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CLEANER GREENER COMMUNITIES

The New NY WORKS for Business

Central New York Regional Sustainability Plan

visioncny

CNY GHG Inventory Results

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ICF International

CNY RPDB Annual Meeting
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Today's Discussion

OVERVIEW OF INVENTORY DEVELOPMENT PROCESS

BASELINE GHG INVENTORY RESULTS

EMISSIONS SUMMARY

EMISSIONS BY SECTOR

GHG Inventory Process

- NYSERDA convened the NYGHG Working Group to develop a standard NYGHG protocol for regional inventories
- Protocol methodology is based on latest methods determined by the working group, and data provided to the group
- CNY GHG Inventory adheres to the protocol for all sources of emissions
- Emission estimates will feed into the Cleaner Greener Communities Program

INVENTORY RESULTS

GHG Inventory Overview

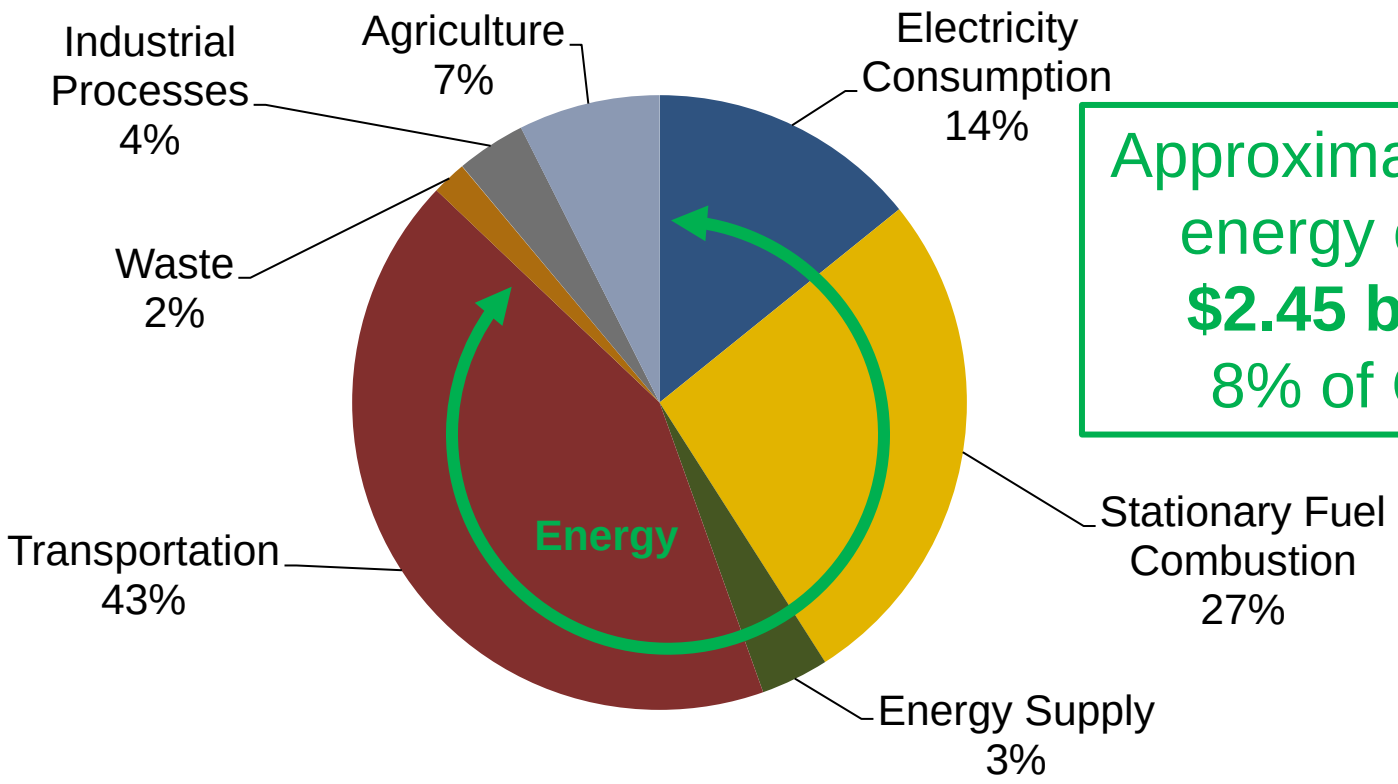
- Tier II Greenhouse Gas (GHG) emissions inventory, 2010
- County- and municipal-level
- Source categories:
  - **Stationary Energy Use**
    - Residential, Commercial, Industrial, and Energy Supply
  - **Mobile Energy Use**
    - On-road, rail, off-road, marine, and aviation*
  - **Solid Waste** (Scope 1* and Scope 3)
  - **Wastewater Treatment**
  - **Agriculture**
  - Land Use, Land Use Change, and Forestry (LULUCF)*
  - Electricity Generation*

*Included for informational purposes only; not included in regional emissions total

Results Summary

- Total 2010 CNY gross emissions: **9.9 million metric tons CO_2e ($MMTCO_2e$)**

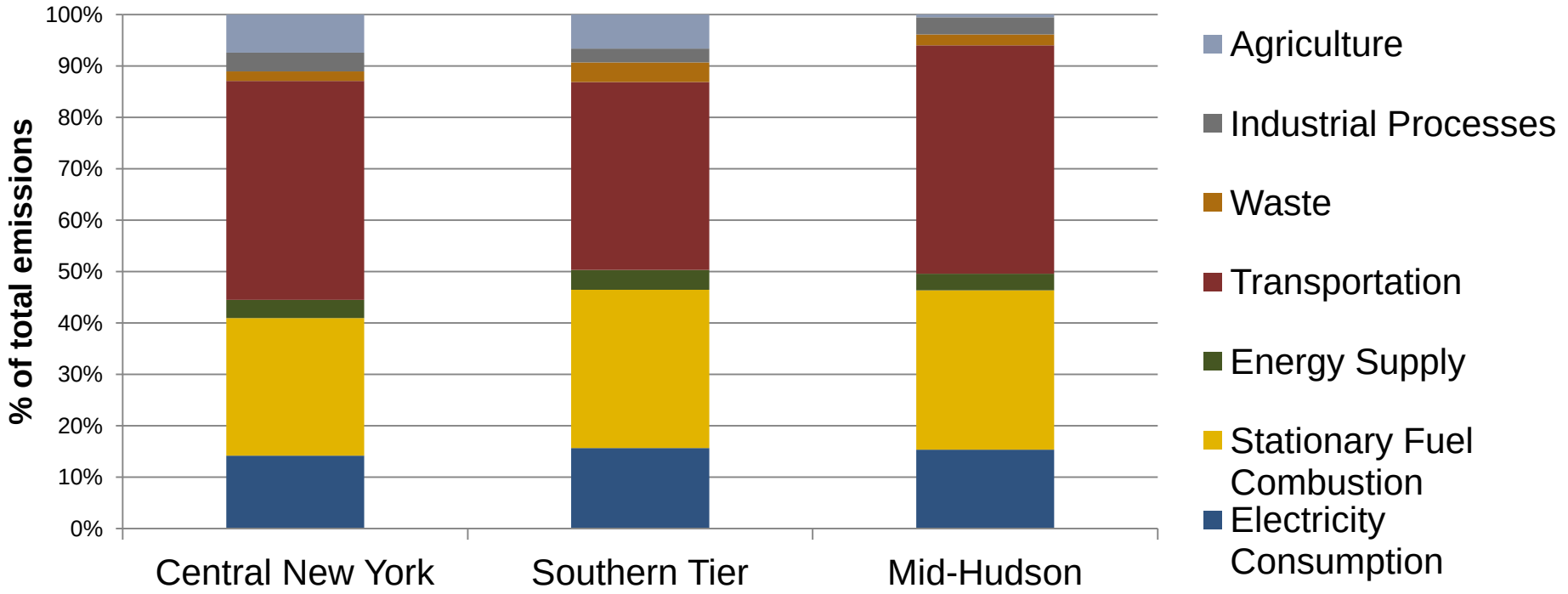
2010 Central New York Emissions by Sector



Approximate 2010 energy costs:
$2.45 billion
8% of GRP

Regional Comparison

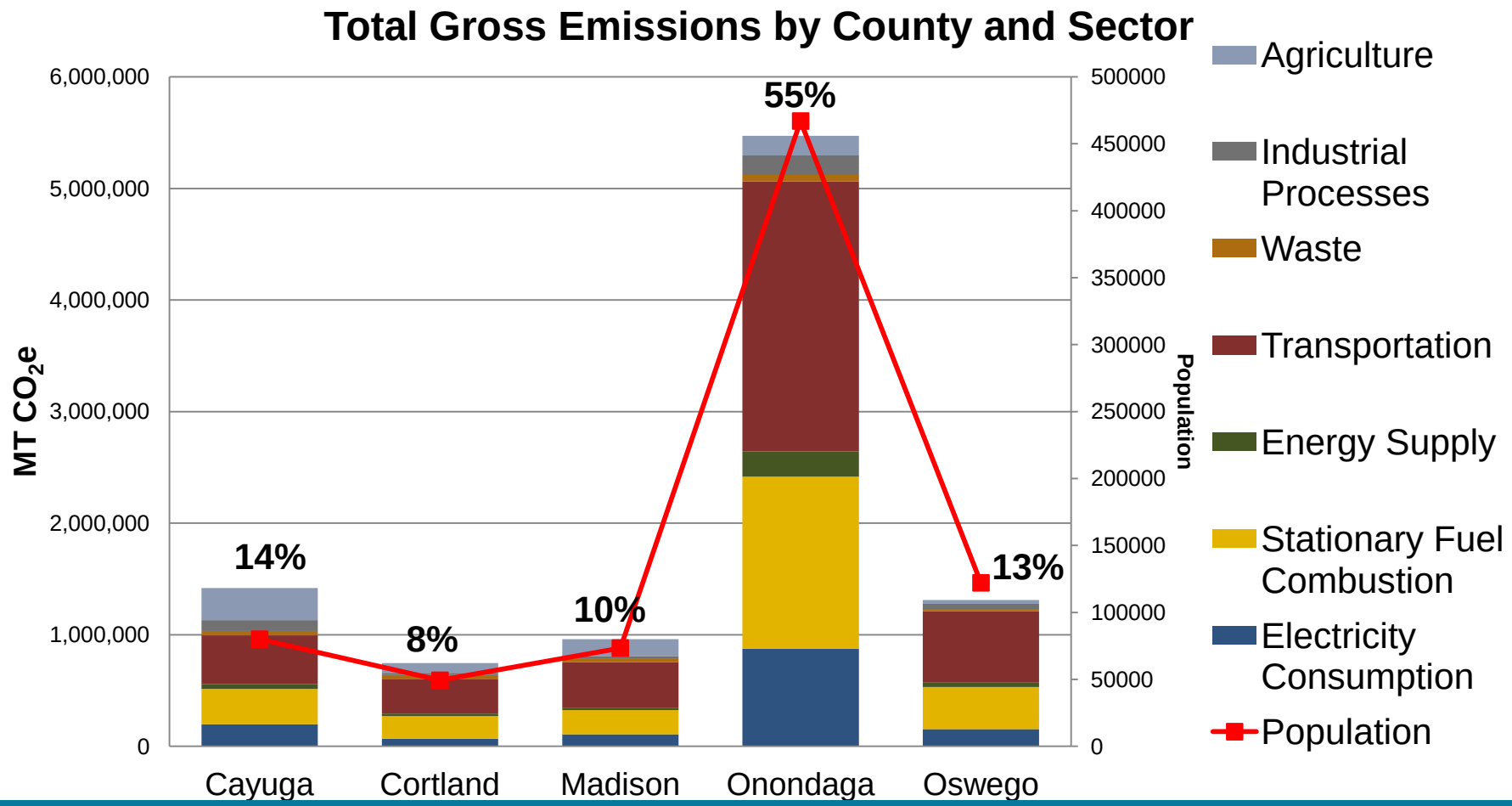
- CNY emissions breakdown is similar to Southern Tier and Mid-Hudson regions, based on preliminary results
- Slightly lower portion from stationary combustion, electricity, and waste



Note: Inventory results from Southern Tier and Mid-Hudson regions are preliminary

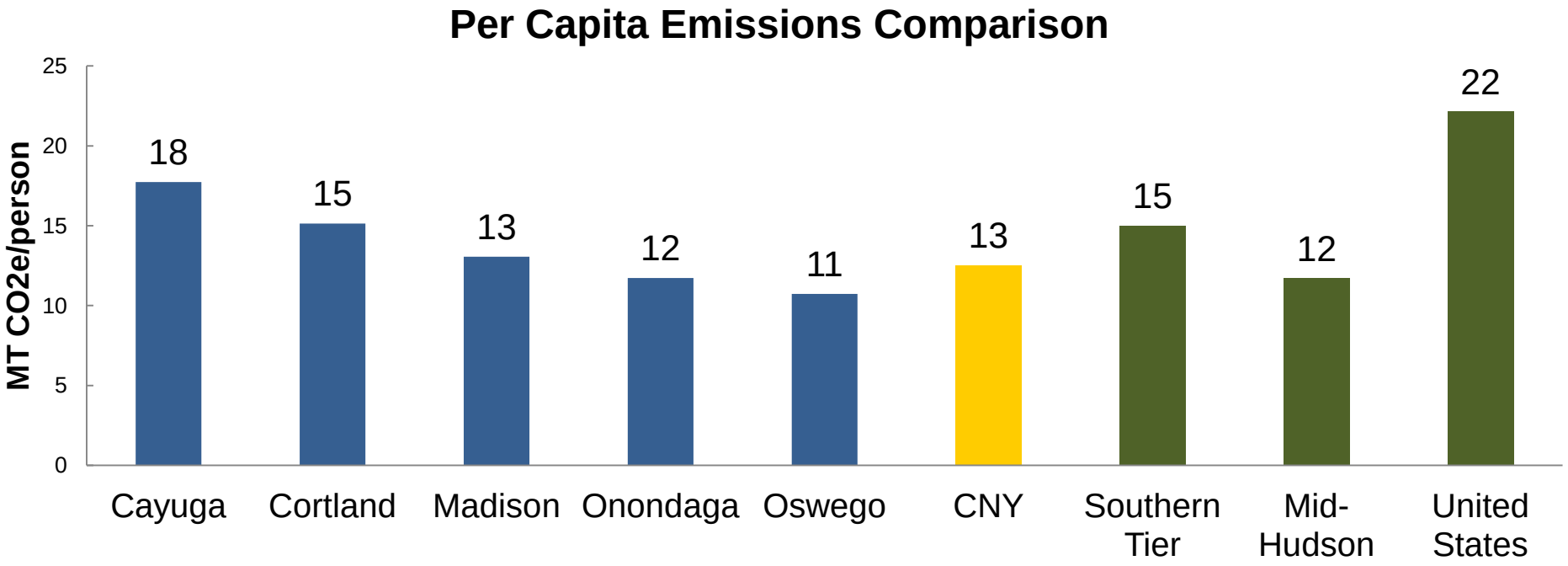
Results Summary

- Total 2010 CNY gross emissions: **9.9 million metric tons CO_2e ($MMTCO_2e$)**



Per Capita Emissions

- CNY per capita emissions are well below the national average
- Primarily due to low electricity emissions (nuclear, hydro, and natural gas)

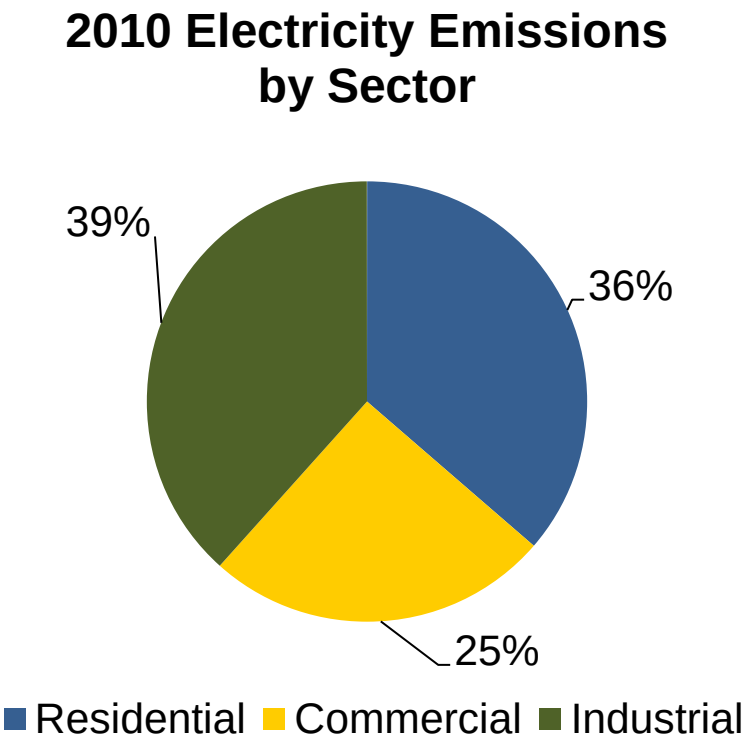


Emissions per dollar of Gross Regional Product:
0.0003 $MTCO_2e$/dollar

Electricity Consumption

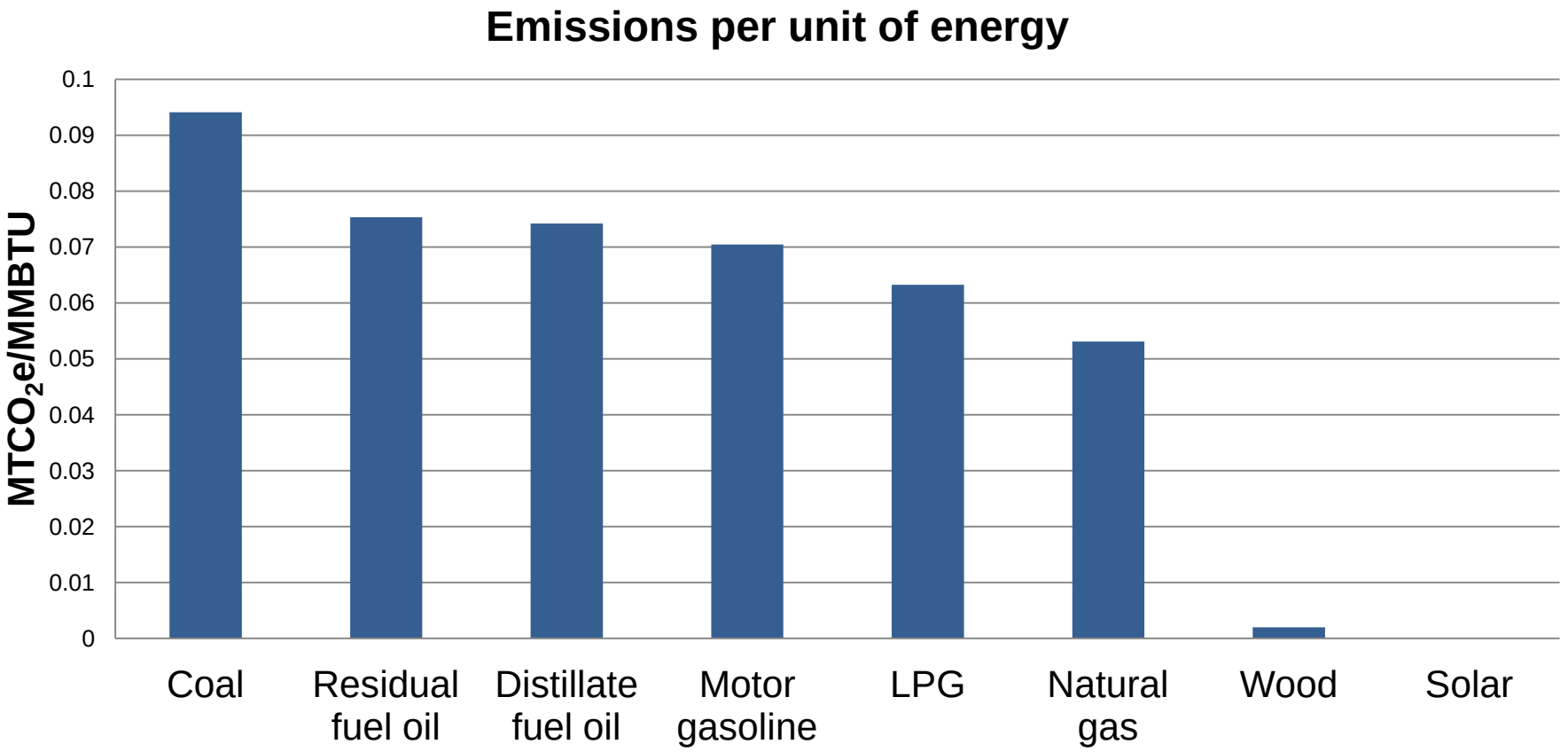
- Emissions based on utility data (if available) or estimates
- Total electricity consumption: 7.1 million MWh (21 million MMBTU)
- Relatively low per-capita electricity use (to Southern Tier)

County	2010 Electricity Consumption Emissions (MT CO_2e)	%
Cayuga	**198,477**	**14%**
Cortland	**69,388**	**5%**
Madison	**108,785**	**8%**
Onondaga	**874,934**	**62%**
Oswego	**154,835**	**11%**
Total	**1,406,418**	**100%**



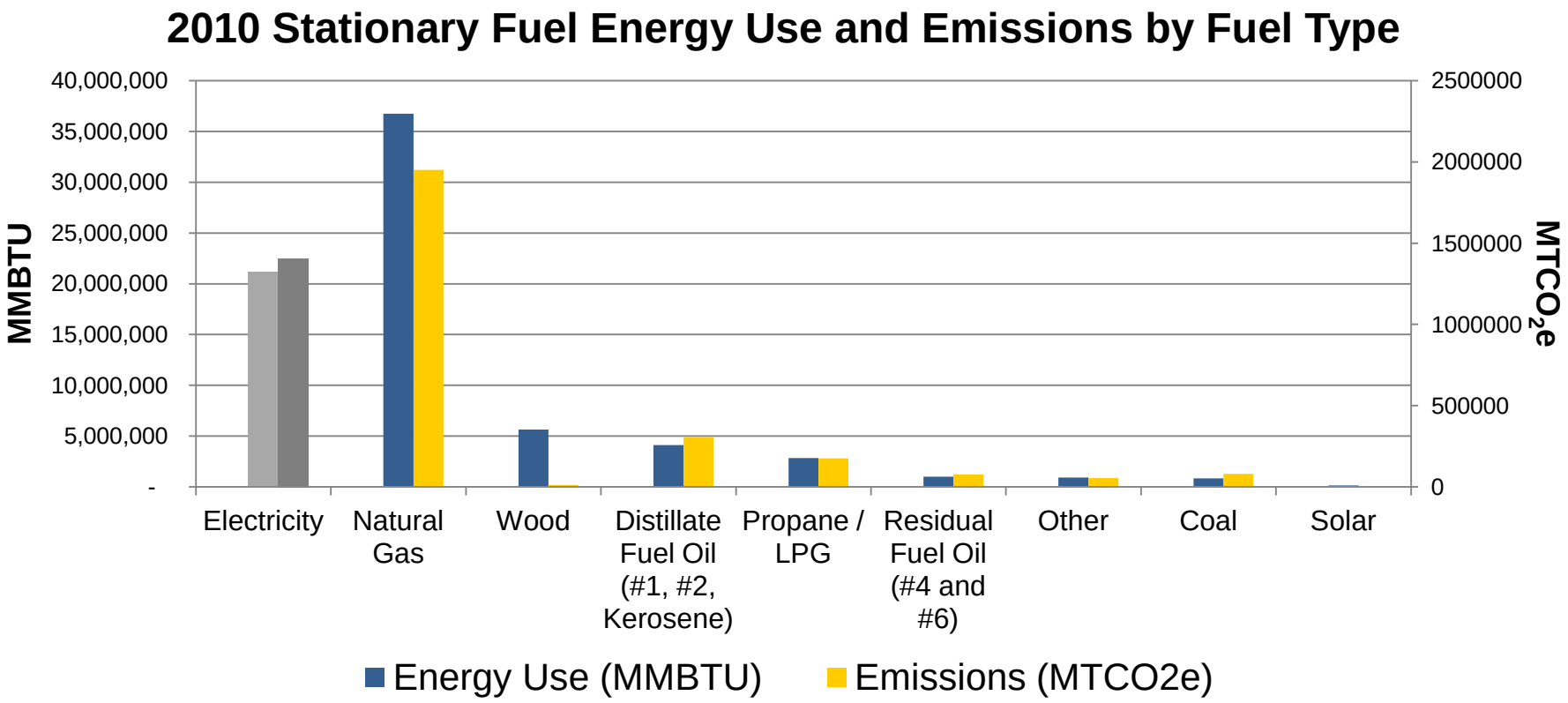
Stationary Fuel Combustion

- Some fuels have higher emissions per heating unit relative to others



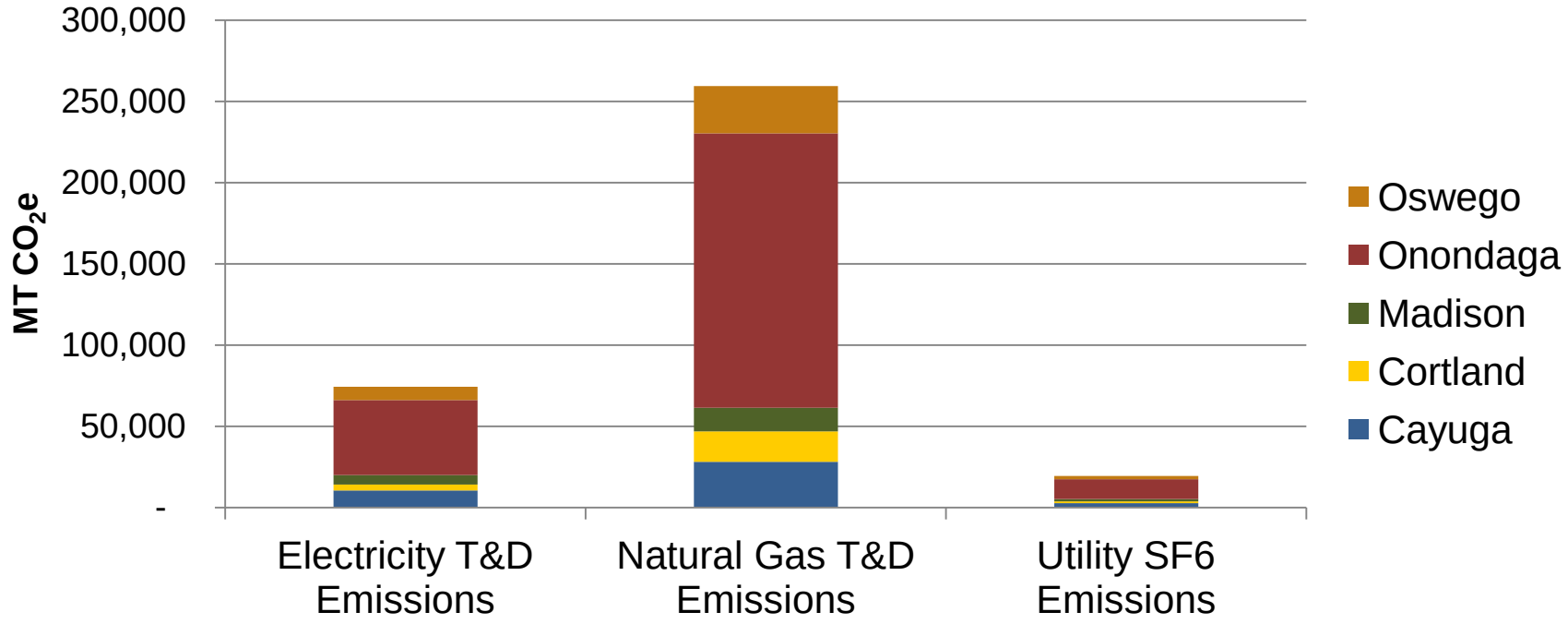
Stationary Fuel Combustion

- 2010 energy use: 52 million MMBTU (39% of total)
- 2010 emissions: 2.65 MMTCO$_2$e (27% of total)
- Emissions driver is housing units, heating fuel types



Energy Supply

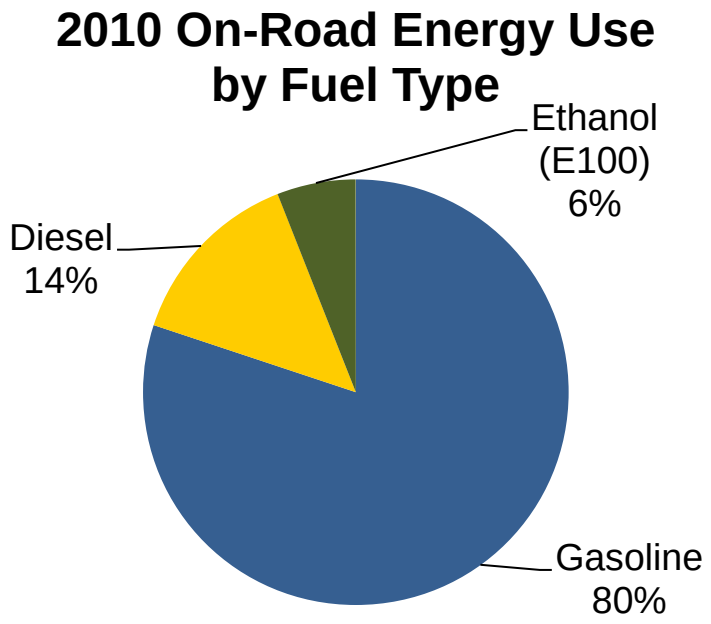
- Emissions from:
  - Electricity Transmission and Distribution (T&D) losses
  - Natural gas T&D losses
  - SF_6 emissions from the utility industry
- 2010 emissions: 0.35 $MMTCO_2e$ (4% of total)



Mobile Fuel Combustion – On-Road

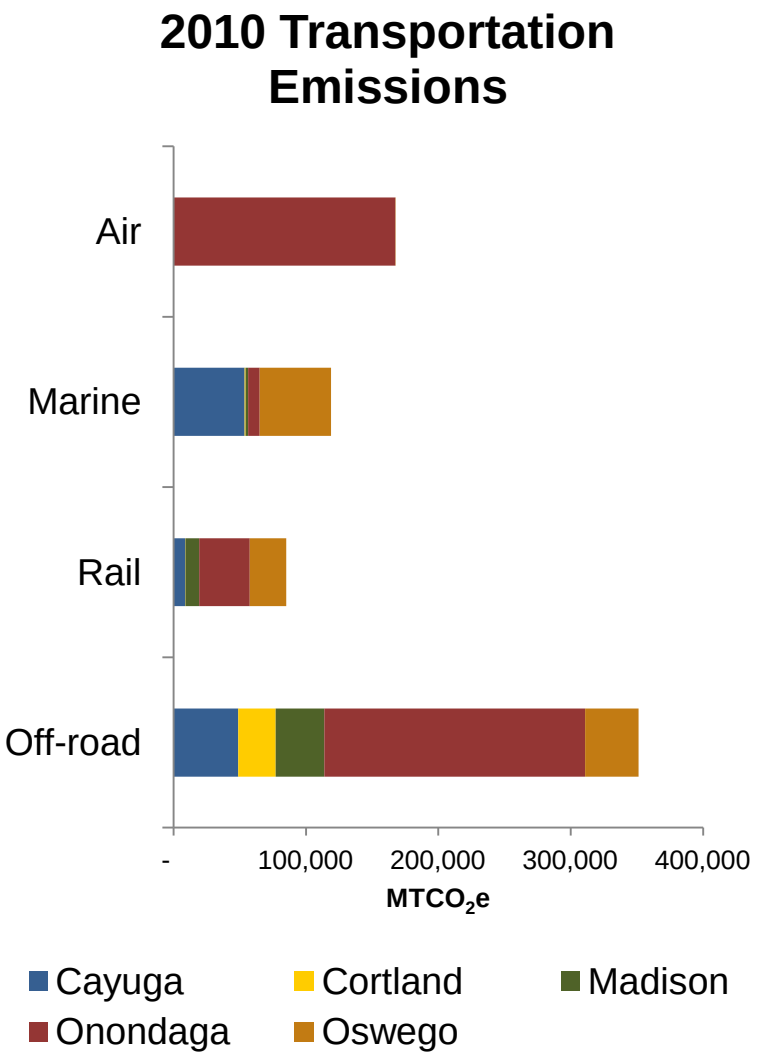
- Emissions from on-road vehicles (e.g., passenger cars, trucks, motorcycles)
- Total 2010 emissions: 3.66 MMTCO_2e (37% of total)
- Total 2010 energy use: 54 million MMBTU (40% of total)
- Emissions driven by distance traveled, type of vehicles

County	2010 On-Road Emissions (MT CO_2e)	%
Cayuga	328,870	9%
Cortland	282,271	8%
Madison	358,657	10%
Onondaga	2,173,660	59%
Oswego	520,097	14%
Total	**3,663,556**	**100%**



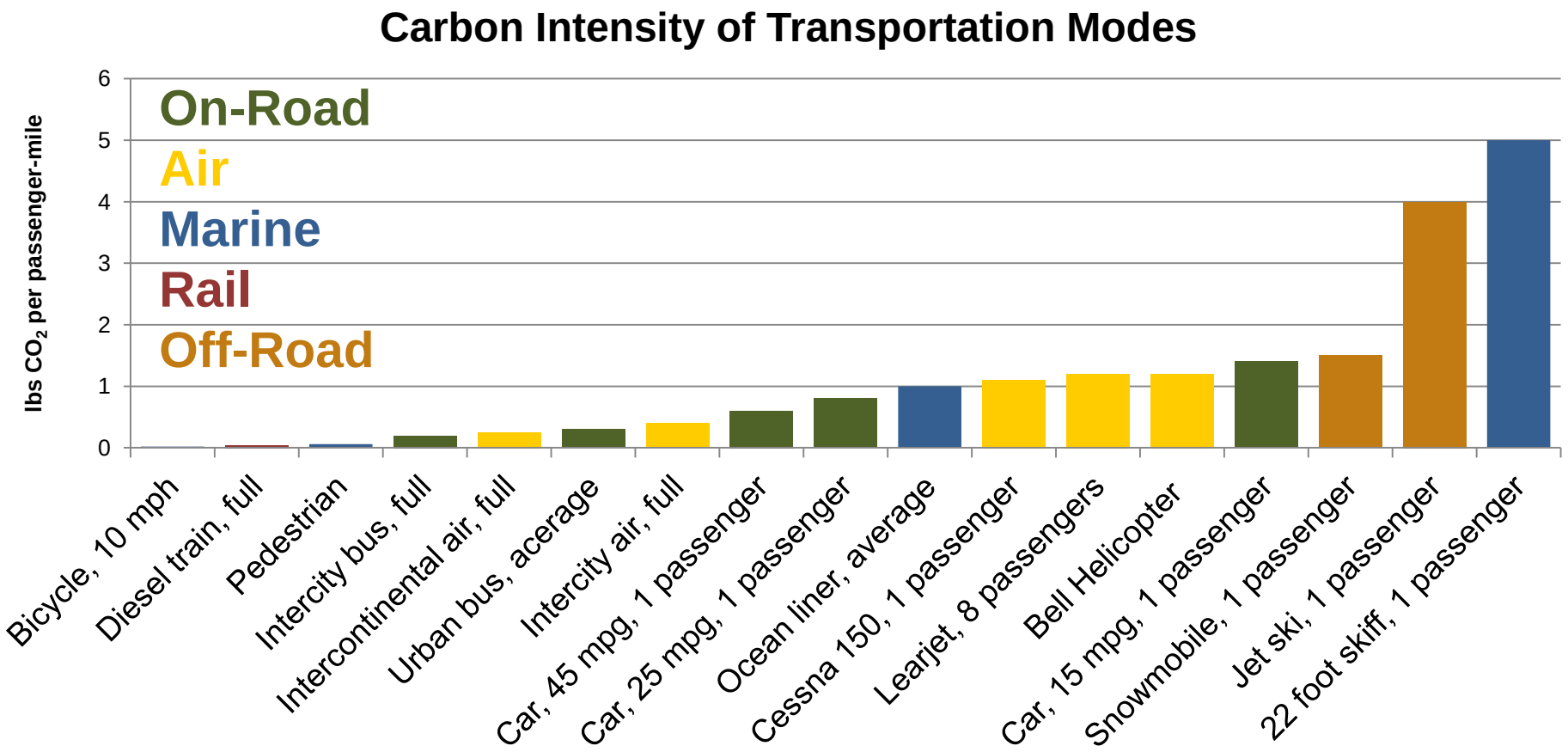
Mobile Fuel Combustion - Other

- Includes emissions from:
  - Off-road equipment (e.g., construction and mining, industrial, agricultural, and commercial equipment, airport vehicles)
  - Marine vessels (recreational, commercial)
  - Rail (passenger and freight)
  - Aviation (flights in and out of the 3 regional airports) **optional source*
- 2010 emissions: 0.56 $MMTCO_2e$ (6% of total)



Mobile Fuel Combustion

- Primary mode of transportation in CNY is passenger cars

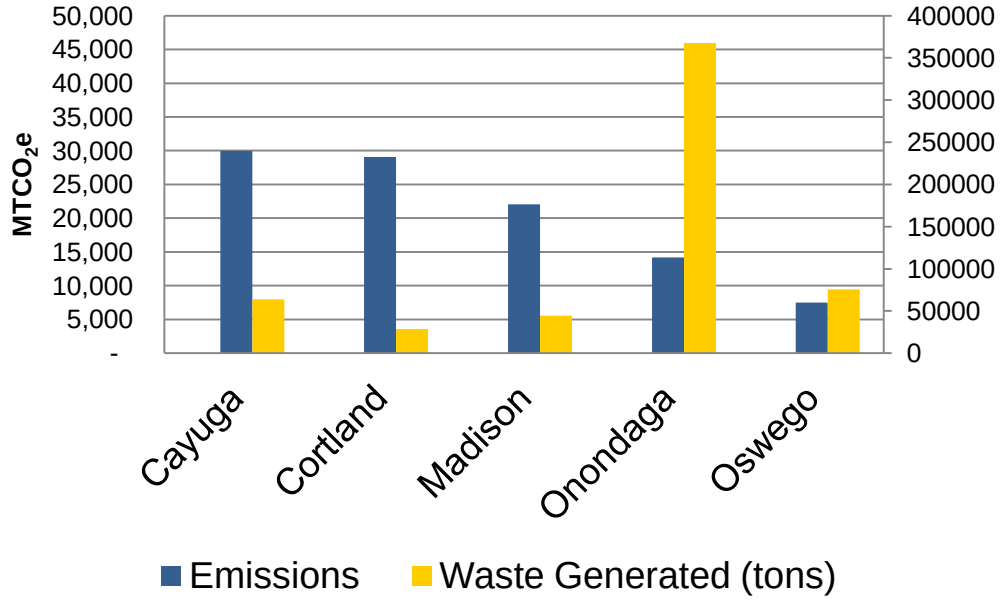


Source: Jerry Jenkins and the Wildlife Conservation Society, Climate Change in the Adirondacks: The Path to Sustainability, 2010, p. 72

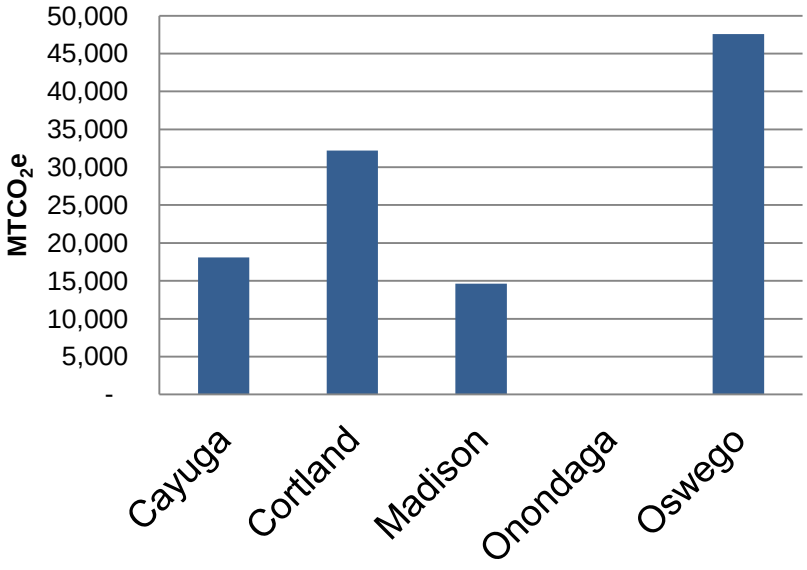
Solid Waste

- 580,000 tons of waste generated in 2010
- 2010 emissions: 0.10 $MMTCO_2e$ (1% of total)
- Waste emissions low relative to waste generated because of Waste-to-Energy – especially in Onondaga County

Emissions from Waste Generated in CNY

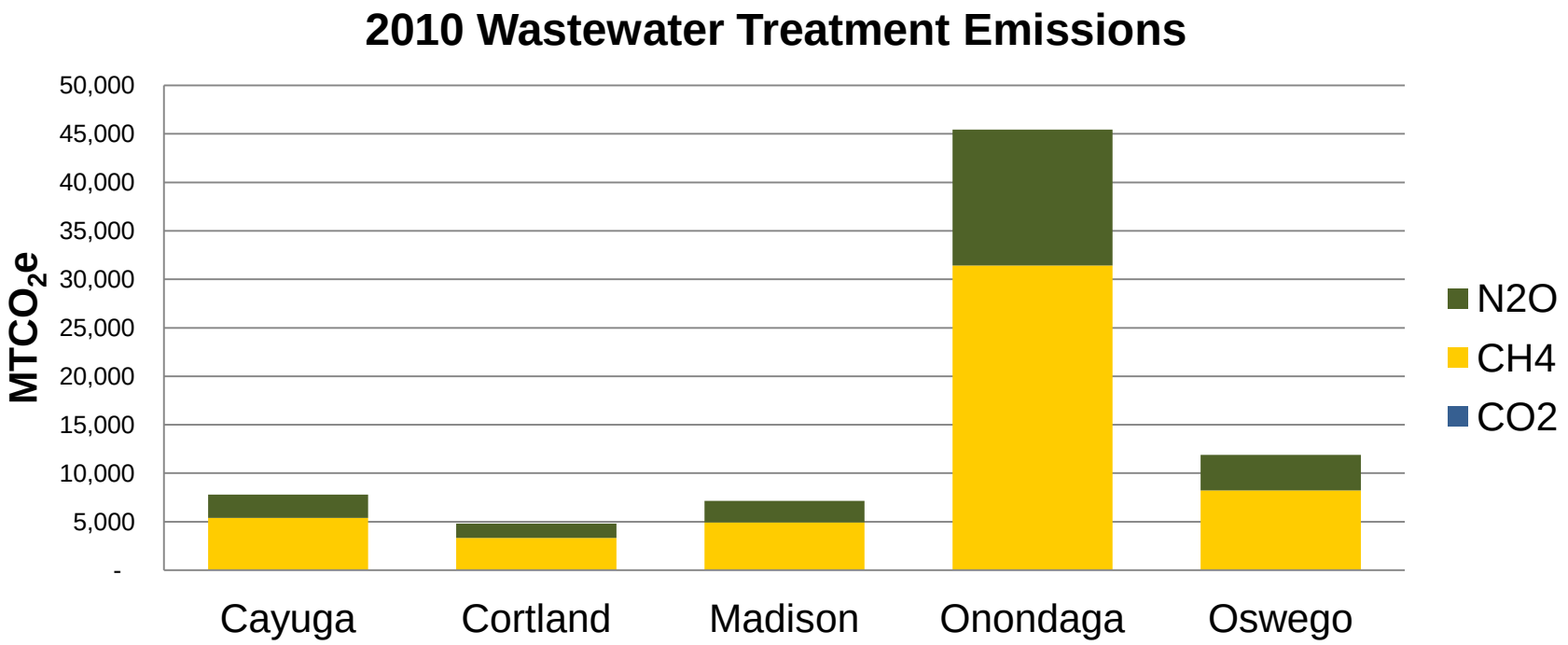


Emissions from Landfills in CNY



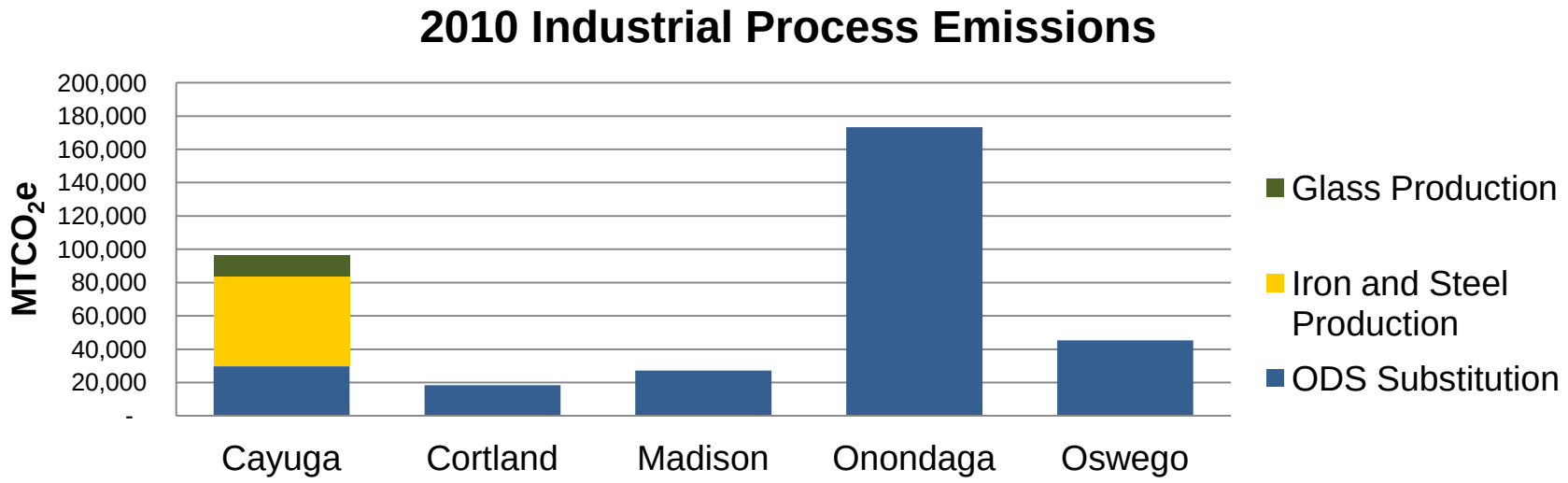
Wastewater Treatment

- Primary emissions driver is population
- 2010 emissions: 0.08 $MMTCO_2e$ (1% of total)



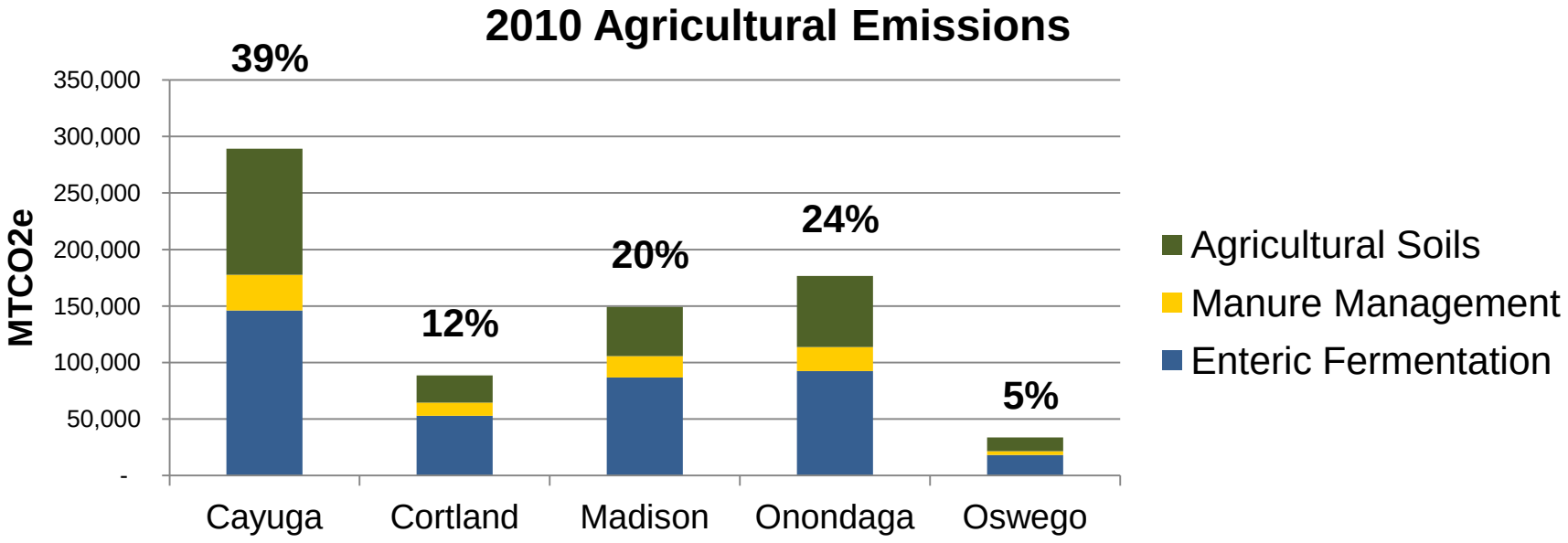
Industrial Processes

- Emissions from large industrial facilities (as reported through EPA's GHG Reporting Program)
  - Nucor Steel, Auburn (Cayuga County)
  - Owens-Brockway Glass Container Inc. (Cayuga County)
- Emissions from substitution of ozone-depleting substances (ODS) – driven by population
- Total emissions: 0.36 $MMTCO_2e$ (4% of total)



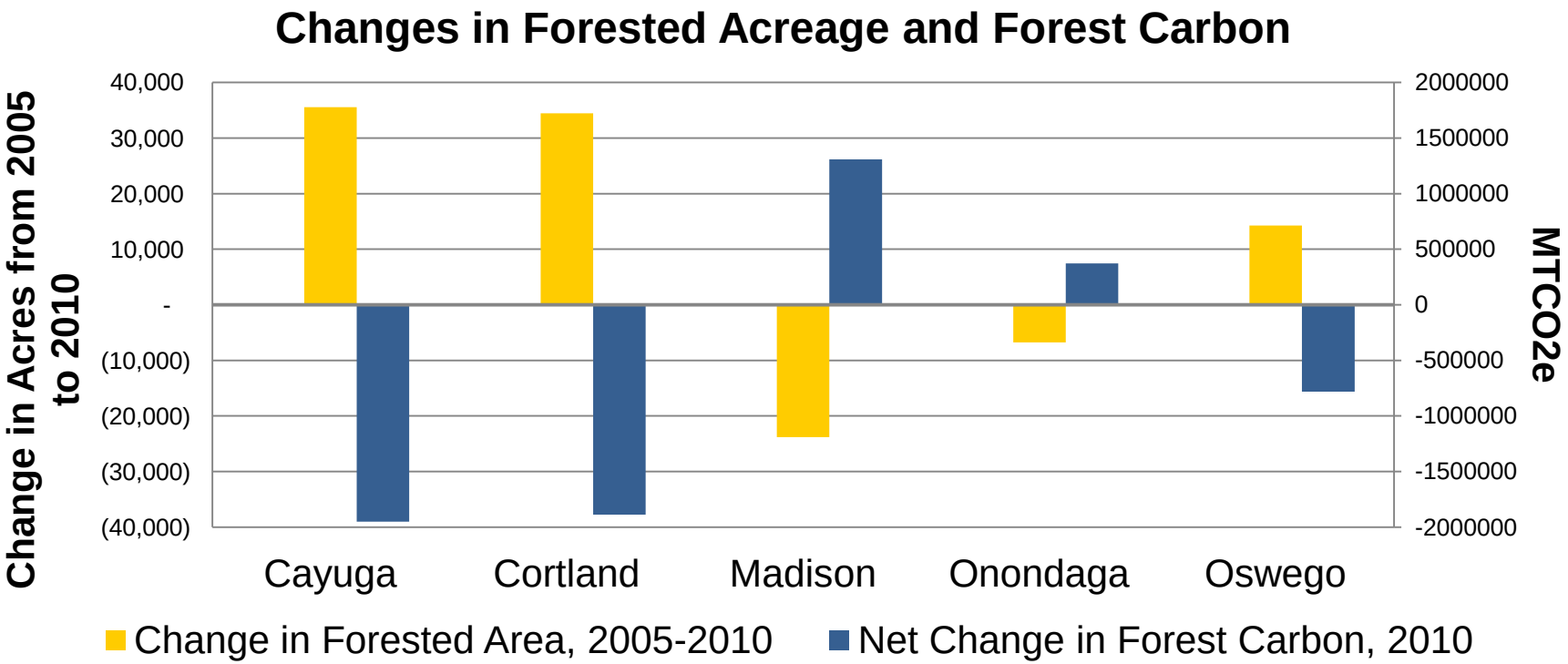
Agriculture

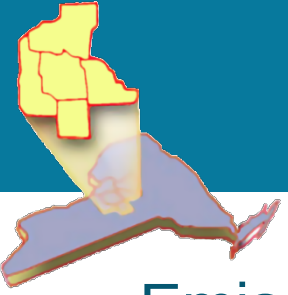
- Includes emissions from:
  - Enteric fermentation (driven by livestock population)
  - Manure management (driven by livestock population)
  - Agricultural soils (driven by crop production)
- 2010 emissions: 0.74 MMTCO$_2$e (7% of total)
  - Agriculture also contributes 7% of emissions in the Southern Tier



Land Use, Land Use Change & Forestry

- Represents carbon sequestration from forests i.e., carbon taken out of the atmosphere as trees grow
  - Optional emissions source
- 2010: 2.9 $MMTCO_2e$ ***sequestered*** (30% of gross emissions)





Electricity Generation

- Emissions from electric generation facilities in the region (included for informational purposes only)
- Nuclear power generates high electricity relative to emissions
- 2010 emissions: 2.2 $MMTCO_2e$

Fuel Used	MWh Generated	% of MWh	Emissions (MTCO2e)	% of Emissions
Nuclear	20,600,536	82%	0	0%
Natural Gas	3,603,997	14%	1,482,491	69%
Hydropower	299,982	1%	-	0%
MSW	199,331	1%	173,364	8%
Wind	128,446	1%	-	0%
Coal	101,262	0%	447,959	21%
Other	68,138	0%	55,750	3%

Key Takeaways

- Emissions are primarily driven by population
- CNY has relatively clean electricity (nuclear and hydropower), which contributes to lower per capita emissions
- Fuel consumed in buildings is dominated by natural gas (with a relatively low emissions intensity)
- Transportation is a major emission source, and represents a larger portion of emissions than in comparable regions
- Waste emissions are low relative to waste generated because of high prevalence of Waste-to-Energy

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Questions?

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Supplemental Slides

FULL RESULTS AND METHODS

Full Results

	Scope	Total Emissions ($MMTCO_2e$)	Percent of Gross Total
*Electricity Generation**	*1*	*2.2*	
Electricity Consumption	**2**	**1.4**	**14%**
Residential	2	0.5	5%
Commercial	2	0.4	4%
Industrial	2	0.5	5%
Stationary Fuel Combustion		**2.7**	**27%**
Residential	1	1.2	12%
Commercial	1	0.8	8%
Industrial	1	0.6	6%
Energy Supply	**1 & 2**	**0.4**	**4%**
Transportation		**4.2**	**43%**
On-road	1	3.7	37%
Off-road	1	0.4	4%
Rail	1	0.1	1%
Marine	1	0.1	1%
*Air**	*3*	*0.2*	
Waste		**0.2**	**2%**
*Solid Waste, Scope 1**	*1*	*0.1*	
Solid Waste, Scope 3	3	0.1	1%
Wastewater Treatment	1	0.1	1%
Industrial Processes	**1**	**0.4**	**4%**
Agriculture	**1**	**0.7**	**7%**
LULUCF	**1**	**(2.9)**	
Net Total (Including LULUCF)		7.0	
Gross Total (excluding LULUCF)		**9.9**	**100%**

Overall Methodology Notes

- Consistent with statewide GHG emissions protocol
- All fuel emission factors from EPA's Mandatory Reporting of Greenhouse Gases, Final Rule, 40 CFR Parts 86, 87, 89, 90, 94, 98, 1033, 1039, 1042, 1045, 1048, 1051, 1054, 1065. Table C-1 and C-2
- Electricity emission factors: eGRID NYUP subregion
  - 497.92 lb CO_2/MWh, 15.94 lb CH_4/GWh, 6.77 lb N_2O/GWh
- Global warming potentials:
  - CH_4 = 21 MT CO_2e per MT CH_4
  - N_2O = 310 MT CO_2e per MT N_2O

Electricity Consumption Methodology

- Calculated at municipal level
- Primary data source: Utilities
  - National Grid, NYSEG, Oneida-Madison Electric Coop, Village of Hamilton, Village of Solvay
  - Provided data by city/town/village and sector (Residential, Commercial, Industrial)
- If utility data available covers a whole town, use it!
- If not…
  - **Residential:** Allocate statewide residential electricity consumption (from EIA) based on total housing units in each municipality (from U.S. Census Bureau's American Communities Survey (ACS))
  - **Commercial:** Allocate statewide commercial electricity consumption (from EIA) based on commercial square footage (from NYS Dept of Labor and EIA Commercial Building Energy Consumption Survey (CBECS)), home heating fuel use (from ACS), and Heating Degree-Days
  - **Industrial:** No alternate methodology available. Estimates based on available utility data only.

Natural Gas Consumption Methodology

- Calculated at municipal level
- Primary data source: Utilities
  - National Grid, NYSEG
  - Provided data by city/town/village and sector (Residential, Commercial, Industrial)
- If utility data available covers a whole town, use it!
- If not…
  - **Residential:** Allocate statewide residential natural gas consumption (from EIA) to municipalities based on housing unit size and home heating fuel use (from ACS), weighted by Heating-Degree Days
  - **Commercial:** Allocate statewide commercial natural gas consumption (from EIA) based on commercial square footage (from NYS Dept of Labor and EIA Commercial Building Energy Consumption Survey (CBECS)), home heating fuel use (from ACS), and Heating Degree-Days
  - **Industrial:** Natural gas consumption reported by large industrial facilities in each municipality (through EPA's Greenhouse Gas Reporting Program)

Residential Stationary Fuels Methodology

- Underlying data:
  - Number of Single Family Attached (SFA), Single Family Detached (SFD) and Multi-family (MF) housing units (HU) – ACS
  - Number of housing units that use each heating fuel type (natural gas, oil, propane, coal, wood, solar) – ACS
  - Statewide residential fuel consumption – EIA

1. Calculate adjusted housing units to reflect difference in energy use per housing unit by size

$$Adjusted\ HU = \frac{108}{108} \times \mathrm{SFDHU} + \frac{89}{108} \times \mathrm{SFAHU} + \frac{54}{108} \times \mathrm{MFHU}$$

2. Calculate adjusted housing units that use each fuel type

$$Adjusted\ HU_{fuel} = HU_{fuel} \times \frac{Adjusted\ HU}{Total\ HU}$$

3. Calculate fuel use for each fuel type, adjusted for HDD

$$Fuel\ Use_{county} = Fuel\ use_{state} \times \frac{(Adjusted\ HU_{fuel} \times HDD)_{county}}{(Adjusted\ HU_{fuel} \times HDD)_{state}}$$

Commercial Stationary Fuels Methodology

- Underlying data:
  - Commercial sector employment by county – NYS Dept. of Labor
  - Average commercial square footage per worker in NYS – EIA Commercial Building Energy Consumption Survey (CBECS)
  - Number of housing units that use each heating fuel type (natural gas, oil, propane, coal, wood, solar) – ACS
  - Statewide commercial fuel consumption – EIA

1. Calculate commercial square footage per fuel for each county, weighted by HDD

   Commercial square footage = Employment × Square footage per worker × % of state housing units using each fuel type × (HDD_{county}/HDD_{state})

2. Calculate percentage of weighted commercial fuel consumption in each county by fuel type

3. Multiply above percentage by state commercial fuel use

Industrial Stationary Fuels Methodology

- Combines reported consumption from facilities reporting under EPA's Greenhouse Gas Reporting Program (GHGRP) with estimates of remaining consumption

1. Calculate statewide industrial fuel emissions based on EIA industrial fuel consumption data

$$= \sum_{by\ fuel} (trillion\ BTU\ consumed \times 10^{-6} \times {}^{MT\ CO_2e}/_{MMBTU})$$

2. Calculate statewide emissions not included in GHGRP

= Statewide industrial fuel emissions – statewide GHGRP emissions

3. Calculate county-level emissions not included

$$= Remaining\ emissions_{State} \times \frac{Industrial\ Employment_{County}}{Industrial\ Employment_{State}}$$

4. Calculate total county-level emissions

= County GHGRP emissions + County remaining emissions

Energy Supply Methodology

- Electricity T&D losses:
  - Electricity consumption (MWh) × loss factor (5.28% for eGRID eastern region) = MWh lost
  - Apply normal electricity emission factors
- Natural gas T&D losses:
  - Natural gas consumption (mcf) × loss factor (1.8% as reported by National Grid) = Natural gas lost
  - Apply normal natural gas emission factors
- SF_6 emissions from utilities:
  - Electricity consumption (MWh) × implied SF6 emission factor
  - Implied SF6 emission factor = $\frac{National\ SF6\ emissions}{National\ electricity\ consumption}$ = 0.0031 $MTCO_2e/MWh$

Mobile Emissions – On-Road Methodology

- Underlying data:
  - Vehicle Miles Traveled (VMT) by county – from NYSDOT model
  - Vehicle mix by NYSDOT regions – from NYSDOT
  - Average fleet fuel economy (miles/gallon) – from FHWA (regional data not available)

1. Calculate CO_2 emissions by fuel type (diesel or gasoline) and vehicle type (passenger car, bus, combination truck, motorcycle, single-unit truck, other 2/4 axle trucks)

$$CO_2\ emissions\ (MT) = VMT \times \frac{1}{miles\ per\ gallon} \times \frac{MT\ CO_2}{gallon}$$

2. Calculate CH_4 and N_2O consumption based on ratio of national on-road CH_4 and N_2O emissions to national on-road CO_2 emissions

Mobile Emissions – Rail Methodology

- Underlying data:
  - 2002 locomotive fuel consumption by county – from NYSERDA 2002 Locomotive Survey for New York State
    - Diesel fuel consumption for Class I, II/III, passenger and commuter lines, and yard locomotives

1. Sum diesel fuel consumption by county across different locomotive types
2. Multiply total diesel fuel consumption for each county by diesel emission factors

Mobile Emissions – Off-Road Methodology

- Emissions taken directly from EPA's NONROAD model, calculated for New York State by NYS Dept. of Environmental Conservation
- Model outputs tons CO_2 emissions by county for several off-road equipment types
- Remove "pleasure craft" (counted under Marine)
- Covert short tons CO_2 to metric tons CO_2e

Mobile Emissions – Marine Methodology

- Underlying data:
  - County-level NONROAD model outputs for "pleasure craft" emissions
  - County-level "Commercial marine vessels" CO emissions – National Emissions Inventory

1. Calculate recreational vehicle emissions
   - Convert NONROAD model output emissions for tons CO_2 from "pleasure craft" to $MTCO_2e$
2. Calculate commercial vehicle emissions
   - Multiply CO emissions by ratio of CO_2/C emissions for low-sulfur fuel oil no. 6
   - $CO_2/C = \frac{25{,}000\ lb\ CO2}{1000\ gal} \div \frac{5\ lb\ CO}{1000\ gal} = 5{,}000$ (emission factors from EPA's AP 42)
3. Add recreational and commercial marine vehicle emissions

Mobile Emissions – Air Methodology

- Underlying data:
  - Number and distance of domestic flights coming in and out of the three airports in the region – Bureau of Transportation Statistics
    - Syracuse Hancock International Airport, Hamilton Municipal Airport, and Fulton/Oswego Airport

1. Calculate flight miles for the region's airports

$$Regional\ flight\ miles = Departures\ Performed \times Departure\ flight\ distance + Arrivals\ performed \times Arrival\ flight\ distance$$

2. Divide total flight miles in half to avoid double-counting between airports

3. Multiply flights by implied national emissions factor, based on national flight miles and national aviation emissions

$$Regional\ flight\ emissions = \frac{Regional\ flight\ miles}{2} \times \frac{National\ emissions}{National\ flight\ miles}$$

Solid Waste Methodology

- **Scope 1 – Emissions from landfills in CNY**
  - Reported emissions from EPA's Greenhouse Gas Reporting Program
  - 4 landfills in CNY region
- **Scope 3 – Emissions from waste generated in CNY**
  - Underlying data:
    - NYS DEC 2010 Annual Landfill Facility Reports for facilities that receive waste from CNY – amount and type of waste received (and from where), LFG collection acreage, total landfill acreage, percent alternative daily cover (ADC)
    - Onondaga County Resource Recovery Agency's 2010 Annual Report – waste generated in Onondaga County
    - Oswego County generation estimated using regional average disposal per capita
    - NYS DEC 2008 solid waste plan (*Beyond Waste*) – composition of waste discarded for rural and suburban communities
  - General approach: Use IPCC guideline-based First Order Decay (FOD) model for each county to estimate the amount of emissions the waste generated in 2010 will produce over its decay lifetime, with inputs based on the characteristics of landfills that receive their waste

Solid Waste Methodology (cont'd)

1. Run the FOD model with inputs based on traits of landfills receiving CNY waste:
   - Half-life of waste in CNY – based on average annual rainfall (k = 0.038)
   - Composition of waste discarded
   - Amount of solid waste generated per year
   - Amount of ADC – calculated for each county by weighting ADC for each landfill receiving its waste by amount of waste sent there

2. Adjust FOD model outputs by LFG collection area – calculated for each county by weighting LFG collection acreage percentage for each landfill receiving its waste by amount of waste sent there, and multiplying by a default collection efficiency of 75%
   - E.g., if model says landfills emit 10,000 $MTCH_4$, but landfills collect 50% of LFG, emissions assumed to be 10,000 × (1-0.5*0.75) = 6,250 $MTCH_4$

Wastewater Treatment Methodology

- Use EPA's State Inventory Tool (SIT) Wastewater module
- Input population for each county, use New York State defaults for characteristics of wastewater treatment plants (WWTPs)
- Assumes 21% of population is served by septic systems

Agriculture Methodology

- Underlying data:
  - Livestock populations by county (Cattle and Dairy Cows) – from USDA
  - Crop production by county (Corn, Soybeans, Wheat, Oats, and Alfalfa) – from USDA
  - Fertilizer application by county – from New York State Dept. of Agriculture and Markets
- Calculate emissions using EPA's State Inventory Tool (SIT) Agriculture module, using New York state default emission factors
  - Enter livestock populations broken down into SIT categories (replacement heifers, steer stockers, etc.) using statewide breakdowns from EPA's Regional GHG Inventory Guidance
  - Enter crop production and fertilizer consumption

LULUCF Methodology

- Underlying data:
  - Forested acres by county in 2005 and 2010 – from U.S. Forest Service
  - Carbon sequestration rates for Central New York from Carbon Online Estimator (COLE)

1. Estimate annual change in forested acreage

   (2010 acreage – 2005 acreage) / 5

2. Multiply change in acreage by regional carbon sequestration rate of 185 metric tons Carbon per hectare)
3. Convert units to $MTCO_2e$

Electricity Generation Methodology

- Underlying data:
  - Nationwide dataset of electricity generation facilities – EIA 923 dataset
  - For each facility, includes total fuel consumption, MMBTUs, and MWh generated ***by fuel type***

1. Identify electric generating facilities in each region (using EIA form 860 dataset, which identifies the county of each facility)
2. Multiply fuel consumption amounts from EIA 923 dataset by the appropriate emission factors for each fuel type

Municipal Allocation Methodology

- Emissions allocated to the municipal level where possible.
- Village emissions included in towns, but also reported separately.
- Methodology varies by sector.
- **Electricity Consumption** – calculated based on utility-reported consumption for each municipality
- **Residential Stationary Fuels** – calculated same as counties, based on housing unit size, heating fuel use, and residential fuel consumption
- **Commercial Stationary Fuels** – county emissions allocated to municipalities based on number of occupied housing units

Municipal Allocation Methodology (cont'd)

- **Industrial Stationary Fuels** – assigned to counties based on locations of industrial facilities in GHGRP; non-GHGRP emissions not allocated
- **Energy Supply** – calculated same as county-level, multiplying electricity consumption, natural gas consumption, and population by loss and emission factors
- **On-road** – county emissions allocated based on number of occupied housing units, weighted by commuting characteristics of each municipality (% drive alone vs. carpool)

Municipal Allocation Methodology (cont'd)

- **Off-road** – county emissions allocated to municipalities; basis of allocation varies by equipment type:
  - **Recreational and logging equipment** – inverse of population density
  - **Construction and mining equipment** – population
  - **Residential and commercial lawn and garden equipment** – single family housing units
  - **Commercial equipment** – commercial stationary fuel emissions
  - **Industrial equipment** – not allocated
  - **Airport equipment** – not allocated
  - **Railroad equipment** – not allocated
- **Solid Waste**
  - **Scope 1** – emissions assigned to municipalities based on landfill locations
  - **Scope 3** – county-level emissions allocated by population

Municipal Allocation Methodology (cont'd)

- **Wastewater Treatment** – county emissions allocated by population
- **Industrial Processes** – facility emissions assigned to municipalities based on facility location; ODS substitution emissions allocated by population
- **Agriculture** – county emissions allocated based on land use
  - **Enteric fermentation and manure management** emissions allocated based on percentage of land use in "Pasture/Grass"
  - **Agricultural soils** emissions allocated based on percentage of land use growing the calculated crops: Alfalfa, Corn, Wheat, Oats, and Soybeans
- **LULUCF** – not allocated to municipalities
- **Electricity Generation** – not allocated to municipalities