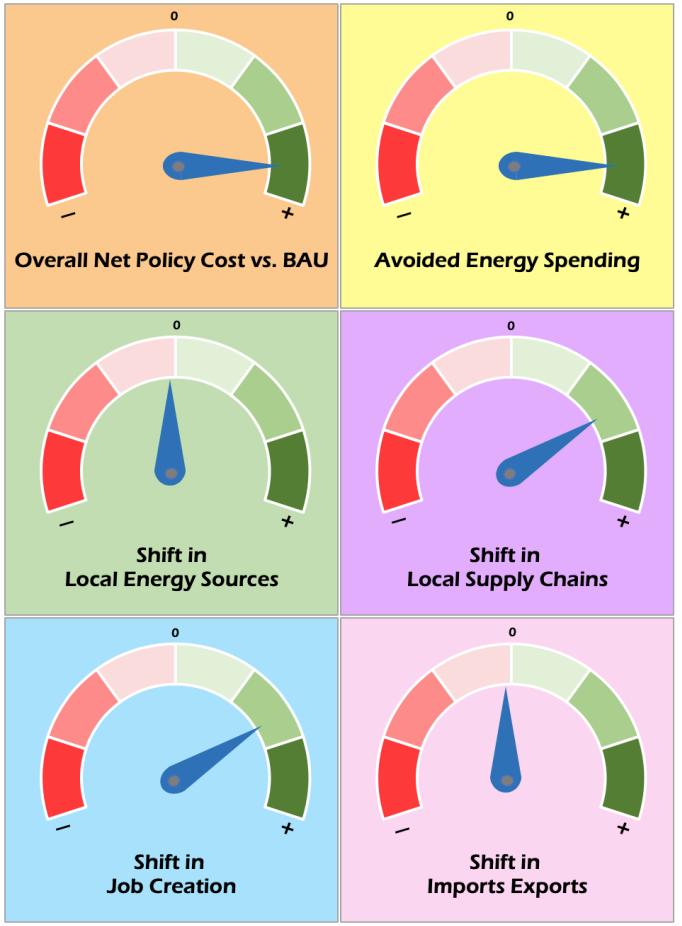
Year	Annualized incremental capital costs for high-efficient stoves	Changes in cost of fuel used by high-efficient stoves over regular stoves	Incremental O&M costs for the use of high-efficient stoves	Cost of Program Administration	Total Cost vs. BAU
2019	Q2.8	-Q19	Q0	Q15	-Q1.1
2020	Q5.8	-Q41	Q0	Q16	-Q18
2025	Q24	-Q193	Q1.6	Q23	-Q144
2030	Q63	-Q534	Q3.4	Q68	-Q400
2035	Q138	-Q1,250	Q6.1	Q90	-Q1,017
2040	Q234	-Q2,339	Q8.9	Q115	-Q1,980
2045	Q356	-Q3,925	Q12	Q143	-Q3,414
2050	Q504	-Q6,161	Q14	Q172	-Q5,470
Sum	Q5,545	-Q58,789	Q201	Q2,735	-Q50,307

Mapping to Macroeconomic Factors

Financial Flow	Macro Factor	Positive/ Negative	Scale of Impact
Annualized incremental capital costs for high-efficient stoves	Shift in Local Supply Chains	Positive	Medium
Changes in cost of fuel used by high-efficient stoves over regular stoves	Avoided Energy Spending	Positive	High
Incremental O&M costs for the use of high-efficient stoves	Shift in Local Supply Chains	Positive	Medium
Cost of Program Administration	Shift in Job Creation	Positive	Medium
Total Cost vs. BAU	Overall Net Policy Cost vs. BAU	Positive	High

Summary and Result Charts





Walkthrough – Industry Example

- Example Policy: Energy efficiency in kilns
  - Policy Description
  - Financial flows analyzed
  - Macroeconomic factors rating
  - Results

Policy Description

- Policy Name: Energy efficiency in kilns
- The actions implemented under this policy are aimed at reducing emissions of GHGs from fuel combustion in industrial furnaces/ovens.
- Among the measures to improvement the efficiency in furnaces/ovens are:
  - automated energy management or process controls for the best use of heat generated;
  - improvements in fuel combustion;
  - and the reduction of thermal losses.
- The goals for the option are to reduce BAU fuel use by 10% by 2030 and by 25% by 2050.

Financial Flows

Financial Flows from Microeconomic Analysis (first four)

Year	Government Grant	Initial annualized investment costs	O&M Costs	Government technical assistance costs
2019	Q0.00	Q0.00	Q0.00	Q0.26
2020	Q0.00	Q0.00	Q0.034	Q0.28
2025	Q17	Q5.6	Q0.053	Q0.35
2030	Q39	Q19	Q0.49	Q0.45
2035	Q0.31	Q20	Q1.3	Q0.58
2040	Q0.58	Q15	Q2.0	Q0.75
2045	Q0.19	Q2.4	Q3.0	Q0.96
2050	Q0.030	Q1.6	Q4.7	Q1.2
Sum	**Q65**	**Q316**	**Q47**	**Q20**

Financial Flows (ctd)

Financial Flows from Microeconomic Analysis (final three)

Year	Net cost of fuel: Cement	Net cost of fuel: Other Sectors	Total Net Cost over BAU
2019	Q0.00	Q0.00	Q0.26
2020	Q0.00	-Q0.0027	Q0.31
2025	-Q0.10	-Q0.0064	Q22
2030	-Q0.24	-Q0.024	Q59
2035	-Q0.31	-Q0.077	Q22
2040	-Q0.39	-Q0.077	Q18
2045	-Q0.47	-Q0.16	Q6.0
2050	-Q0.59	-Q0.26	Q6.7
Sum	**-Q8.8**	**-Q2.3**	**Q438**

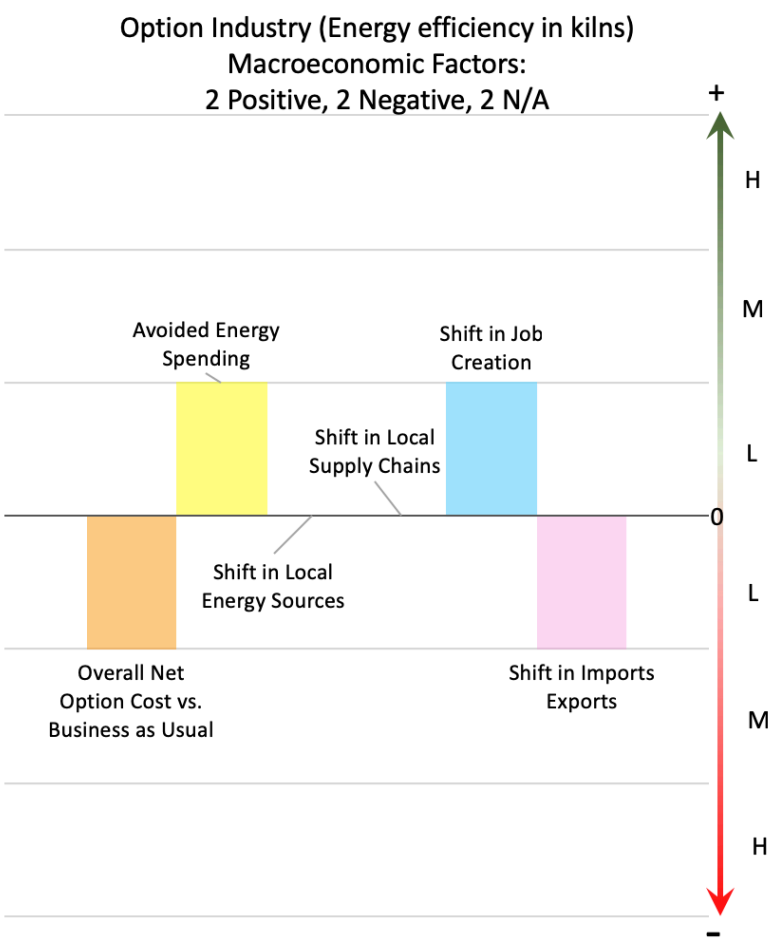
Mapping to Macroeconomic Factors (first four financial flows)

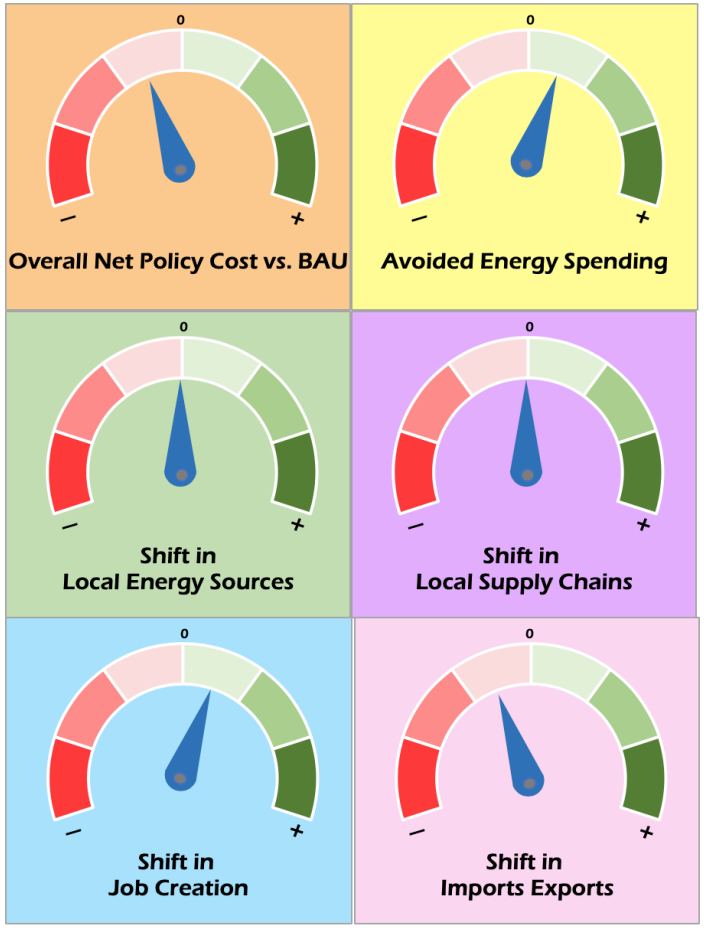
Financial Flow	Macro Factor	Positive/ Negative	Scale of Impact
Government Grant	Shift in Imports Exports	Negative	Low
Initial annualized investment costs	Shift in Imports Exports	Negative	Low
O&M Costs	Shift in Job Creation	Positive	Low
Government technical assistance costs	Shift in Job Creation	Positive	Low

Mapping to Macroeconomic Factors (final three financial flows)

Financial Flow	Macro Factor	Positive/ Negative	Scale of Impact
Net cost of fuel: Cement	Avoided Energy Spending	Positive	Low
Net cost of fuel: Other Sectors	Avoided Energy Spending	Positive	Low
Total Net Cost over BAU	Overall Net Option Cost vs. Business as Usual	Negative	Low

Summary and Results Charts





Thanks!

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