

Attachment B: 1990 Greenhouse Gas “Back-Cast” - Results and Methods

This attachment describes the GHG emissions results and methodologies that ICF used to conduct an emissions back-cast to 1990. A discussion of limitations is also provided.

Summary of Results

In 1990, it is estimated that the Chicago Region produced approximately 128 MMTCO₂e of GHG emissions. Table B-1 presents a summary of estimated emissions by sector for the Chicago Region.

Table B-1: 1990 Estimated Regional Emissions by Sector (MMTCO₂e)

Sector	Total Emissions	Percent of Total
Stationary Energy	88.84	69%
Residential buildings	36.17	28%
Commercial and institutional buildings and facilities	29.54	23%
Manufacturing industries	21.87	17%
Energy industries	0.05	0.04%
Fugitive emissions from oil and natural gas systems	1.22	1%
Transportation	26.82	21%
On-road	24.89	19%
Railways	0.75	1%
Waterborne navigation	0.07	0.1%
Aviation	+	+
Off-road	1.11	1%
Waste	12.81	10%
Disposal of solid waste generated in the region	12.44	10%
Biological treatment of waste generated in the region	0.01	0.01%
Wastewater generated in the region	0.36	0.3%
Total	128.46	100%

+ Does not exceed 0.005 MMTCO₂e or 0.005%

Methodology

The methodologies and data used to back-cast GHG emissions for 1990 for each sector and sub-sector are summarized in the sections below.

Stationary Energy

Residential Buildings, Commercial and Institutional Buildings and Facilities, Manufacturing Industries

Electricity and natural gas-related emissions in residential, commercial, institutional, and manufacturing facilities were projected backwards from 2010 and 2015 using statewide energy consumption data from the Illinois Commerce Commission (2017a and 2017b). The statewide data includes electricity consumption supplied by Commonwealth Edison Company and natural gas consumption supplied by People's Gas, Northern Illinois Gas¹, and Nicor Gas between 1991 and 2015.

The change in natural gas consumption between 1991 and 2010 for the statewide consumption was applied to the regional natural gas consumption in 2010 for each of the natural gas utility providers. Similarly, the change in electricity consumption at the statewide level for Commonwealth Edison Company was used to estimate a change in regional electricity consumption. ICF compared the change in consumption at the state- and regional-levels between 2010 and 2015 to develop a 1990-2010 consumption change for the region.

Although the statewide consumption data were available for 1991 and not 1990, it is expected that the change in natural gas consumption between 1990 and 1991 is marginal overall, and the change in consumption between 1991 and 2010 is roughly representative of regional consumption changes.

Natural gas emission factors used for the 2015 inventory were also used for the 1990 estimations. For electricity, ICF estimated a 1990 electricity emission factor using state-level data from the Energy Information Administration (EIA) for the four primary states that comprise the RFC West region in the U.S. Environmental Protection Agency's (EPA) eGRID database (Illinois, Indiana, Ohio, and West Virginia) (EIA 2017). Using the EIA data, ICF estimated a combined emission factor for these states in 1990 and 2015. We then applied the percentage change in the 1990 and 2015 emission factor to the 2015 RFC West emission factors for CO₂, CH₄, and N₂O used for the inventory. Using the derived 1990 emission factors, ICF estimated emissions associated with 1990 electricity consumption.

Energy Industries & Fugitive Emissions from Oil and Natural Gas Systems

Emissions from energy industries and fugitive emissions from oil and natural systems in 2010 and 2015 were estimated using facility-level data from the U.S. EPA. Because that level of data isn't available for 1990, ICF projected emissions backwards using the change in gross domestic product (GDP) for the region between 1990 and 2010.

Gross domestic product data for the state of Illinois and the Chicago Region were obtained from the Bureau of Economic Analysis (BEA 2010, 2017, 2018). Data for 1990 was only available at the state level. The change in GDP at the state and regional level for the years for which data were available for both (2001-2015) were compared to confirm that the change in state GDP from 1990 to 2010 would be reasonably representative of the change in GDP at the regional level. The change in GDP was then applied to emissions in these sectors to estimate 1990 emissions.

¹ Northern Illinois Gas was a predecessor of Nicor Gas.

Transportation

On-Road Transportation

To estimate on-road transportation emissions in 1990, ICF relied on statewide vehicle miles traveled (VMT) data from the Federal Highway Administration (2017). Statewide VMT data for Illinois were available for almost all years since 1980 for rural and urban travel. We first compared the trends in statewide and regional VMT for the years in which data were available for both state and region (2000, 2010, and 2015) and observed that, between 2000 and 2010, the growth in VMT at the regional level was 5% less than the state. To estimate 1990 regional VMT, we quantified the change in VMT between 1990 and 2010 for urban travel² and assumed that this change, adjusted by 5%, would be representative of the change in VMT for the region. With 1990 VMT estimated, we estimated fuel consumption using the fuel efficiency of 1990 vehicles from the Energy Information Administration (EIA 2012). Using the fuel consumption values, we estimated emissions using the CO₂ combustion emission factors from the U.S. EPA (2015). For CH₄ and N₂O emissions, we multiplied 1990 VMT by vehicle emission factors (in units of grams per mile) from the U.S. EPA (2015) by vehicle type and for the 1990 time period.

Railways

For the railways, waterborne navigation, and aviation sub-sectors, ICF primarily relied on GDP data to back-cast emissions, because detailed data collection for these sectors would be time consuming, infeasible, and/or may not yield any meaningful data. Additionally, emissions in these sub-sectors are a small proportion of the inventory; thus, using GDP to back-cast is a suitable and efficient approach given the scope and intent of this analysis.

Transportation emissions from passenger transit rail in 1990 (i.e., CTA, Metra Rail, NICTD) were estimated by projecting fuel consumption backwards using the change in regional GDP, as described above. Emissions from electricity use were estimated by multiplying consumption data by the 1990 electric emission factor, as described above. Emissions from diesel were estimated by multiplying consumption data by CO₂, CH₄, and N₂O emission factors from the U.S. EPA (2015).

Emissions from Amtrak trains were estimated using the train miles in the region in 2010 and applying a percentage change of -11%, which is the nationwide change in train miles for the Amtrak system (BTS n.d.). The fuel economy of Amtrak trains was estimated using national mileage and consumption information from 1990 from the Bureau of Transportation Statistics (BTS). Fuel consumption was then estimated using the mileage in the region and the national fuel economy estimates, and emissions were estimated by multiplying the consumption data by diesel fuel CO₂, CH₄, and N₂O emission factors from the U.S. EPA (2015).

Emissions from freight rail were estimated by applying the change in GDP for the region between 1990 and 2010 to the 2010 estimates of freight rail fuel consumption. Fuel consumption was then estimated using the mileage and fuel economy estimates, and emissions were estimated by multiplying the consumption data by diesel fuel CO₂, CH₄, and N₂O emission factors from the U.S. EPA (2015).

² Urban travel was assumed to be most representative of the region, because the CMAP region is heavily urbanized.

Waterborne Navigation

Fuel consumption data in commercial marine sources from the 2010 inventory year were projected backwards to 1990 using the change in regional GDP, as described above. Emissions from recreational boats in 1990 were quantified using fuel consumption data from the MOVES2014a model (U.S. EPA 2018). Fuel consumption values for 1990 for both the commercial and recreational sources were multiplied by fuel emission factors from the U.S. EPA (2015) to estimate GHG emissions.

Aviation

Fuel consumption data in commercial aviation sources from the 2010 inventory year were projected backwards to 1990 using the change in regional GDP, as described above. Fuel consumption values for 1990 were multiplied by fuel emission factors from the U.S. EPA (2015).

Off-Road

1990 off-road vehicle and equipment emissions were estimated directly from the NONROAD component of the MOVES2014a model, consistent with the 2010 and 2015 inventory methods (U.S. EPA 2018). Methane and N₂O emissions were quantified by multiplying consumption data by fuel-specific CH₄ and N₂O emission factors from the U.S. EPA (2015).

Waste

Disposal of Solid Waste Generated in the Region

Solid waste disposal emissions in 1990 were estimated using the same methodology described in the inventory report (i.e. the methane commitment method). Waste tonnage data for 1990 were provided by the Illinois EPA, collected as part of the previous inventory conducted by ICF. Methane capture in 1990 for nearly all landfills in the region was limited, based on methane capture rates, also collected as part of the previous inventory effort. As such, we assumed that no methane was captured from landfills in the region in 1990.

Biological Treatment of Waste Generated in the Region

Waste emissions from the biological treatment of waste generated in the region were estimated using the 2010 data pertaining to the amount of waste diverted for composting and the U.S. EPA's national inventory (U.S. EPA 2016a and 2016b). The rate of per capita composting in 1990 was likely less than the rate in 2010 or 2015, because municipal composting programs have increased in recent years. Thus, to account for the lower composting rate in 1990, we incorporated the change in composting rates in the national inventory between 1990 and 2011 into the estimation of composting emissions for the region in 1990. Using the same factors and methods as the 2010 and 2015 inventories, we estimated composting-related emissions using the 1990 population and the adjusted composting rate.

Wastewater Generated in the Region

Waste emissions from wastewater generated in the region were estimated based on the quantity of wastewater generated and emissions measurements from plants treating wastewater generated in the region for the 2010 inventory. We applied the per capita wastewater generation values to the 1990 regional population to determine the wastewater generated in 1990. For the rate of CH₄ and N₂O emissions generated per gallon of wastewater, we adjusted the 2010 emission rates based on the U.S. EPA's national inventory (U.S. EPA 2016a and 2016b). Wastewater treatment in 1990 had a lower

emissions efficiency rate per gallon of wastewater treated, because methane capture and other technology was not as widely implemented. Thus, to account for the reduced efficiency in 1990, we incorporated the change in per capita waste emissions from the national inventory between 1990 and 2011 into the calculation of regional emissions rates for 1990. Applying the change in national per capita emissions to the Chicago region 2010 emissions rates resulted in increased emissions of CH₄ and N₂O per gallon of wastewater treated for 1990.

Limitations

As described above, the estimation of 1990 emissions is mostly based on projections backward using trend data rather than actual activity data. As a result, the estimation can only be considered a rough approximation rather than representative of actual emissions overall or for individual sectors. The purpose of this estimate was to derive an estimation of 1990 regional emissions that was more representative of 1990 regional emissions than a prior linear back-cast prepared using only the 2000 to 2005 overall emissions trend. The estimation is not appropriate for a detail evaluation of 1990 emissions or detailed sector by sector trend analysis and is only intended for informing potential overall mass emissions targets using 1990 as a base year.

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