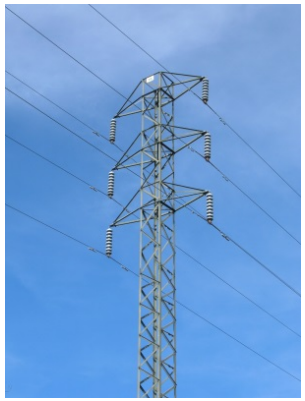
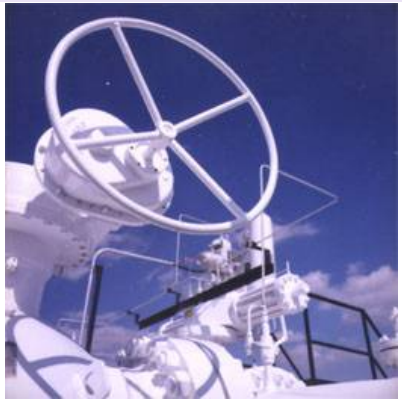
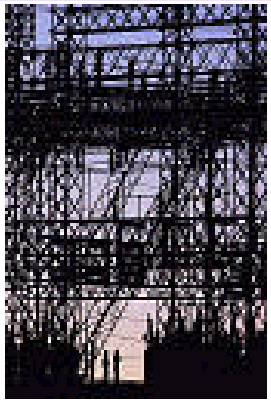
LSU | Center for Energy Studies





Status and briefing on the Louisiana greenhouse gas inventory and emissions analysis.

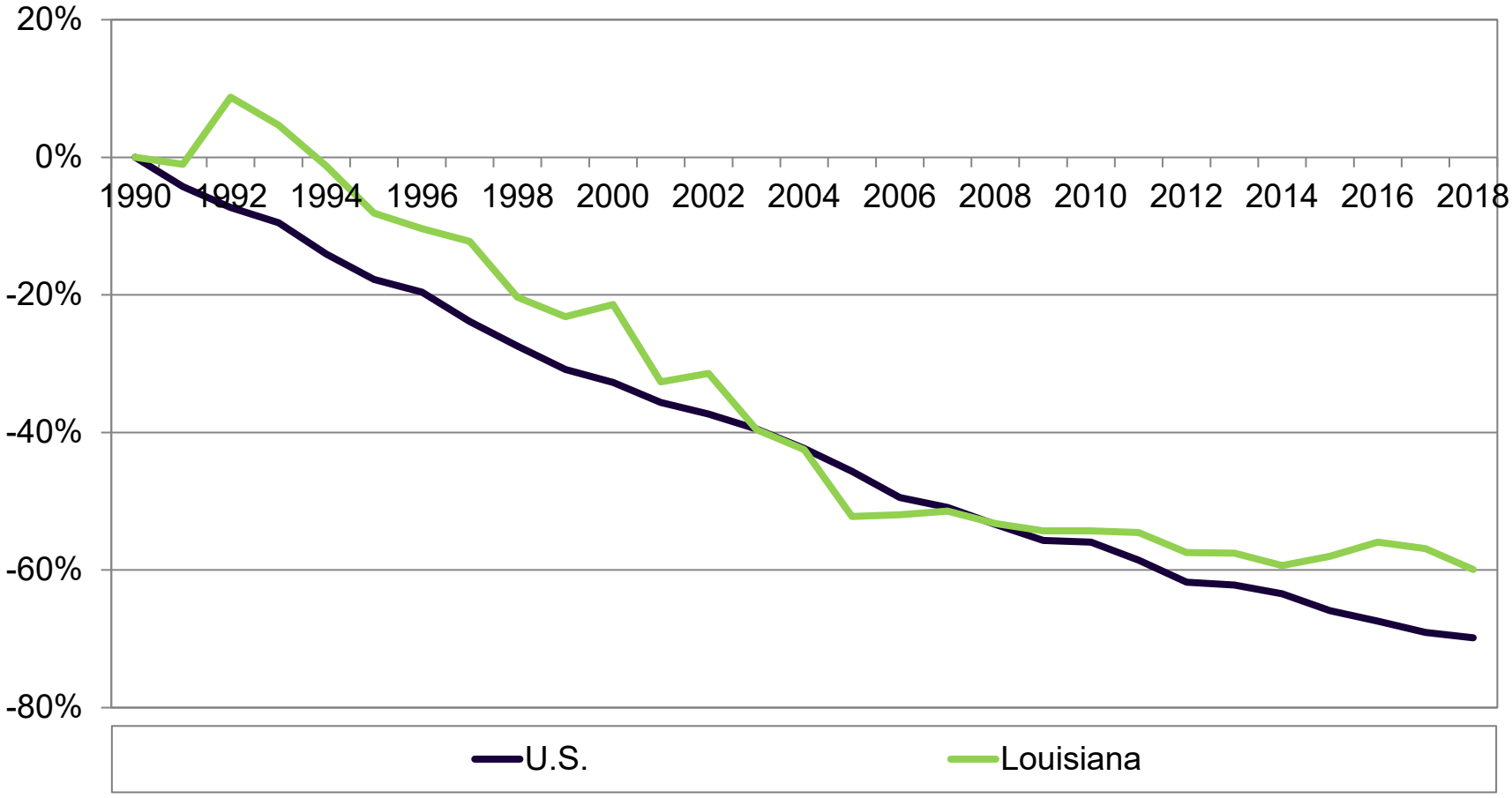
Scientific Advisory Group ("SAG") Meeting, Governor's Climate Initiatives Task Force, March 29, 2021, Baton Rouge, Louisiana.

David E. Dismukes, Ph.D.
Center for Energy Studies
Louisiana State University

Section 1: Louisiana CO_2 Emission Trends

Gross CO_2E per GDP and GSP, U.S. and Louisiana

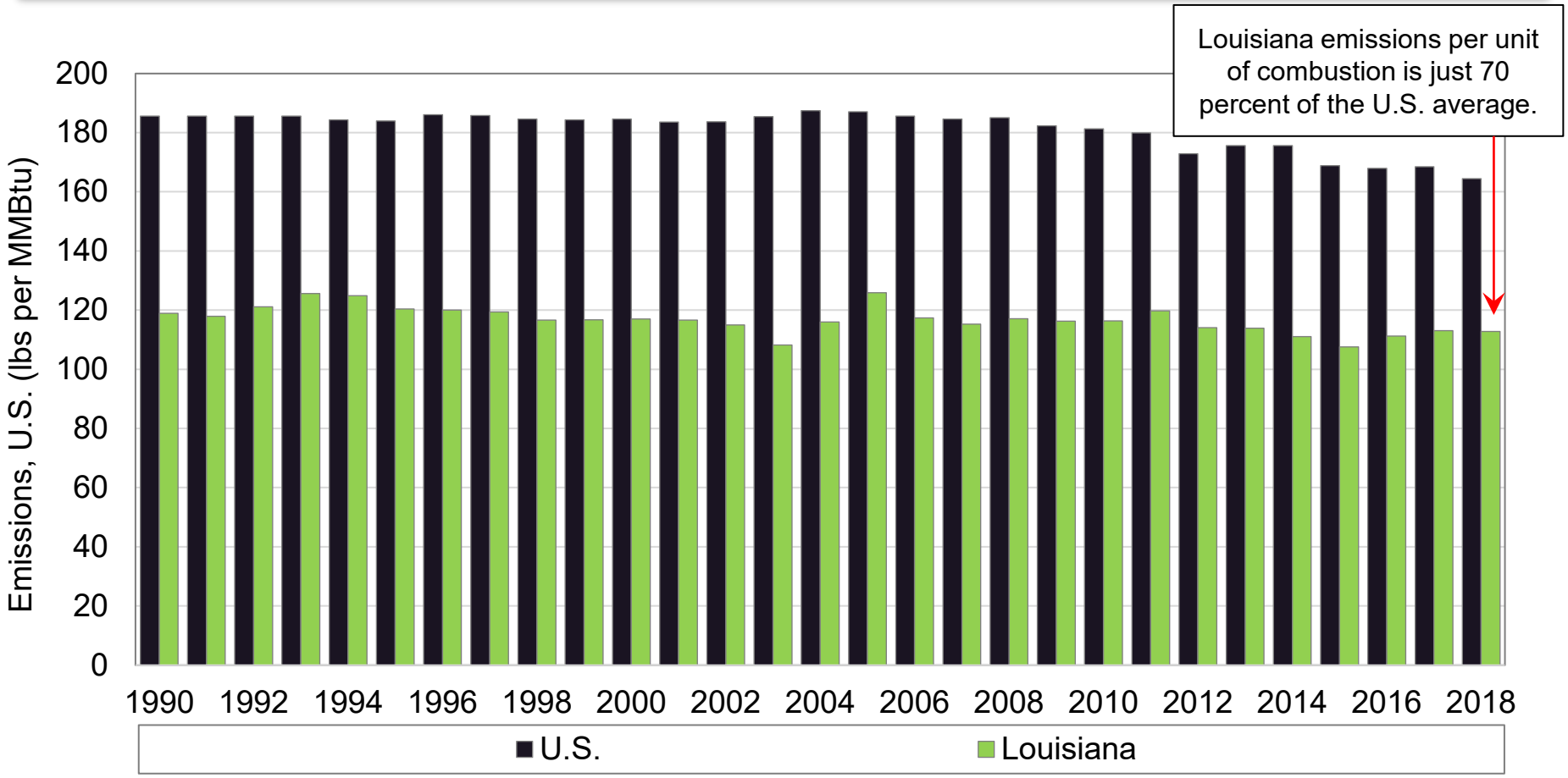
Historic Louisiana CO_2 emissions trends per unit of economic output fallen faster than the U.S. average from 2002 to 2008, but have slowed since.



Note: CO_2 emissions are from fossil fuel combustion only.
Source: U.S. Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018; and State CO_2 Emissions from Fossil Fuel Combustion.

CO_2E per Btu of fossil fuel consumption, U.S. and Louisiana

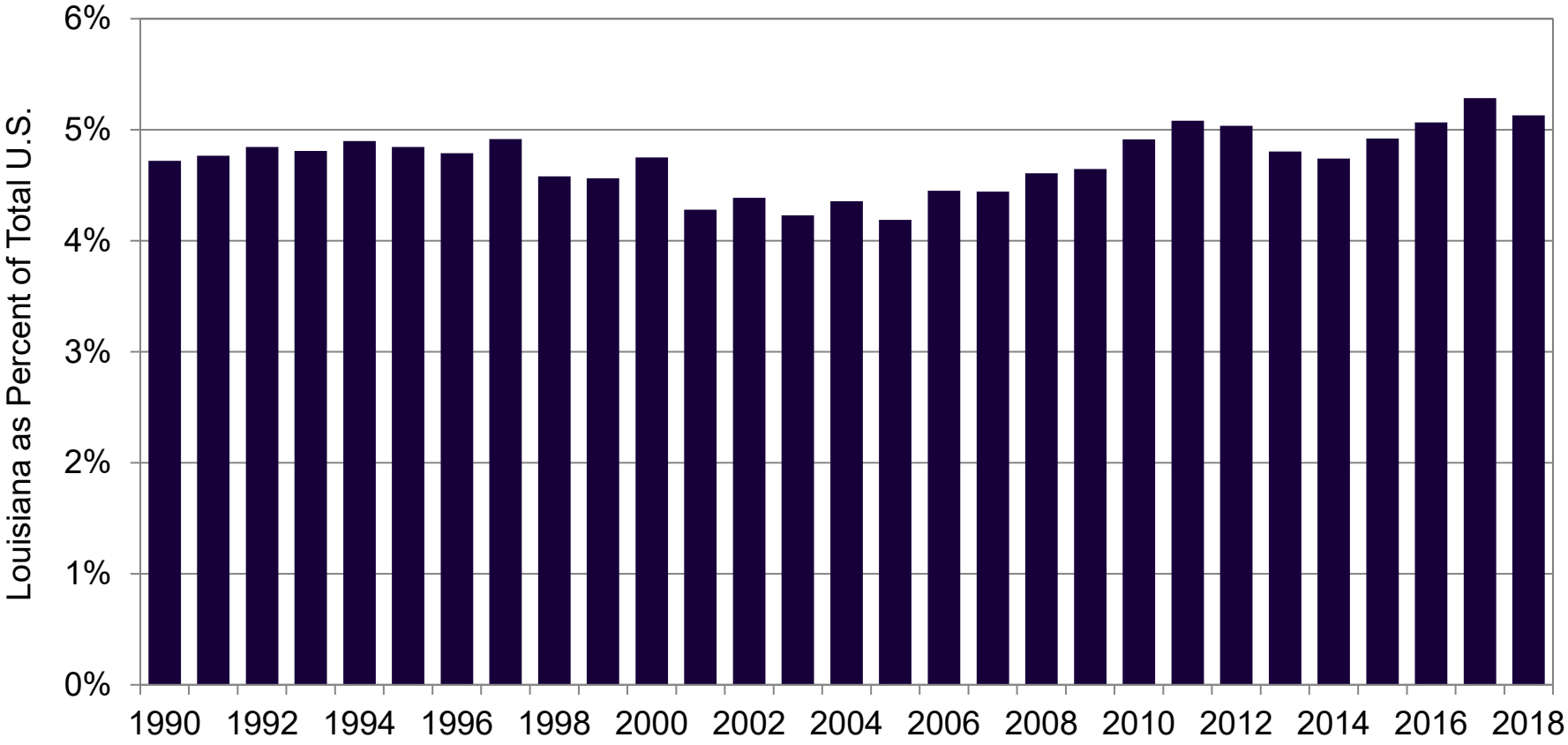
Louisiana also tends to be significantly more efficient in emissions per unit of energy consumed. Louisiana's high reliance on relatively clean-burning natural gas is one of the primary sources of this competitive emissions advantages.



Source: U.S. Environmental Protection Agency, State CO2 Emissions from Fossil Fuel Combustion. Available at: https://www.epa.gov/statelocalenergy/state-co2-emissions-fossil-fuel-combustion; and U.S. Energy Information Administration, Detailed State Electricity Data. Available at: https://www.eia.gov/electricity/data/state/

Louisiana share of total U.S. CO_2 emissions

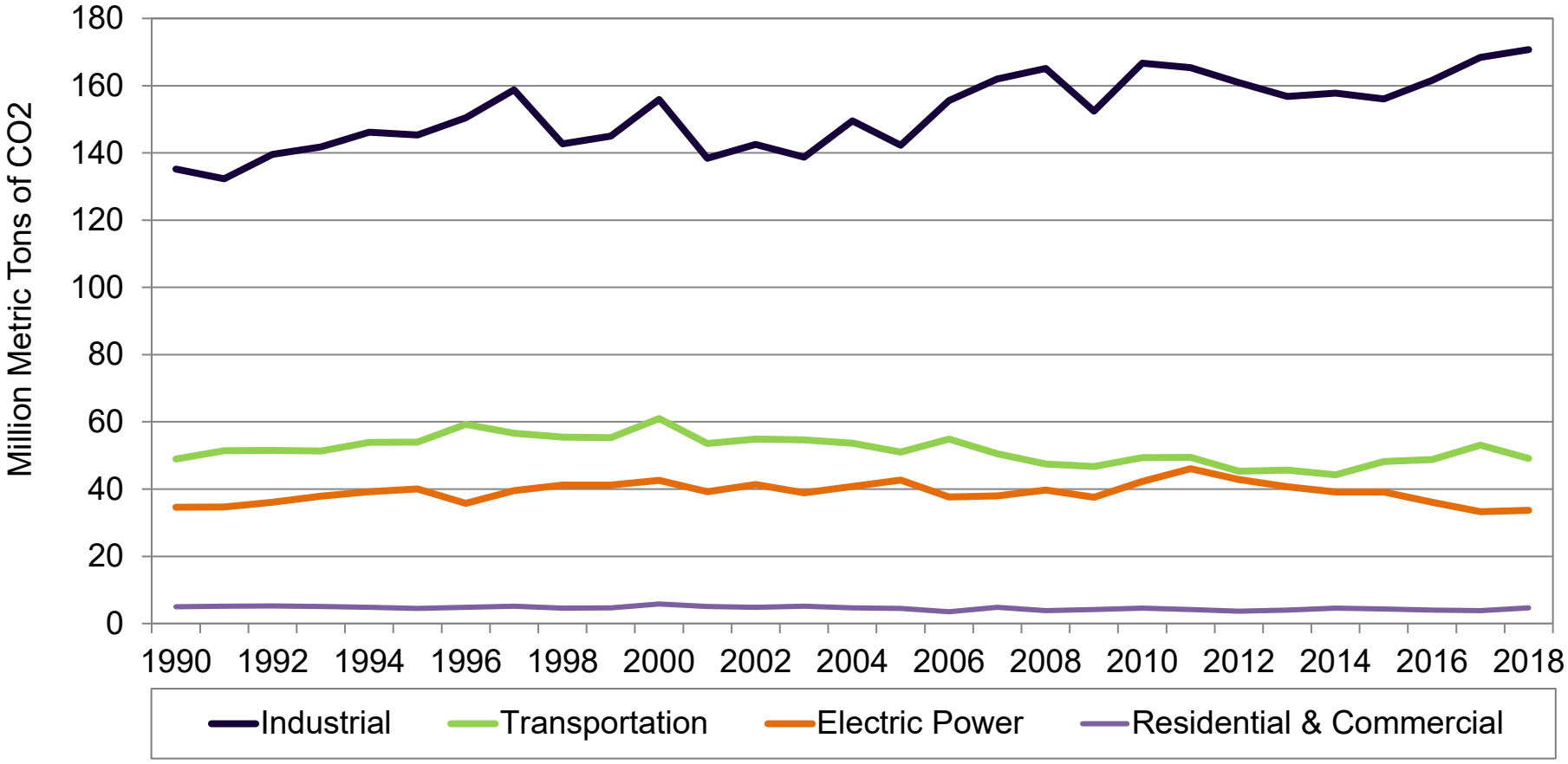
Louisiana's share of total U.S. CO_2 emissions has been between four and five percent. Louisiana now accounts for just over five percent of all U.S. carbon emissions.



Note: CO_2 emissions are from fossil fuel combustion only.
Source: U.S. Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018; and State CO_2 Emissions from Fossil Fuel Combustion.

Louisiana CO_2 emissions per sector

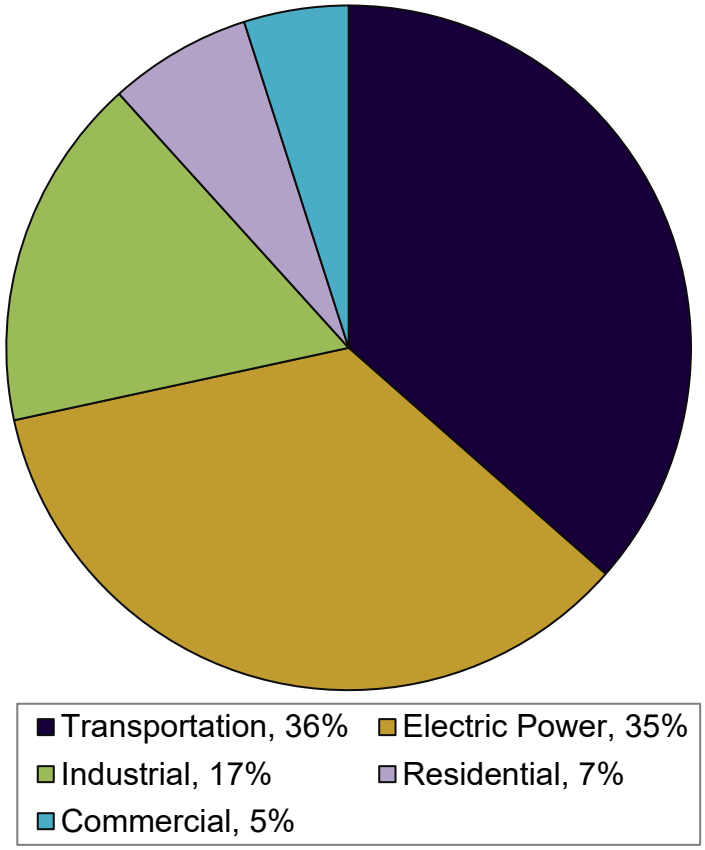
Louisiana carbon emissions have been dominated by the industrial sector.



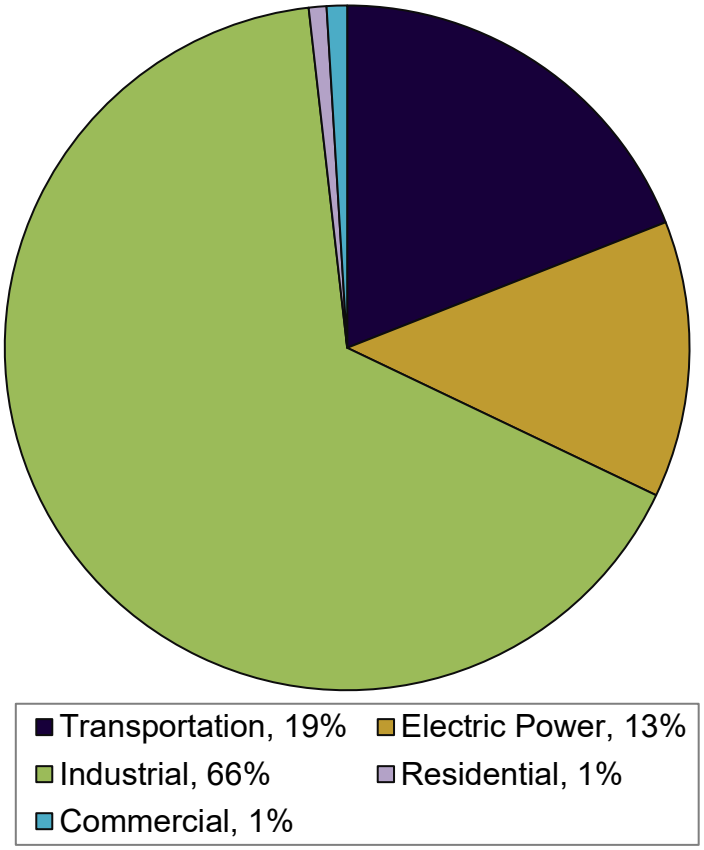
Note: CO_2 emissions are from fossil fuel combustion only.
Source: U.S. Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018; and State CO_2 Emissions from Fossil Fuel Combustion.

U.S. and Louisiana CO_2 emissions per sector, 2018

In the U.S., power generation comprises about 35 percent of overall national emissions.



In Louisiana, power generation comprises about 17 percent of overall state emissions. Louisiana's primary source of CO_2 emissions comes from industrial sources.



Note: CO_2 emissions are from fossil fuel combustion only.
Source: U.S. Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018; and State CO_2 Emissions from Fossil Fuel Combustion.

Section 2: 2010 Greenhouse Gas Inventory

2010 Study: Objectives

- Develop a **comprehensive state-wide greenhouse gas inventory.**
- **Conduct a thorough review of measures being taken or contemplated by other states to accommodate climate change** concerns or expected federal greenhouse gas regulations.
- Prepare a **high-level assessment of the impacts of the most likely federal greenhouse gas regulatory schemes on Louisiana's economy.**
- Prepare a **list of potential state and industry strategies** for responding to requirements and opportunities brought by federal greenhouse gas regulation.

2010 Study: Methodology

- The **EPA's State Inventory Tool (SIT) was the principal method employed in the state's GHG inventory**. Emission estimations are calculated across specific sources of emissions within economic sectors such as residential, commercial, mobile, industrial, and agricultural.
- **Emphasis was placed on CO2 emissions; however, all six internationally-recognized GHG gases were included** in the inventories: CO2, methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexaflouride (SF6).
- **2005 was selected for the inventory because U.S. climate legislation employed that year as the base year** against which emission reductions would be compared.

2010 Study: Sources

- The **EPA's State Inventory Tool (SIT) was used because it is a proven and vetted calculation tool, is consistent for all states, and is readily available.** It is also a "top-down" model that uses state-level data.
- Other sources utilized:
  - Energy Information Administration (EIA)
  - Louisiana Department of Natural Resources (LDNR) and other relevant federal and state agencies
  - World Resources Institute Climate Analysis Indicators Tool (CAIT-US) Version 3.0
  - Input from our Project Advisory Team, and information developed during an earlier GHG inventory prepared by CES for LDNR in 2000.

2010 Study: Areas of Focus

- **The 2010 GHG study was segmented across the following areas:**
  - State-Level Emissions
  - Source-Specific Emissions
  - Sector-Specific Emissions
  - Emissions Projections
- **Most sub-sections (especially those that were based upon the EPA's SIT tool) included the following elements:**
  - Overview
  - Historical emissions
  - Data assessment
  - Results

Summary of 2010 results.

Not surprisingly, most emissions come from direct combustion of fossil fuels.

	Greenhouse Gas	CO_2 Equivalent Emissions MMT	Percent Total Emissions
Energy			
CO_2 from fossil fuel combustion	CO_2	191.32	84.0%
Stationary combustion (non-CO_2)	CH_4	0.18	0.1%
	N_2O	0.42	0.2%
Mobile combustion (non-CO_2)	CH_4	0.06	0.0%
	N_2O	0.92	0.4%
Natural gas & oil systems	CO_2	0.25	0.1%
	CH_4	13.13	5.8%
Coal mining	CH_4	0.04	0.0%
Industrial Processes	CO_2	3.30	1.4%
	N_2O	3.27	1.4%
	HFC, PFC,SF_6	6.85	3.0%
Wastes			
Municipal solid waste	CH_4	0.37	0.2%
Wastewater	CH_4	0.65	0.3%
	N_2O	0.13	0.1%
Agriculture	CH_4	2.76	1.2%
	N_2O	3.68	1.6%
Land-use Change & Forestry	CH_4	0.17	0.1%
	N_2O	0.13	0.1%
	CO_2	-13.02	
Total Gross CO_2		227.66	100.00%
Total Net CO_2		214.64	

Section 3: 2020 Greenhouse Gas Inventory

2020 Study: Methodology

- The 2020 study, like the 2010 study, **will rely heavily upon the EPA's State Inventory Tool (SIT)** in order to estimate emissions across specific sources.
- Also, like the 2010 study, emphasis will be placed on CO_2 emissions; **however, all six internationally-recognized GHG gases will be included in the inventories**: CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexaflouride (SF_6).
- The 2020 GHG inventory will largely **analyze the same sets of sources and sectors** that previous GHG inventories were based upon.

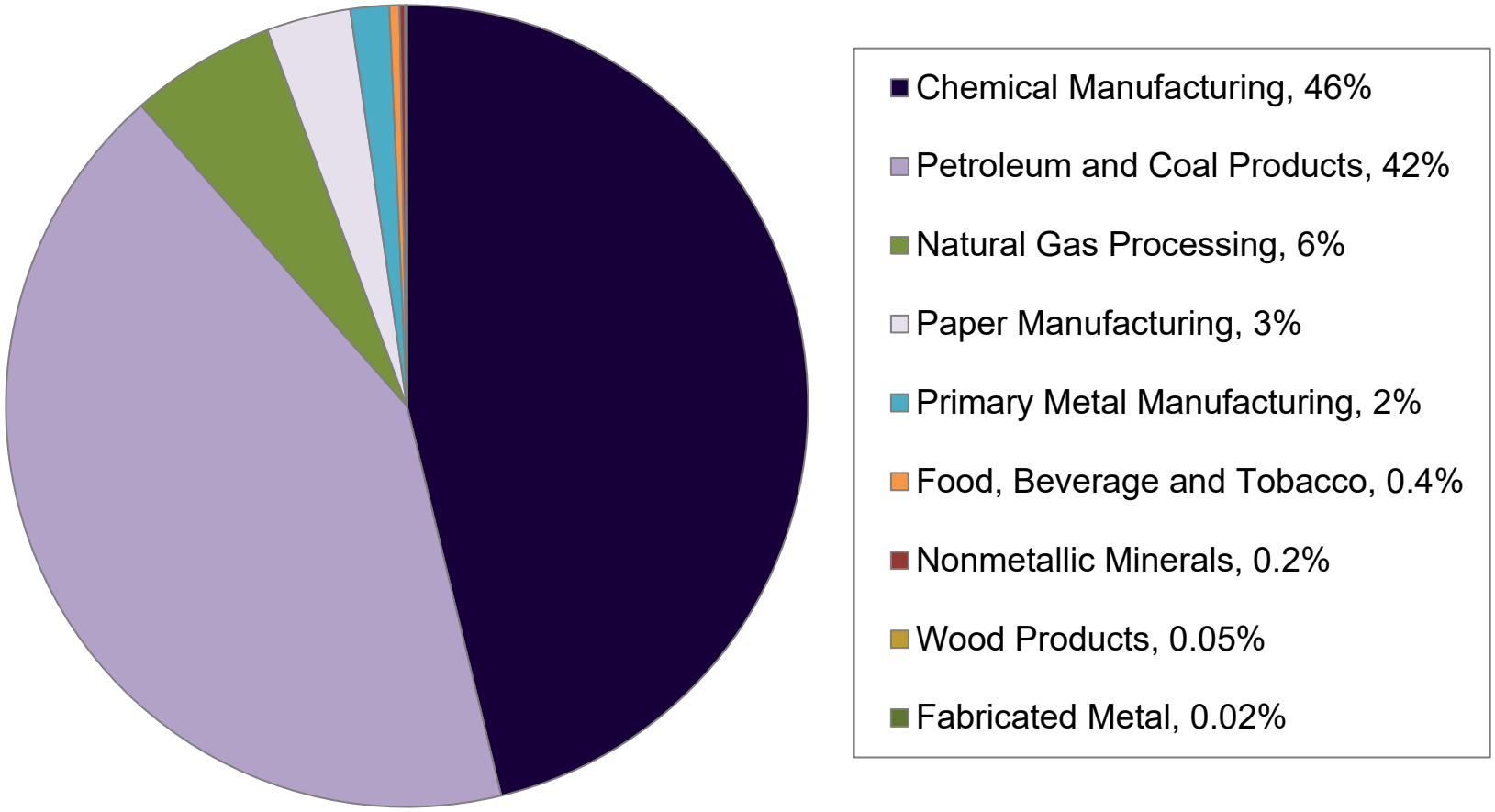
Potential Additions to 2020 Greenhouse Gas Inventory

2010 Study **explicitly made no attempt to break-out greenhouse gas emissions by industrial sub-sector**.

- **Industrial sector greenhouse gas emissions were found in the 2010 study to comprise nearly half (49 percent) of all state emissions.**
- Industrial emissions could be separated by sub-sector based on 2007 North American Industry Classification System (NAICS)
- Majority of industrial sector emissions were determined in the 2010 analysis to be driven by electric power consumption.

Example: Potential industrial decomposition (Prior CES-CCUS Feasibility Study).

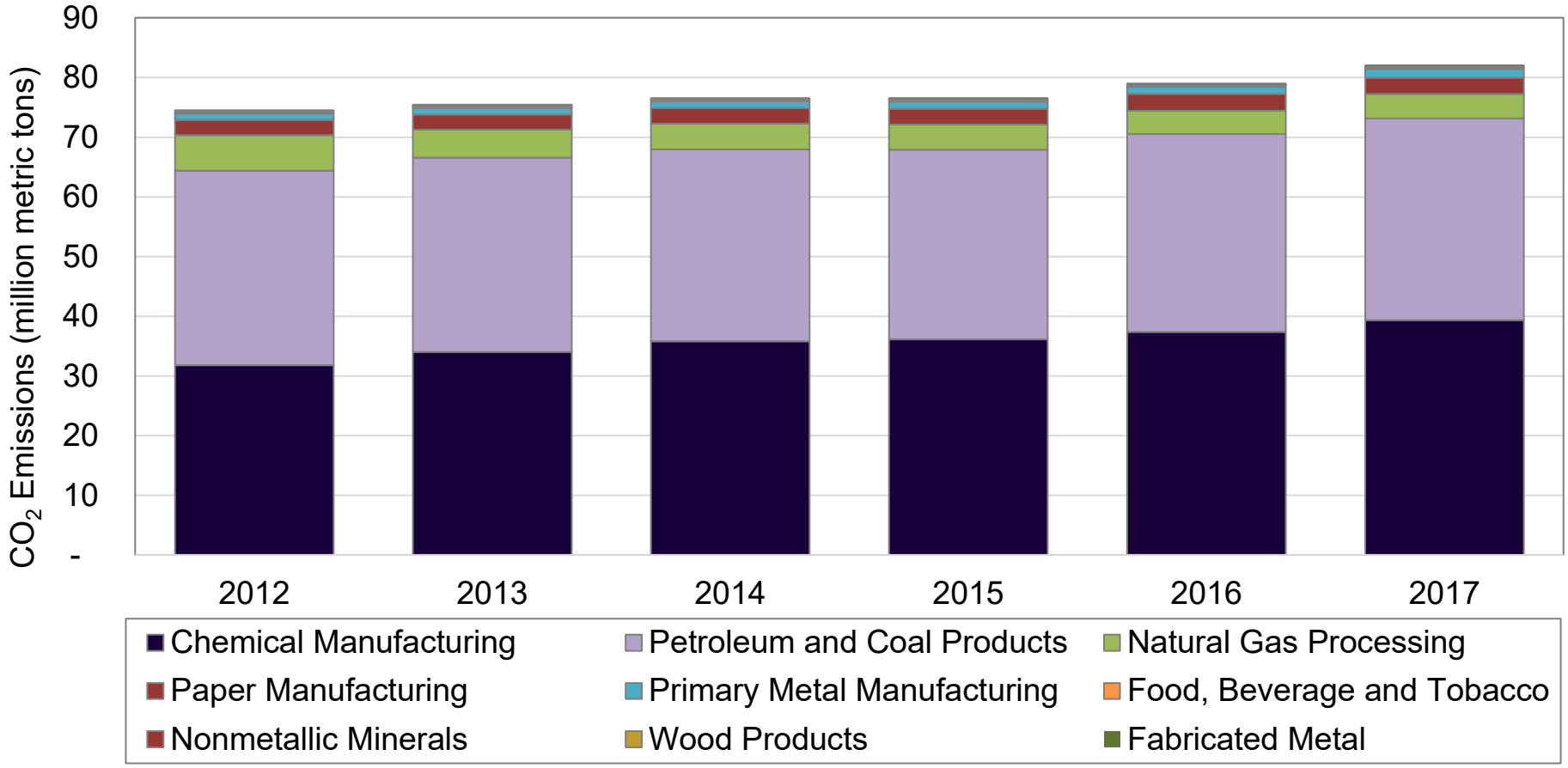
Most of the Louisiana industrial CO_2 emissions are concentrated in the chemical and refining sectors. Natural gas processing is a distant third.



Source: U.S. EPA Envirofacts.

Louisiana industrial and gas processing facilities, CO_2 emissions.

Refinery-related activity has led to the relatively larger 2016 emissions increase; while chemical manufacturing increased in 2017.



Source: U.S. EPA Envirofacts.

Louisiana industrial and gas processing facilities, top 10 CO_2 emitters.

Industrial emissions come from stationary combustion as well as other industrial operations. **This differentiation is important since the cost of capturing CO2 from chemical/refinery emissions is much lower than capturing from individual stationary combustion sources.** The largest source, however, is to the north of the industrial corridor at the state's largest ammonia plant.

Facility Name	Facility Type	Stationary Combustion	Electricity Generation	Ammonia Production	Hydrogen Production	Petrochemical Production	Refining
		(metric tons total emissions)					
CF Industries Nitrogen - Donaldsonville	Chemical Manufacturing	14,277,707	-	21,405,086	-	-	-
ExxonMobil - Baton Rouge Refinery	Petroleum and Coal Products	27,039,348	-	-	-	222,825	10,200,415
Citgo Petroleum - Lake Charles	Petroleum and Coal Products	20,730,968	-	-	-	-	7,077,450
Norco Manufacturing Complex	Petroleum and Coal Products	15,448,233	-	-	126,668	330,827	6,886,008
Marathon Petroleum Company	Petroleum and Coal Products	16,794,081	-	-	-	-	6,891,871
Union Carbide Corp, St Charles	Chemical Manufacturing	13,821,670	-	-	-	2,710,378	-
Valero Refining - New Orleans	Petroleum and Coal Products	5,869,363	-	-	3,781,646	-	5,981,683
Eagle US 2 LLC	Chemical Manufacturing	7,710,797	9,381,927	-	-	130,391	-
Phillips 66 - Alliance Refinery	Petroleum and Coal Products	8,901,410	-	-	-	-	5,172,241
Motiva Enterprises - Convent Refinery	Petroleum and Coal Products	7,572,384	-	-	130,006	-	5,429,001
Total		**138,165,960**	**9,381,927**	**21,405,086**	**4,038,319**	**3,394,421**	**47,638,669**

Source: U.S. EPA Envirofacts.

Data Inputs for EPA's State Inventory Tool – Agriculture

- The agricultural module for the SIT will be consistent with those of the 2010 study and range across some of the following areas:
  - Enteric Fermentation
  - Manure Management
  - Agricultural soils
  - Rice Cultivation
  - Agricultural Residue Burning

Data Inputs for EPA's State Inventory Tool – Land-Use Change and Forestry

- The land-use change and forestry module for the SIT will be consistent with those of the 2010 study and range across some of the following areas:
  - Forest Carbon Flux
  - Urban Trees
  - Landfilled Yard Trimmings and Food Scraps
- In addition, the module will consider some of the following new data types:
  - Land Converted to Forest Land
  - Forest Land Converted to Land

Data Inputs for EPA's State Inventory Tool – Waste Management

- The waste management module for the SIT will be consistent with those of the 2010 study and range across some of the following areas:
  - Municipal solid waste landfills (CH_4)
  - Methane flaring at landfills (CH_4)
  - Landfill gas recovered (CH_4)

Current Status

- SIT has been compiled and preliminary estimates have been conducted.
- Generator-specific emissions analysis has been completed. Also have preliminary estimates of (a) electric consumption SIT module and (b) fossil fuel combustion (generation) sector in the fossil fuel SIT module. These will need to be reconciled.
- Site-specific industrial emissions have been updated. These will need to be reconciled with the fossil fuel combustion SIT module and oil and gas systems SIT module.
- Preliminary estimates by SIT module will be provided to SAG chairs no later than week of April 5, 2021. One powerpoint will be provided per SIT module along with estimates and data.

Section 4: Preliminary Analysis: Fossil fuel combustion

SIT module results: fossil fuel consumption overview

- Most GHG emissions arise from the combustion of fossil fuels.
- Fossil fuel consumption is ubiquitous across over every major economic sector.
- The GHG state inventory tool estimates fossil fuel-related emissions across six sectors/areas: residential; commercial; transportation; electric power; bunker fuels; and industrial.
- Coal, petroleum, and natural gas are the main emitters of fossil fuels from combustion
- For Louisiana, the industrial sector is the largest GHG emitter followed by the transportation and electric power sectors.

Mathematics of estimating fossil fuel emissions – general equation

The fossil fuel module estimates the carbon content of fossil fuels, in tons, converts to metric tons, and then standardizes to CO_2 equivalent. This is done for each fuel type and for each economic sector

Emissions ($MMTCO_2E$) =
Consumption (BBtu) × Emission Factor (lbs C/BBtu) × 0.0005 short ton/lbs × Combustion Efficiency (% as a decimal) × 0.9072 (Ratio of Short Tons to Metric Tons) ÷ 1,000,000 × (44/12) (to yield $MMTCO_2E$)

Mathematics of estimating fossil fuel emissions – industrial equation

Primary difference is in non-energy consumption – or "feedstock" energy consumption

Emissions ($MMTCO_2E$) =
(Total Consumption (BBtu) – [Non-Energy Consumption (BBtu) × Storage Factor (%)]
× Emission Factor (lbs C/BBtu) × Combustion Efficiency (% as a decimal))
× 0.9072 (Ratio of Short Tons to Metric Tons) ÷ 1,000,000 × (44/12) (to yield $MMTCO_2E$)

Combustion of Fossil Fuels - Residential

Residential fuel types

Residential Sector 2017

Fuel Type	Consumption (Billion Btu)		Emission Factor (lbs C/Million Btu)		Combustion Efficiency (%)		Emissions (short tons carbon)		Emissions (MMTCE)		Emissions ($MMTCO_2E$)
Coal	-	x	62.02	x	100.0%	=	-	=	0.000	=	0.000
Distillate Fuel	44	x	44.47	x	100.0%	=	978	=	0.001	=	0.003
Kerosene	2	x	44.01	x	100.0%	=	44	=	0.000	=	0.000
Hydrocarbon Gas Liquids	1,699	x	37.11	x	100.0%	=	31,525	=	0.029	=	0.105
Natural Gas	29,680	x	31.90	x	100.0%	=	473,396	=	0.429	=	1.575
Other	-	x		x		=	-	=	0.000	=	0.000

Residential Sector 2018

Fuel Type	Consumption (Billion Btu)		Emission Factor (lbs C/Million Btu)		Combustion Efficiency (%)		Emissions (short tons carbon)		Emissions (MMTCE)		Emissions ($MMTCO_2E$)
Coal	-	x	62.02	x	100.0%	=	-	=	0.000	=	0.000
Distillate Fuel	8	x	44.47	x	100.0%	=	178	=	0.000	=	0.001
Kerosene	4	x	44.01	x	100.0%	=	88	=	0.000	=	0.000
Hydrocarbon Gas Liquids	1,748	x	37.11	x	100.0%	=	32,434	=	0.029	=	0.108
Natural Gas	38,629	x	31.90	x	100.0%	=	616,133	=	0.559	=	2.049
Other	-	x		x		=	-	=	0.000	=	0.000

Combustion of Fossil Fuels - Industrial

Feedstock uses.

Industrial Sector 2018

☑ Default Non-Energy Consumption Data

Fuel Type	Total Consumption (Billion Btu)		Non-Energy Consumption (Billion Btu)		Storage Factor (%)		Net combustible Consumption (Billion Btu)		Emission Factor (lbs C/Million Btu)		Combustion Efficiency (%)		Emissions (short tons carbon)		Emissions (MMTCE)		Emissions ($MMTCO_2E$)
Coking Coal	-	- (	-	×	10%	) =	-	×	0.00	×	100.0%	=	-	=	0.000	=	0.000
Other Coal	3,960	- (	77	×	0%	) =	3,960	×	55.85	×	100.0%	=	110,592	=	0.100	=	0.368
Asphalt and Road Oil	15,039	- (	15,039	×	100%	) =	66	×	45.31	×	100.0%	=	1,496	=	0.001	=	0.005
Aviation Gasoline Blending Components	(276)	- (	-	×	0%	) =	(276)	×	41.60	×	100.0%	=	(5,741)	=	-0.005	=	-0.019
Crude Oil	-	- (	-	×	0%	) =	-	×	44.77	×	100.0%	=	-	=	0.000	=	0.000
Distillate Fuel	31,937	- (	170	×	50%	) =	31,852	×	44.47	×	100.0%	=	708,230	=	0.642	=	2.356
Feedstocks, Naphtha less than 401 F	65,677	- (	61,447	×	62%	) =	27,288	×	40.90	×	100.0%	=	558,038	=	0.506	=	1.856
Feedstocks, Other Oils greater than 401 F	239,081	- (	217,698	×	62%	) =	103,074	×	44.47	×	100.0%	=	2,291,853	=	2.079	=	7.623
Kerosene	41	- (	-	×	0%	) =	41	×	44.01	×	100.0%	=	902	=	0.001	=	0.003
LPG	625,348	- (	552,401	×	62%	) =	280,236	×	37.07	×	100.0%	=	5,193,959	=	4.712	=	17.277
Lubricants	3,058	- (	3,058	×	9%	) =	2,783	×	44.53	×	100.0%	=	61,959	=	0.056	=	0.206
Motor Gasoline	3,675	- (	-	×	0%	) =	3,675	×	42.90	×	100.0%	=	78,830	=	0.072	=	0.262
Motor Gasoline Blending Components	-	- (	-	×	0%	) =	-	×	42.90	×	100.0%	=	-	=	0.000	=	0.000
Misc. Petro Products	29,248	- (	29,248	×	0%	) =	29,248	×	44.77	×	100.0%	=	654,770	=	0.594	=	2.178
Petroleum Coke	98,809	- (	-	×	30%	) =	98,809	×	61.39	×	100.0%	=	3,032,942	=	2.751	=	10.089
Pentanes Plus	32,988	- (	15,402	×	62%	) =	23,366	×	42.10	×	100.0%	=	491,844	=	0.446	=	1.636
Residual Fuel	3,812	- (	-	×	50%	) =	3,812	×	45.15	×	100.0%	=	86,056	=	0.078	=	0.286
Still Gas	286,652	- (	29,673	×	65%	) =	267,265	×	40.11	×	100.0%	=	5,359,996	=	4.862	=	17.829
Special Naphthas	1,308	- (	1,229	×	0%	) =	1,308	×	43.51	×	100.0%	=	28,456	=	0.026	=	0.095
Unfinished Oils	5,487	- (	-	×	0%	) =	5,487	×	44.77	×	100.0%	=	122,837	=	0.111	=	0.409
Waxes	147	- (	147	×	58%	) =	62	×	43.64	×	100.0%	=	1,347	=	0.001	=	0.004
Natural Gas	1,341,378	- (	40,624	×	62%	) =	1,315,998	×	31.90	×	100.0%	=	20,990,168	=	19.042	=	69.820
Other	-	- (		×		) =	-	×		×		=	-	=	0.000	=	0.000

Non-energy related emissions (feedstock uses)/shares (fossil fuels)

Feedstock shares based on national industry averages

National Non-Energy Consumption %'s	2	3	4	5	6	26	27	28	29	30
	1990	**1991**	**1992**	**1993**	**1994**	**2014**	**2015**	**2016**	**2017**	**2018**
Industrial Sector										
Coking Coal	0%	0%	0%	100%	100%	100%	100%	100%	100%	100%
Other Coal	0%	1%	1%	1%	1%	1%	1%	2%	2%	2%
Natural Gas	4%	3%	3%	4%	4%	4%	4%	3%	3%	3%
Asphalt and Road Oil	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
LPG	73%	77%	73%	73%	76%	91%	88%	86%	87%	88%
Lubricants	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pentanes Plus	47%	47%	47%	46%	47%	49%	49%	47%	47%	47%
Feedstocks, Naphtha less than 401 F	94%	93%	94%	93%	94%	98%	98%	94%	94%	94%
Feedstocks, Other Oils greater than 401 F	88%	90%	83%	79%	76%	96%	95%	92%	92%	91%
Still Gas	2%	3%	2%	3%	2%	11%	11%	10%	10%	10%
Petroleum Coke	4%	2%	9%	3%	6%	0%	0%	0%	0%	0%
Special Naphthas	94%	94%	94%	93%	95%	98%	98%	95%	95%	94%
Distillate Fuel	1%	1%	1%	1%	1%	0%	1%	1%	1%	1%
Residual Fuel	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Waxes	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Misc. Petro Products	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Other Coal	0%	1%	1%	1%	1%	1%	1%	2%	2%	2%
Aviation Gasoline Blending Components	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Crude Oil	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Kerosene	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Motor Gasoline	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Motor Gasoline Blending Components	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Unfinished Oils	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Transportation	**1990**	**1991**	**1992**	**1993**	**1994**	**2014**	**2015**	**2016**	**2017**	**2018**
Lubricants	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Section 5: Preliminary Analysis: Electricity consumption

Electricity emission factors

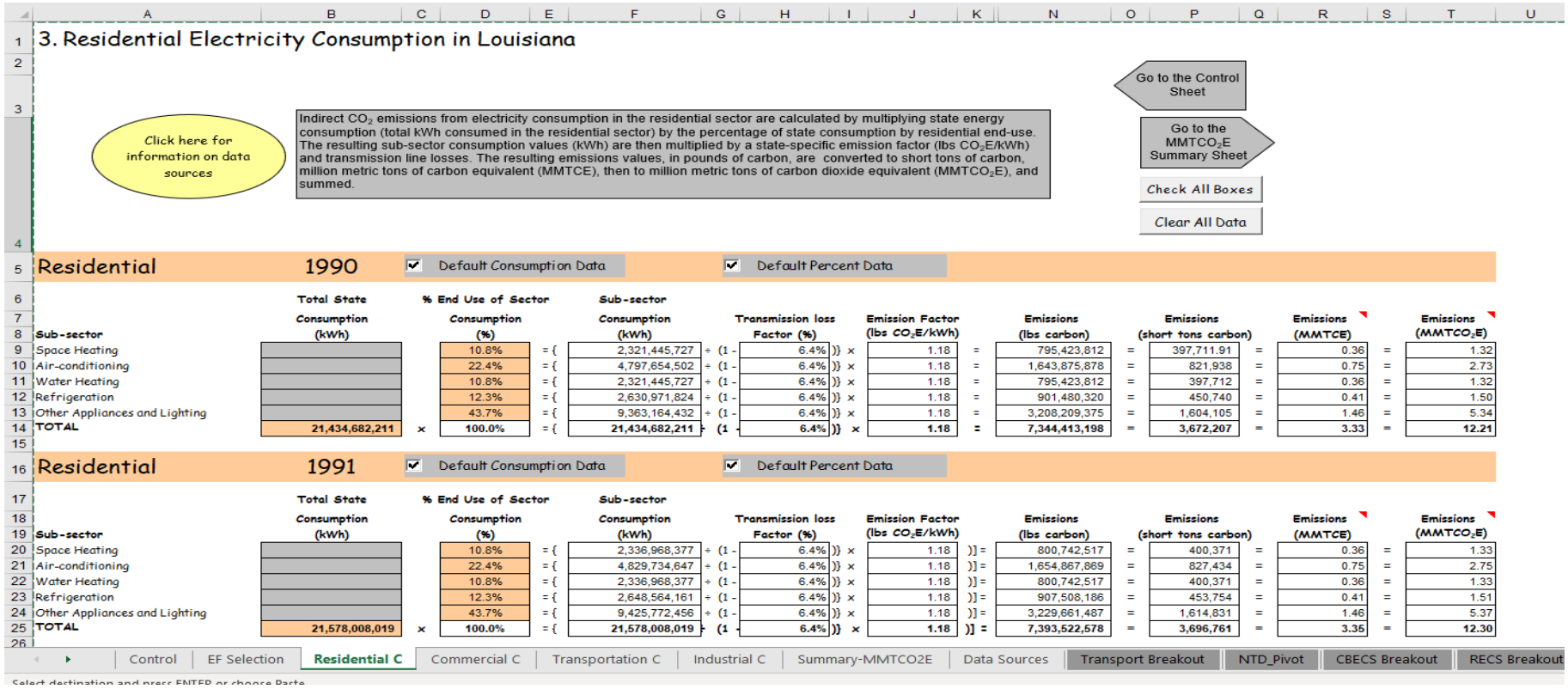
- Electricity emission factors are derived from the generation that is utilized to make the electricity which is consumed across end-user classes.
- These emission factors, in turn, are a function of the fuel mix and generation profiles of the utilities in a respective state.
- Emission factors are measured in terms of pounds per megawatthour (“MWh”) generated/consumed.
- Utilities with relatively-higher shares of coal generation (and other fossil fuels) will have higher emission factors than those that are more concentrated by nuclear, high efficiency natural gas turbines, high efficiency industrial cogeneration and renewables.
- Emission factors come from EPA’s eGRID database.

Calculation/Formulas

$$\text{Emissions}_i = (\text{consumption}_i / \text{losses}_i) \times EF$$

$$\text{Total EC emissions} = \sum_{i=1}^{n} emissions_i$$

ECM module layout (residential)



3. Residential Electricity Consumption in Louisiana

Go to the Control Sheet

Go to the $MMTCO_2E$ Summary Sheet

Check All Boxes

Clear All Data

Click here for information on data sources

Indirect CO_2 emissions from electricity consumption in the residential sector are calculated by multiplying state energy consumption (total kWh consumed in the residential sector) by the percentage of state consumption by residential end-use. The resulting sub-sector consumption values (kWh) are then multiplied by a state-specific emission factor (lbs CO_2E/kWh) and transmission line losses. The resulting emissions values, in pounds of carbon, are converted to short tons of carbon, million metric tons of carbon equivalent (MMTCE), then to million metric tons of carbon dioxide equivalent ($MMTCO_2E$), and summed.

Residential 1990 — Default Consumption Data — Default Percent Data

Sub-sector	Total State Consumption (kWh)		% End Use of Sector Consumption (%)		Sub-sector Consumption (kWh)		Transmission loss Factor (%)		Emission Factor (lbs CO_2E/kWh)		Emissions (lbs carbon)		Emissions (short tons carbon)		Emissions (MMTCE)		Emissions ($MMTCO_2E$)
Space Heating			10.8%	= {	2,321,445,727	÷ (1 -	6.4%	)} ×	1.18	=	795,423,812	=	397,711.91	=	0.36	=	1.32
Air-conditioning			22.4%	= {	4,797,654,502	÷ (1 -	6.4%	)} ×	1.18	=	1,643,875,878	=	821,938	=	0.75	=	2.73
Water Heating			10.8%	= {	2,321,445,727	÷ (1 -	6.4%	)} ×	1.18	=	795,423,812	=	397,712	=	0.36	=	1.32
Refrigeration			12.3%	= {	2,630,971,824	÷ (1 -	6.4%	)} ×	1.18	=	901,480,320	=	450,740	=	0.41	=	1.50
Other Appliances and Lighting			43.7%	= {	9,363,164,432	÷ (1 -	6.4%	)} ×	1.18	=	3,208,209,375	=	1,604,105	=	1.46	=	5.34
TOTAL	**21,434,682,211**	×	**100.0%**	= {	**21,434,682,211**	÷ (1 -	**6.4%**	)} ×	**1.18**	=	**7,344,413,198**	=	**3,672,207**	=	**3.33**	=	**12.21**

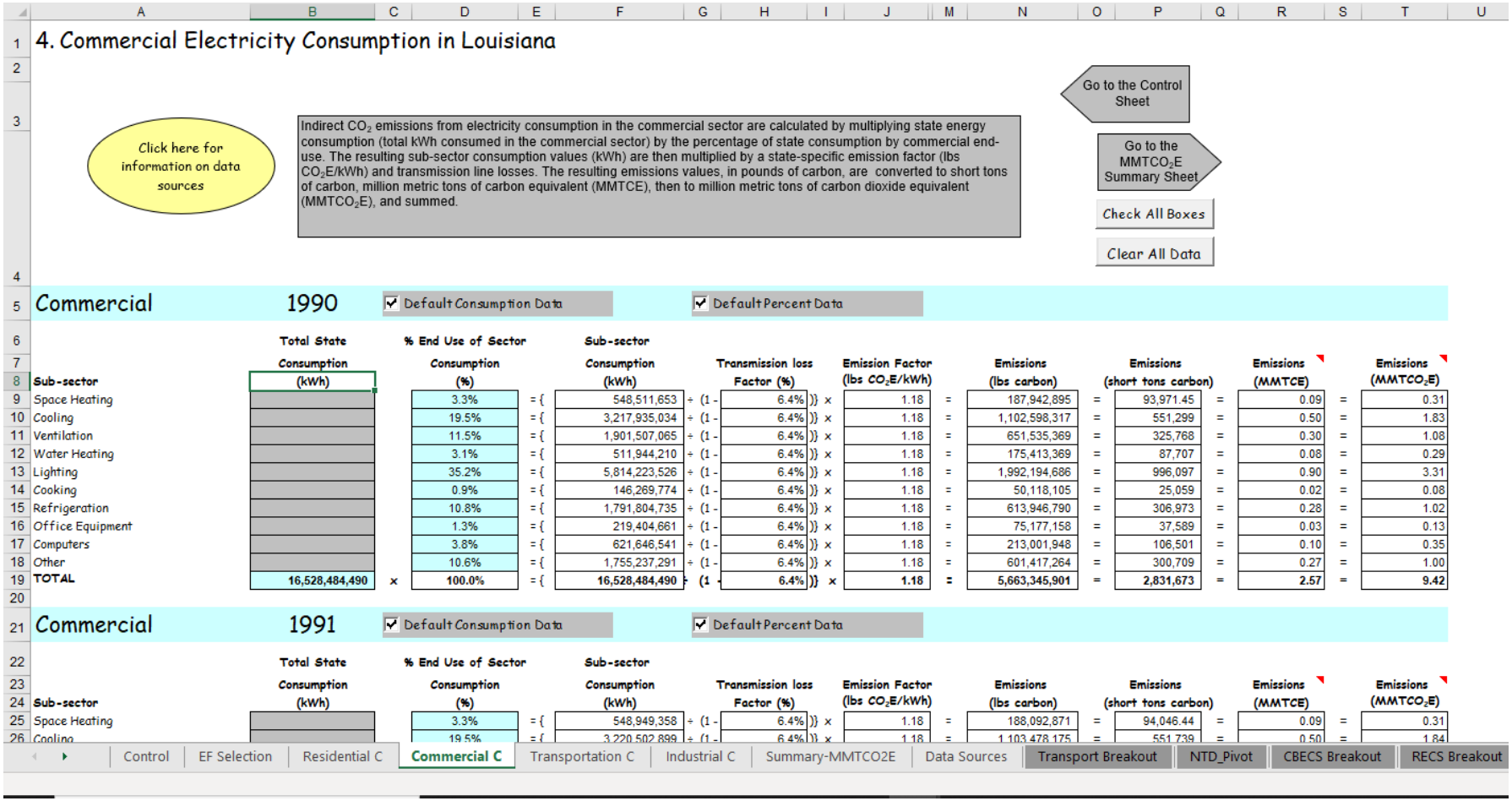
Residential 1991 — Default Consumption Data — Default Percent Data

Sub-sector	Total State Consumption (kWh)		% End Use of Sector Consumption (%)		Sub-sector Consumption (kWh)		Transmission loss Factor (%)		Emission Factor (lbs CO_2E/kWh)		Emissions (lbs carbon)		Emissions (short tons carbon)		Emissions (MMTCE)		Emissions ($MMTCO_2E$)
Space Heating			10.8%	= {	2,336,968,377	÷ (1 -	6.4%	)} ×	1.18	)] =	800,742,517	=	400,371	=	0.36	=	1.33
Air-conditioning			22.4%	= {	4,829,734,647	÷ (1 -	6.4%	)} ×	1.18	)] =	1,654,867,869	=	827,434	=	0.75	=	2.75
Water Heating			10.8%	= {	2,336,968,377	÷ (1 -	6.4%	)} ×	1.18	)] =	800,742,517	=	400,371	=	0.36	=	1.33
Refrigeration			12.3%	= {	2,648,564,161	÷ (1 -	6.4%	)} ×	1.18	)] =	907,508,186	=	453,754	=	0.41	=	1.51
Other Appliances and Lighting			43.7%	= {	9,425,772,456	÷ (1 -	6.4%	)} ×	1.18	)] =	3,229,661,487	=	1,614,831	=	1.46	=	5.37
TOTAL	**21,578,008,019**	×	**100.0%**	= {	**21,578,008,019**	÷ (1 -	**6.4%**	)} ×	**1.18**	)] =	**7,393,522,578**	=	**3,696,761**	=	**3.35**	=	**12.30**

Control | EF Selection | Residential C | Commercial C | Transportation C | Industrial C | Summary-MMTCO2E | Data Sources | Transport Breakout | NTD_Pivot | CBECS Breakout | RECS Breakout

Select destination and press ENTER or choose Paste

ECM module layout (commercial)



4. Commercial Electricity Consumption in Louisiana

Click here for information on data sources

Indirect CO_2 emissions from electricity consumption in the commercial sector are calculated by multiplying state energy consumption (total kWh consumed in the commercial sector) by the percentage of state consumption by commercial end-use. The resulting sub-sector consumption values (kWh) are then multiplied by a state-specific emission factor (lbs CO_2E/kWh) and transmission line losses. The resulting emissions values, in pounds of carbon, are converted to short tons of carbon, million metric tons of carbon equivalent (MMTCE), then to million metric tons of carbon dioxide equivalent ($MMTCO_2E$), and summed.

Go to the Control Sheet

Go to the $MMTCO_2E$ Summary Sheet

Check All Boxes

Clear All Data

Commercial 1990 — Default Consumption Data — Default Percent Data

Sub-sector	Total State Consumption (kWh)		% End Use of Sector Consumption (%)		Sub-sector Consumption (kWh)		Transmission loss Factor (%)		Emission Factor (lbs CO_2E/kWh)		Emissions (lbs carbon)		Emissions (short tons carbon)		Emissions (MMTCE)		Emissions ($MMTCO_2E$)
Space Heating			3.3%	= {	548,511,653	÷ (1 -	6.4%	)} x	1.18	=	187,942,895	=	93,971.45	=	0.09	=	0.31
Cooling			19.5%	= {	3,217,935,034	÷ (1 -	6.4%	)} x	1.18	=	1,102,598,317	=	551,299	=	0.50	=	1.83
Ventilation			11.5%	= {	1,901,507,065	÷ (1 -	6.4%	)} x	1.18	=	651,535,369	=	325,768	=	0.30	=	1.08
Water Heating			3.1%	= {	511,944,210	÷ (1 -	6.4%	)} x	1.18	=	175,413,369	=	87,707	=	0.08	=	0.29
Lighting			35.2%	= {	5,814,223,526	÷ (1 -	6.4%	)} x	1.18	=	1,992,194,686	=	996,097	=	0.90	=	3.31
Cooking			0.9%	= {	146,269,774	÷ (1 -	6.4%	)} x	1.18	=	50,118,105	=	25,059	=	0.02	=	0.08
Refrigeration			10.8%	= {	1,791,804,735	÷ (1 -	6.4%	)} x	1.18	=	613,946,790	=	306,973	=	0.28	=	1.02
Office Equipment			1.3%	= {	219,404,661	÷ (1 -	6.4%	)} x	1.18	=	75,177,158	=	37,589	=	0.03	=	0.13
Computers			3.8%	= {	621,646,541	÷ (1 -	6.4%	)} x	1.18	=	213,001,948	=	106,501	=	0.10	=	0.35
Other			10.6%	= {	1,755,237,291	÷ (1 -	6.4%	)} x	1.18	=	601,417,264	=	300,709	=	0.27	=	1.00
TOTAL	16,528,484,490	x	100.0%	= {	16,528,484,490	÷ (1 -	6.4%	)} x	1.18	=	5,663,345,901	=	2,831,673	=	2.57	=	9.42

Commercial 1991 — Default Consumption Data — Default Percent Data

Sub-sector	Total State Consumption (kWh)		% End Use of Sector Consumption (%)		Sub-sector Consumption (kWh)		Transmission loss Factor (%)		Emission Factor (lbs CO_2E/kWh)		Emissions (lbs carbon)		Emissions (short tons carbon)		Emissions (MMTCE)		Emissions ($MMTCO_2E$)
Space Heating			3.3%	= {	548,949,358	÷ (1 -	6.4%	)} x	1.18	=	188,092,871	=	94,046.44	=	0.09	=	0.31
Cooling			19.5%	= {	3,220,502,899	÷ (1 -	6.4%	)} x	1.18	=	1,103,478,175	=	551,739	=	0.50	=	1.84

Control | EF Selection | Residential C | Commercial C | Transportation C | Industrial C | Summary-MMTCO2E | Data Sources | Transport Breakout | NTD_Pivot | CBECS Breakout | RECS Breakout

Section 6: Conclusions

Preliminary numbers – 2018 (not for attribution or dissemination)

Emission Sector Source	Total MMTCO$_2$E
Agricultural	7.83
Combustion of Fossil Fuels	219.74
Coal	0.07
Electricity Consumption	37.55
Industrial Processes	8.74
Land-use, land-use changes, forestry	-35.64
Mobile Combustion	0.36
Natural Gas and Oil[1]	6.92
Solid Waste	2.74
Stationary Combustion	0.09
Wastewater[2]	
Total	248.40

	Greenhouse Gas	CO_2 Equivalent Emissions MMT	Percent Total Emissions
Energy			
CO_2 from fossil fuel combustion	CO_2	191.32	84.0%
Stationary combustion (non-CO_2)	CH_4	0.18	0.1%
	N_2O	0.42	0.2%
Mobile combustion (non-CO_2)	CH_4	0.06	0.0%
	N_2O	0.92	0.4%
Natural gas & oil systems	CO_2	0.25	0.1%
	CH_4	13.13	5.8%
Coal mining	CH_4	0.04	0.0%
Industrial Processes	CO_2	3.30	1.4%
	N_2O	3.27	1.4%
	HFC, PFC, SF_6	6.85	3.0%
Wastes			
Municipal solid waste	CH_4	0.37	0.2%
Wastewater	CH_4	0.65	0.3%
	N_2O	0.13	0.1%
Agriculture	CH_4	2.76	1.2%
	N_2O	3.68	1.6%
Land-use Change & Forestry	CH_4	0.17	0.1%
	N_2O	0.13	0.1%
	CO_2	-13.02	
Total Gross CO_2		227.66	100.00%
Total Net CO_2		214.64	

Conclusions

Major milestones include:

- Various scoping & status mtgs with SAG = 1 to 3 months.
- First, preliminary data & report = 3 to 4 months.
- Second version of data & report = 5 months.
- Task Force briefing/Final Report = 6 months.

Contact Information

David E. Dismukes, Ph.D.
Professor and Executive Director
Center for Energy Studies
Email: dismukes@lsu.edu

Phone: 225-578-4343

URL: www.enrg.lsu.edu