Town of Yorktown

Report 2/2

Total Town Estimate

Greenhouse Gas Emissions Report

March, 2022

For the year 2020

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Town of Yorktown Greenhouse Gas Emissions Report

The Town of Yorktown has applied to attain the status of a certified Climate Smart Community as designated by New York State Energy Research and Development Authority (NYSERDA). Fundamental to that certification is understanding the sources of greenhouse gases (GHG) and communicating this to our residents. This includes direct emissions from fossil fuels (natural gas, gasoline, fuel oil, diesel) and indirect emissions resulting from the production of electricity consumed and other purchases and investments.

Town of Yorktown Background

The Town of Yorktown includes portions of 9 zip codes (100% of 4 of them and very small percentages of the other 5) and roughly 37,000 residents, and 13,000 households. Electricity and natural gas to the town is provided through two major utility companies: NYSEG provides electric service only to a portion of the town, and ConEd supplies electricity and gas to the remainder of the town. As such, much of the town relies on fuel oil for heating. It is worth noting that the electricity produced by ConEd has a significantly higher cost and amount of CO2/watt compared to NYSEG power.

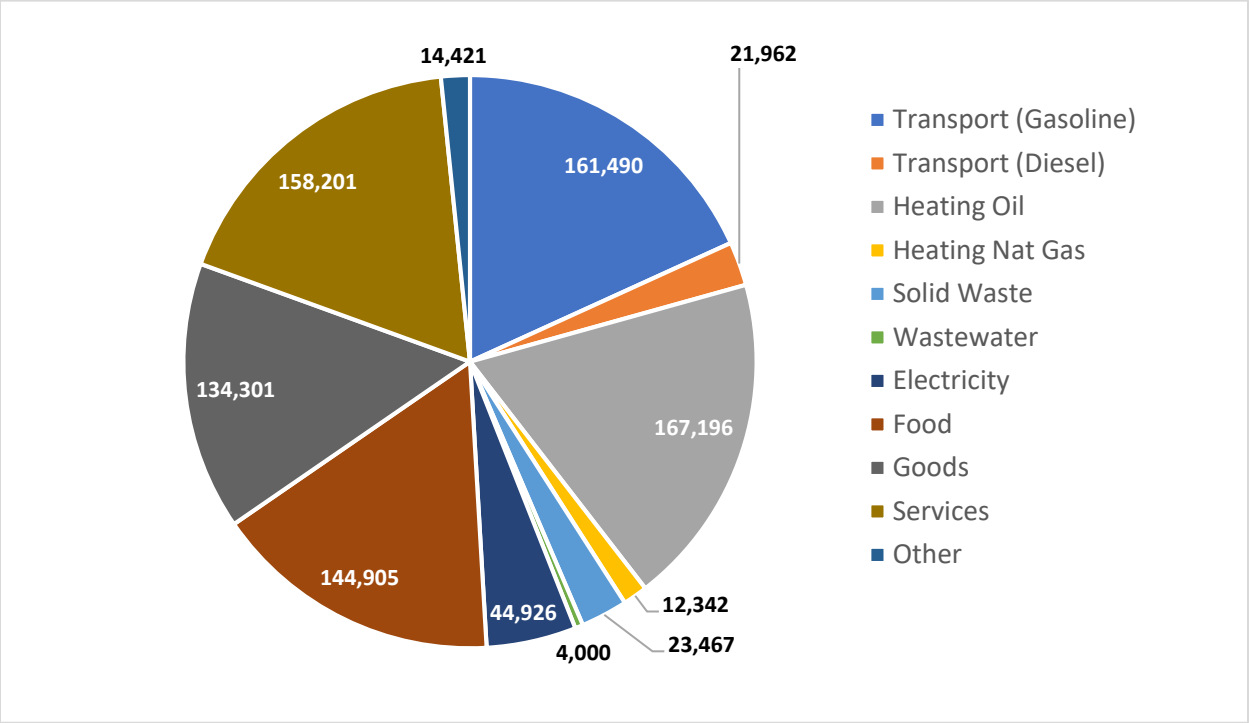
Emissions are categorized in 3 groups defined by the Climate Smart Communities Program:

- Scope 1: Direct emissions that occur physically within a boundary, such as those emitted by burning natural gas or fuel oil in homes, schools, and businesses
- Scope2: Indirect emissions from utility energy generation plants based on the amount of electricity (or other utilities such as hot water or steam) consumed within the boundary, regardless of where the plants are located
- Scope 3: Other indirect, upstream, or lifecycle emissions attributed to community activity regardless of where they occur

It is important for residents to understand how they can impact the global problem. Therefore, I will discuss and include emissions in all 3 categories.

Figure 1 shows the breakdown of emissions for the Town of Yorktown. It shows that transportation is the largest single component, followed by heating. Note that the next largest emissions are from the food we eat, the things and services we purchase. These are scope 3 emissions. Finally, the electricity we use is shown (scope 2). While this may not appear very large, we will use more and more electricity as we migrate away from fossil fuels, so in the future this will become larger and critically important.

Figure 1



The rounded total for heating (scope1), transportation, electrical generation and transmission (scope 2) solid waste and wastewater emissions is about 470,000 metric tons per year. Note that scope 3 adds roughly another 420,000 metric tons per year. The total is approximately 890,000 M tons per year for annual community emissions for the Town of Yorktown. (Note that per the census data, only about 200 of the nearly 13,000 homes heat with propane. The emissions are too small to show on these graphs.) It is also worth noting that only a small portion of Yorktown heats with natural gas, all of which is supplied by ConEd. Fuel oil is the predominant heating fuel. The total emissions for the town represent a great opportunity for reduction.

Figure 2 shows the emissions on an average per-household basis. The drivers are the same.

Figure 2

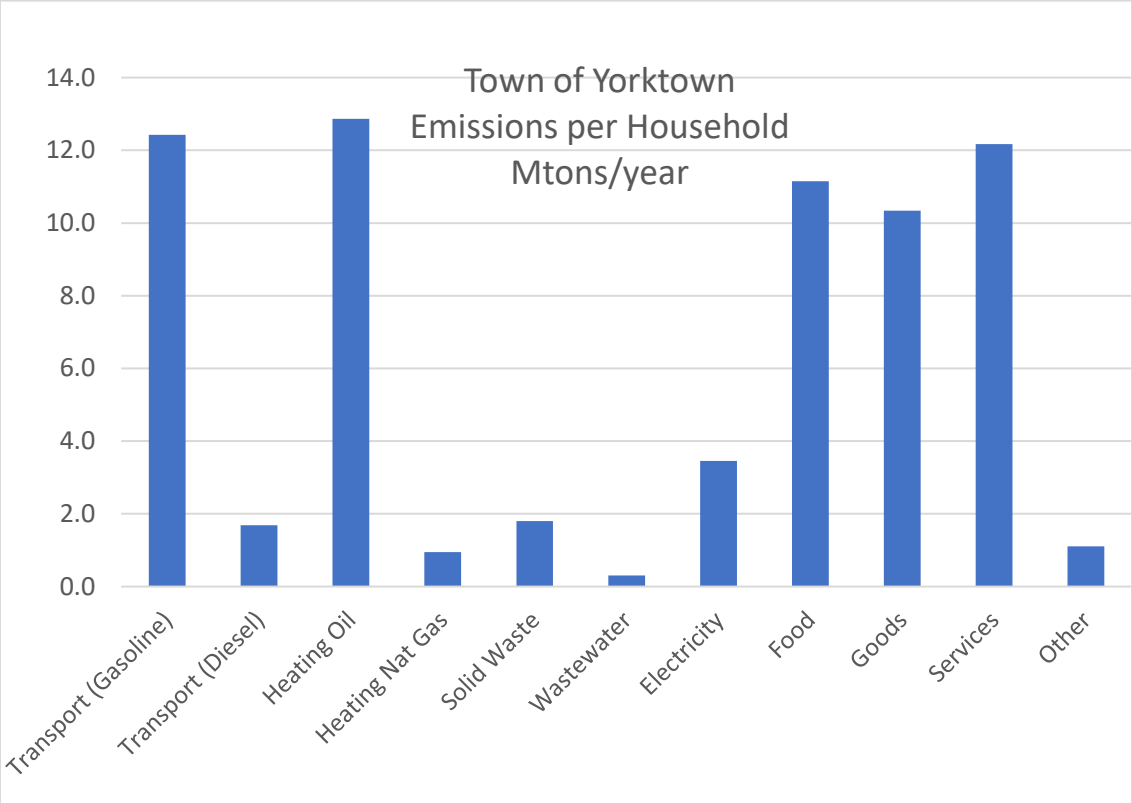


Figure 3 shows the major emissions categories per household. In the case of transportation, the blue bar indicates gasoline, for heating the blue bar indicates heating oil, and for waste, the blue bar indicates wastewater emissions.

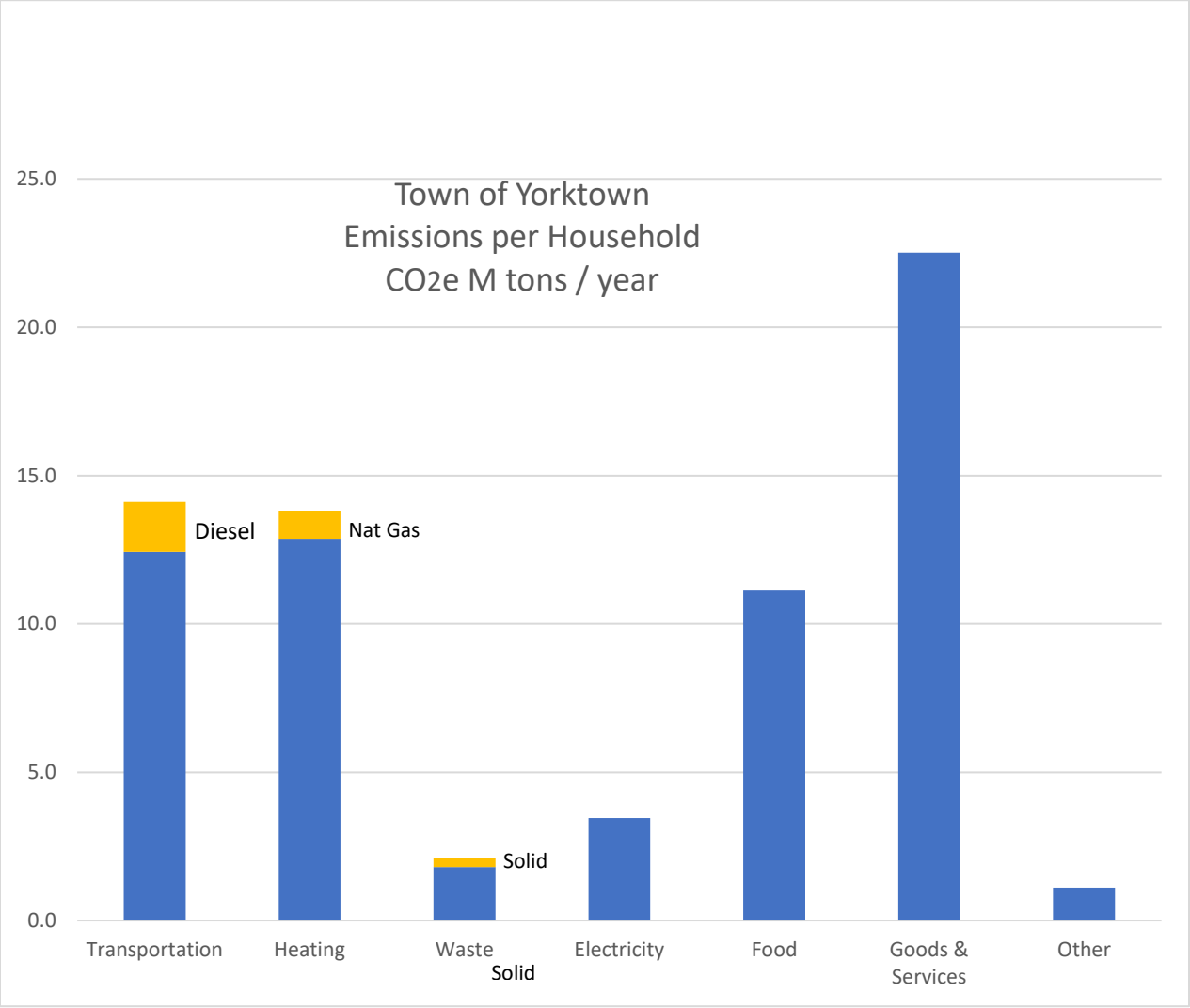


Figure 3

Personalize It

While there is a lot to be learned by looking at the averages for our town, we recommend every resident get familiar with their own personal Greenhouse Gas emissions. To that end, we recommend at locally developed tool which not only calculates emissions for a household, but compares it with the local average and provides tips for reduction: https://cure100.org/carbon-tracker/

Transportation

Direct emissions from transportation are the largest single contributor (note that goods and services are combined in one chart) but followed very closely by heating. Note also that there are significant indirect (scope3) emissions that result from extracting, refining and distributing fuels. While this is not shown, it is estimated that about 24% should be added to diesel and 30% to gasoline to account for the production and distribution according to Auke Hoekstra, Senior Advisor Electric Mobility at Eindhoven Technical University and Founder of ZEnMo simulations in the article "Producing gasoline and diesel emits more CO2 than we thought" https://innovationorigins.com/en/producing-gasoline-and-diesel-emits-more-co2-than-we-thought/ It is interesting to note that the EPA does not mention this significant additional emission nor does the guidance documentation. I suggest it be added in future emissions calculations. In addition, air transportation is highly fossil fuel dependent. As a result, the Town of Yorktown and the Climate Smart Communities Task Force are joined forces with the Lions Club and Yorktown100 to promote an EV car show in the summer of 2021 and another one in conjunction with CURE100 and the Jefferson Valley Mall in October 2021. Our local and state legislators attended including State Senator Pete Harckham, County legislator Vedat Gashi and Yorktown Town Supervisor, Matt Slater. Also, the Yorktown Police Department is piloting their first hybrid vehicle, and the Town is promoting an expansion of EV charging capabilities. More events will be planned in the future.

Heating

Historically, we have heated our homes by burning something. That is primarily fuel oil and natural gas in Yorktown (with some very small amounts of propane, wood or pellets or coal). As with all fuels, there are direct emissions from burning it, and significant indirect emissions resulting from obtaining it. These may include things like constructing an ocean platform, drilling, pumping, refining and transportation. So, we need to remember that the total of the supply chain adds significantly. Since fuel oil and diesel are essentially the same, I recommend adding 24% to the emissions in the future to account for diesel production and distribution.

The ideal buildings would be highly insulated and constructed with passive solar for heating and proper deciduous trees to aid with summer cooling complemented with high efficiency heat pumps. Unfortunately, we have a legacy inventory of buildings that are not very well constructed with consideration for energy use. The best available technology for these is heat pumps. Heat pumps can either use the ambient air outside (air source) or use the constant temperature of the earth to improve efficiency (geothermal). These heating methods rely on electricity to operate. Residents are urged to have a home energy audit, and make a plan to migrate to high efficiency heat pumps when it is time to replace their systems. They should refer to the website for Sustainable Westchester for guidance.

Electricity

Consumers in New York State have a wonderful array of choices for purchasing electricity. Freedom to choose can be a bit overwhelming. Here are some tips to get clean electricity (no carbon is made while generating it) and good value:

Community Solar: This program allows residents to gain the benefits of solar energy without installing anything on their property. It is especially helpful to those who do not have good conditions for rooftop solar. The town supervisor sent a memo to every household in 2021 urging them to sign up for Community Solar through the Sustainable Westchester program and website. They can save 10% on their bills and reduce their carbon footprint. This is a win-win.

Rooftop Solar: Rooftop solar provides up to 25 years of clean electricity and is a great investment for those with a roof with at least 25 years of remaining life and with proper orientation to the sun. It is an especially attractive investment for those served by ConEd. This is because the price of power is one of the highest in the nation. Paybacks well under 5 years can be achieved. There are also arrangements called Power Purchase Agreements in which the solar company pays for the installation and the owner benefits from reduced monthly billing (but the system is owned by the solar company). There is no one solution that is best for everyone. We urge residents to contact Sustainable Westchester or Yorktown100 for advice on proceeding. Caution should be taken to avoid over-priced or under-sized systems.

Clean Energy ESCO's: Residents have the freedom to purchase energy from a large number of providers. Energy Service Companies (ESCO's) can provide energy through your utility grid to your home. I all cases, the utility company (ConEd or NYSEG) will still provide billing, service and transmission and will charge a fee for such. Some ESCO's provide 100% clean energy. Signing up with them will essentially eliminate greenhouse gases associated with making your electricity. We recommend residents study their options carefully and choose a clean ESCO.

Community Choice Aggregation: This program is leveraged by many towns in Westchester. It is not currently available in Yorktown. In this program, (which would require town board approval) every resident in the town would be switched to a clean ESCO with the benefit of a utility rate negotiated with the full buying power of the entire town. Residents have the ability to opt-out at any time.

Food

Agriculture is a major source of emissions in the world (figure 4), and can even provide a degree of carbon sequestration if done in a more natural way. In the food chain, there is significant waste. We also know that beef raised in current farming methods is one of the highest contributors to greenhouse gas emissions. What can people do?

- Purchase only what you need and focus on minimizing food waste.
- Compost any scraps you have in your yard
- Eat less beef
- Choose whole food meatless meals

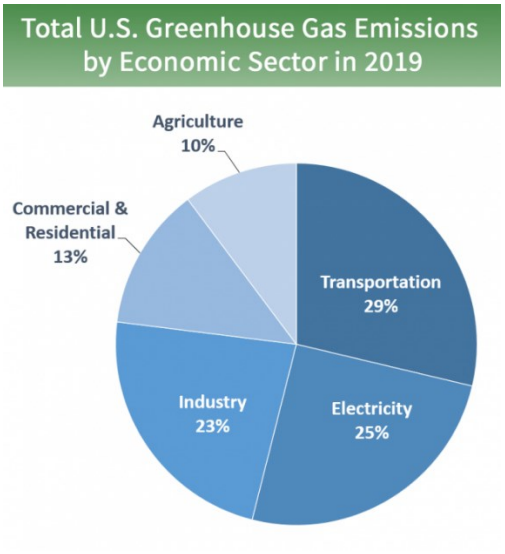


Figure 4

Source: https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

Goods & Services

Everything we purchase has a carbon footprint. This comes from the workers driving to work, product processing, heating of buildings, transportation of raw materials and finished products etc. Certain industries (such as the fashion industry) urge consumers to purchase things that are really not necessary. In addition, services we purchase (such as landscaping with gasoline powered equipment) add more greenhouse gases. Investments we make in companies that either make or consume fossil fuels adds more. What can residents do?

- Buy less and less frequently (for example, keep your cellphone longer)
- Repair rather than replace
- Purchase greener services (like a lawn service that uses electric equipment)
- Curate investments carefully

Summary:

Activities within the Town of Yorktown drive significant greenhouse gas emissions. These may be local (scope1) emissions like burning oil to heat our homes or driving within our town. There are also many emissions that are produced remotely due to energy we consume or things we purchase. There are many actions residents can take such as:

Transportation: Drive less, carpool, take public transportation, avoid air transportation and migrate to an electric car when it is time to replace your current vehicle.

Heating: Have a home energy audit done (typically for free) and follow up on actions. Make a plan to switch to clean electric heat pumps. Assess air source and geothermal options. Don't wait until the last minute, as it may not be possible to switch quickly.

Electricity: Purchase from a clean ESCO, and leverage Community Solar. Evaluate rooftop solar for your home.

Food: Eat less red meat, focus on minimizing food waste. Compost locally.

Goods and Services: Purchase less, keep things longer, and repair rather than replace.

If all residents make the low carbon choices, our total footprint can reduce dramatically.

Background and Methodology for the Calculations

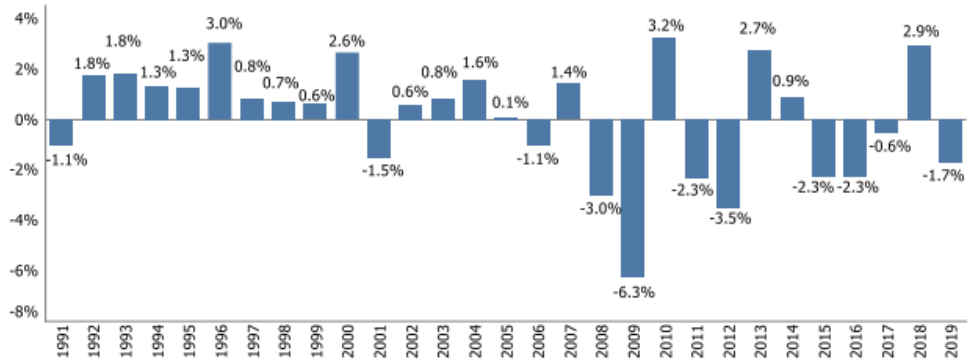
The methods are broadly consistent with those in ICLEI's Community Protocol for GHG emissions, and the New York Regional and Community GHG Inventory. Yorktown started with the 2012 Mid-Hudson Regional Greenhouse Gas Emissions, and where possible, updated that inventory using the Utility Energy Registry, updated census data and information where defensible from the University of California's Cool Climate Tool. In all cases, emissions = activity x emissions factor.

NYS commissioned an inventory that included the Town of Yorktown in 2012 titled "Mid-Hudson Regional Greenhouse Gas Emissions Inventory Final Report for Mid-Hudson Tier II Regional Greenhouse Gas Emissions (GHG) Inventory" completed in December 2012. This report is not within the 5-year period allowed by the CSC program and much has been learned since then.

Nationally, the variation in national emissions has been very small (plus or minus a percent or two) over the years (as can be seen in the reference and figure below). In addition, population and housing units has grown very marginally (less than 1.5%), as indicated by the US Census (2010 compared to 2020). Therefore, it makes sense to compare recent results with the 2012 study in the analysis.

https://www.epa.gov/sites/default/files/2021-04/documents/us-ghg-inventory-2021-chapter-2-trends.pdf

Figure 2-2: Annual Percent Change in Gross U.S. Greenhouse Gas Emissions Relative to the Previous Year



In addition, I will share results extracted from a simple to use software tool on the CURE100 website named REGGIE (for Regional Greenhouse Gas Inventory Estimator). https://cure100.org/carbon-tracker/ While these extracted results are not currently all available on the tool, it could be modified to provide these. It provides data in different consolidated groupings than required by the CSC guidance.

Background on UCB Cool Climate Calculator

The University of California at Berkeley performed and extensive analysis of greenhouse gas emissions in the United States, with additional focus on California. Through their modeling, greenhouse gas emissions can be predicted for every zip code in the USA. The model relies on data including population, income, and spending habits. The results are not, however broken down in the categories (Scope 1,2,3) used by the CSC program.

The modeling and statistical analysis indicated some very consistent results:

- Greenhouse gas emissions are a strong function of household income
- There is a peak in GHG in the wealthy suburbs. (Cities and lower income rural areas are typically lower)

CURE100 was able to obtain the raw data from the study, and I have factored it to adjust for the slight population growth and used ratios determined withing the study to break down the results in more granularity. I use this as a comparison with the prior study and some of the raw data for my separate calculations.

This can all be easily automated in an online tool named REGGIE (Regional Greenhouse Gas Emissions Estimator). I believe it would lower the barrier to entry and provide consistency among towns to simply use a common tool, and I believe this one would be simplest (and adds up to the USA total).

Overview:

I created a master table for reference which includes the prior study results, my current estimation using activity factors multiplied by emission factors. As in all GHG estimates, some of these numbers have more precision than others. It is important to know the approximate values to communicate to the residents and drive actions and establish a baseline.

Alll data in CO_2e M tons/year														
	Stationary Energy - Heating etc.						Minor							
	Residential	Commercial + Industrial	Total	Trasport / Mobile	Solid Waste	Waste water	Industrial processes	Agriculture	Energy supply	Food	Goods	Services	Total not including Food, G&S	Total includes Food, G&S
MHG Inventory 2012	102,371	89,156	**191,527**	189,179	2,093	3,510	13,393	847	10,136				**410,685**	**410,685**
2020 Estimate	87,274	76,008	**163,282**	183,451	23,467	4,000	13,574	847	44,944				**433,565**	**433,565**
Updated REGGIE	108,451	75,354 (indirect)	**183,804**	217,472	11,379		N/A	N/A	44,909	142,343	131,927	155,404	**457,564**	**887,237**
Recommended Value			**179,538**	**183,451**	**23,467**	**4,000**	**13,574**	**847**	**44,926**	**144,905**	**134,301**	**158,201**	**449,803**	**887,211**

Heating:

Total heating, above was originally estimated around 190,000 M tons per year. The REGGIE tool provides about 185,000 for direct + indirect heating for the entire town. I estimated residential heating oil emissions by using 2020 census data for fuel use and number of households, and estimated the usage by contacting oil companies in the Town, and arrived at roughly 900 gallons per year per household as total sold. For natural gas, I used the UER data and standard EPA emissions factors. Once residential emissions were calculated, for commercial and industrial, I used the same ratio as used in 2012. This is because the town has remained relatively stagnant, with a new Lowes, and a shuttered Kmart, so overall I believe this is a good approximation. The net of this was about 165,000 M tons per year. While the number of households and EPA conversion factors are accurate, the estimate for commercial usages are rough approximations. The REGGIE data looks very close to (actually between) these two estimates and would only take a few minutes to calculate. For this value, I used the average of all 3 methods:

Overall, I believe a number of 180,000 M tons per year is a good estimate for heating Scope 1.

Transportation:

Transportation is estimated by considering average fuel economy, total miles traveled, and EPA conversion factors. Note that the town and county were contacted for VMT information which yielded nothing. So it was up to this effort to estimate VMT. The original report yielded 190,000 M tons/year. A table was created with the same vehicle categories recommended in the guidance document. I updated total miles traveled by car per recent EPA national averages, and current census data and a number of cars per household. I also included a factored amount of total truck miles https://www.bts.gov/content/us-vehicle-miles driven in the USA. I referred to the EPA fuel mileage trends and updated all mileage numbers (all average mileages improved). I used 6.78% for biogenic as recommended in the guidance document. For air travel, I referred to UCB data, but took only 20% of the suggested airline emissions due to the pandemic. This updated total was 183,000 M tons/year. It is down due to higher average miles, and less air travel. The REGGIE tool yielded 217,000 M tons / year with adjustment for less air travel.

Overall, I believe a number of 183,000 M tons per year is a good estimate for transportation. This took significant time. The REGGIE number is relatively close and would take minutes to calculate.

Waste

I contacted the local carting company to see if they had data, but their trucks collect from several towns and do not have the ability to separate out the different towns. Yorktown has an active curbside recycling pickup program. Recyclable material is picked up weekly, and trash picked up 2x weekly. The trash goes to the Peekskill waste to energy plant, and therefore I used the factors for incineration as provided in the Community Protocol for Greenhouse Gas Emissions guide. The starting point is the population from the 2020 census, and uses the EPA average values for mixed solid waste and portion recycled. This yielded 23,000 M tons per year. The updated REGGIE tool uses the factors for methane for a landfill and recommended capture rate of 75%. For it to come up with the exact number, it would need an input as to how trash is “disposed of”. It therefore comes out lower than the calculation specific to Yorktown since our waste is incinerated. Both results are higher than the original report.

For waste, I estimate 23,000 M tons per year since incineration is the waste disposal method.

Industrial Processes and Agriculture

These numbers are extremely small, and since there have been no major changes in the town. I ratioed industrial processes for current population from the prior report and maintained the same agriculture emission level (negligible).

Energy

This is where the calculation is far better than previous study. I used UER data for ConEd and NYSEG and the EPA energy Profiler which utilizes a 5.1% line-loss. This should be far more accurate than prior estimates. Note that the emissions per watt for Con Ed are much higher than NYSEG.

The emissions from energy consumed was 45,000 M tons per year.

Food, Goods, Services

These calculations were done using the UCB Cool Climate calculator embedded in REGGIE. They compare well with Philipstown data. Since I broke out some specific numbers not specifically called out in the REGGIE tool, I adjusted the remaining numbers for "goods and services" to maintain the REGGIE total, which was confirmed by UCB to add up to the national totals.

Wastewater treatment facilities: The Town central sewer plant and district is named the "Hallock's Mill" district and the plant is located on Greenwood Street. I reviewed the methodology used by prior consultants for the State, and updated this with current data. I calculated it two ways. Both are high level estimates based on default values as allowable: First, I used the EPA tool:

https://www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool

And I chose default values for all variables. I also inserted the average protein consumption per person of 42.6 kg/person/year, and no use of solids as fertilizer. This yielded 4,000 M tons/year.

Second, I used the prior consultant report cited below (which estimated 3,510 Metric Tons / year in 2010). I used the same methodology in the report Mid-Hudson Regional Greenhouse Gas Emissions Inventory Final Report for Mid-Hudson Tier II Regional Greenhouse Gas Emissions (GHG) Inventory Prepared for New York State Energy Research and Development Authority (NYSERDA) 17 Columbia Circle Albany, New York 12203-6399 Prepared by ICF International, Sub-consultant to VHB, Inc. December 13, 2012 which is reprinted below:

Wastewater emissions are calculated based on the population served by wastewater treatment processes. Population data in the Mid-Hudson Region were obtained from the NYS Data Center.[33]

Wastewater emissions were calculated using EPA's State Inventory Tool (SIT). Methane emissions from municipal wastewater treatment were calculated by multiplying the population served by municipal WWTPs, from the Census 2010 population data for the region, by the annual per-capita 5-day biological oxygen demand (BOD_5) rate times the emission factor of CH_4 emitted per quantity of BOD_5. Default values for New York State in the SIT were used.

$$CH_4\ Emissions\ (MT) = Population\ x\ Per\ capita\ BOD_5 \left(\frac{kg}{day}\right) x \frac{Days}{year} x \frac{MT}{kg} x\ EF \left(\frac{GgCH_4}{GgBOD_5}\right) x\ \%\ of\ WW\ anaerobically\ digested$$

Where:

Population	=	Population served by municipal WWTPs.
Per capita BOD_5	=	5-day biochemical oxygen demand per capita. Default value is 0.09 kg BOD5/day.
EF	=	Emission factor of CH_4 emitted per quantity of BOD_5. Default value is 0.6 Gg CH_4/Gg BOD_5.
% of WW anaerobically digested	=	Fraction of wastewater BOD_5 that is anaerobically digested. Default value is 16.25%.

Nitrous oxide emissions form municipal wastewater treatment were calculated by multiplying the population served by the percent of the population using centralized wastewater treatment (not septic systems), times the amount of direct N_2O emissions from wastewater treatment per person per year.

$$N_2O\ Emissions\ (MT) = Population\ x\ Fraction\ of\ population\ not\ on\ septic\ x\ Direct\ N_2O\ emissions\ from\ WWT \left(\frac{gN_2O}{person}{year}\right) x \frac{MT}{g}$$

Where:

Population	=	Population served by municipal WWTPs.
Fraction of population not on septic	=	Percent of population that is served by centralized WWTPs as opposed to septic systems. The default value for New York State is 79%.
Direct N_2O emissions from WWT	=	The amount of N_2O emitted from WWTPs. Default value is 4.0 grams N_2O per person per year.

Nitrous oxide emissions from wastewater biosolids were calculated using the following equation:

$$N\ in\ Domestic\ Wastewater = Population\ x\ Protein \left(\frac{kg}{person}{year}\right) x\ Frac(npr) \left(\frac{kg\ N}{kg\ protein}\right)\ x\ Fraction\ nonconsumption\ N\ x \left(\frac{MT}{kg}\right)$$

$$N_2O\ Emissions\ (MT) = N\ in\ Domestic\ WW\ (MT) - Direct\ N\ Emissions\ from\ Domestic\ WW\ (MT)\ x\ (1 - \%\ of\ Biosolids\ used\ as\ fertilizer)\ x\ EF \left(\frac{kgN_2O - N}{kgsewageN_{produced}}\right) x \left(\frac{N_2O}{N_2}\right)$$

Where:

Population	=	Population served by municipal WWTPs.
Protein	=	Available protein per person per year (kg/person/year). Default value is 42.6 kg/person/year.[34]
Fraction of population not on septic	=	Percent of population that is served by centralized WWTPs as opposed to septic systems. The default value for New York State is 79%.
Direct N_2O emissions from WWT	=	The amount of N_2O emitted from WWTPs. Default value is 4.0 grams N_2O per person per year.

[34] *Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2010.* Tables 8 to 14.

This yielded 3,980 M Tons CO2e per year.

Thus, 4,000 M Tons CO2 e per year is the number for wastewater emissions.

About the author & acknowledgements:

This report was prepared entirely as a volunteer effort by R. DeAngelis. I am a retired IBM senior engineering manager with extensive experience in energy management. I have degrees in Chemical Engineering and an MBA. I want to acknowledge the carbon tracker team at CURE100 and particularly thank Dr. Chandu Visweswariah for his advice and counsel in the use of REGGIE. I appreciate that the State commissioned the 2012 report. Lastly, I appreciate the extensive work done by the University of California at Berkeley.

I appreciate the opportunity to serve on the Yorktown Climate Smart Communities Task Force.