

Montgomery Township Greenhouse Gas Emissions Inventory and Suggested Policy Options

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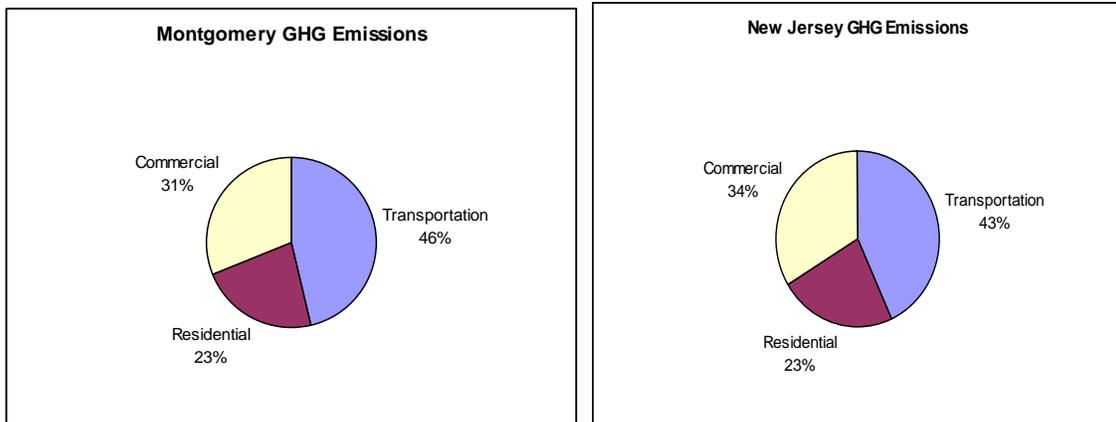
Summary

This greenhouse gas emission inventory was conducted for Montgomery Township, New Jersey for both municipal operations and the township community overall. Data was either collected for 2008 or adjusted to 2008 values. Insufficient historical data was available to identify trends; however, known state-wide growth rates of key emissions sources were used to project future emissions. Data on residential and commercial energy use, transportation, solid waste, sewage, and other sources of greenhouse emissions were gathered and analyzed to calculate an index of current emissions and to help identify promising reduction strategies.

In Montgomery Township the overall energy use and greenhouse gas emissions for 2008 are as follows:

	Energy (MMBtu)	Emissions (tons eCO ₂)
Residential Energy	1,216,351	109,143
Commercial Energy	668,832	79,721
Transportation	1,755,373	162,599
Waste and Sewage		17,805
Total	3,640,556	369,268

As indicated in the charts below, emissions from Montgomery Township coincide very closely with data for the state of New Jersey overall.



Greenhouse gas emissions for municipal facilities and operations were as follows:

	Energy (MMBtu)	Emissions (tons eCO₂)
Electricity	7,669	1,094
Vehicle Fleet	1,667	142

Projected community emissions for 2020 indicates a sixteen percent increase in residential and commercial energy use and a nineteen percent increase in transportation related emissions. Creative and proactive policy changes will be needed to ensure that these increases do not occur and Montgomery is able to achieve its share of the twenty percent reduction in emissions to which the state of New Jersey is committed by 2020.

For the community overall, it is clear that transportation is the major contributor to greenhouse emissions, and a slightly larger share of total emissions than for the state overall. While other measures are needed to reduce transportation-related emissions in the township in the short term, it is a long term imperative that Montgomery begin to adopt policies and practices to help shape a less transportation-intensive community through smart growth policies, clustered housing, transportation alternatives, and mixed-use development. Residential and commercial energy use is also significant; therefore, policies that attempt to reduce building energy use through education and incentives for energy efficient buildings, adoption of energy saving features and appliances, and efficient home energy management are most likely to produce needed emissions reductions. Such practices are also likely to save homeowners and business owners money, and thus are likely to enjoy the support of Montgomery residents and businesses.

Introduction

Global warming may well present the greatest threat to our shared future. A significant rise in carbon dioxide and other greenhouse gas emissions has already led to a temperature increase of one degree Fahrenheit over the past century, the greatest temperature increase in more than a millennium. If the emission of these heat-trapping gases continues, the consequences may well be devastating. Among the expected impacts are ocean level rises that will threaten shorelines and wetlands, significant changes in water resources, reduced and otherwise changed food production, reduced biodiversity, and increased stresses on vital ecosystems such as forests, wetlands, and coral reefs. Most disconcerting, if left unchecked, the effects of climate change can in turn intensify the causes of change, inciting a positive feedback loop that could define an inherent momentum toward severe climactic change which is difficult or impossible to address.

The effects in New Jersey will be significant. The Garden State can expect a four degree Fahrenheit temperature increase over the next century, as well as a sea level increase of 27 inches along our coast. These changes will lead to a significant loss of habitat, threats to shoreline property, loss of or changes in drinking water supplies, shifting of forest habitats, more frequent fires, and the destruction of 20 to 70 percent of shorebird habitat. Public expenditures will need to increase considerably to address the threats to property and public health presented by these changes.

Economic consequences will be felt across the Garden State. Sea level increase will affect tourism, an industry that brings nearly \$2.2 billion dollars into New Jersey each year. In addition, New Jersey can expect to spend hundreds of millions of dollars protecting its coastlines. The EPA estimates that the protection of Long Beach Island alone could total between \$100- \$500 million. The increased frequency and harshness of severe storms are expected to entail considerable economic and human costs.

In Montgomery Township, a large number species of plants and animals could be at risk. Longer growing seasons may occur as a result of warmer temperatures, but this may also make our crops more susceptible to pests and weeds. Warmer temperatures will have associated changes in the water cycle, affecting ecosystems, water supply and agriculture. This loss of water will affect the state's blueberry yields. More intense rain events are likely, and although there will be more precipitation overall, the likelihood of summer droughts will increase.

In summary, a partial list of the impacts of climate change in New Jersey includes:

- Significant loss or deterioration of shoreline and shore communities
- Significant loss in wetlands
- Temperature rise of 4-11°F by 2100.
- Increase in precipitation by 10-25%
- Possible increase in severe weather, including heat waves
- Rising temperatures raising concentration of ground level ozone (smog)
- Increased encephalitis, Lyme disease, and possibly malaria
- Decrease in agricultural yield

New Jersey residents contribute significantly to the emissions that cause climate change. New Jersey residents overall produce somewhat less greenhouse gas emissions than the national average, largely as a result of the less carbon-intensive electricity production in the state. Garden State residents constitute three percent of the US population, but they are responsible for only two percent of US greenhouse gas emissions. However, New Jersey residents constitute only one-tenth of one percent of the world's population but are responsible for a full half of one percent of all greenhouse emissions globally. Hence, Montgomery residents produce roughly five times the greenhouse gas emissions of the average person on the planet.

It is perhaps for these reasons that Montgomery Township's Mayor Cecilia Birge has expressed such strong support for efforts to reduce the Township's contribution to climate change, and interest in the US Mayor's Climate Protection agreement. The agreement sets a goal of a seven percent reduction in carbon dioxide emissions from 1990 levels by 2012. However, a township may change the agreement to define its own, unique goals as well. In addition, communities signing onto this agreement have agreed to seek emissions reductions through actions ranging from anti-sprawl policies to urban forest restoration projects to education campaigns. Moreover, the state of New Jersey has adopted a targeted reduction of a full twenty percent by 2020 and eighty percent by 2050. Achieving these targets will require significant efforts among local municipalities. This carbon inventory serves as the starting point in the effort to decrease Montgomery Township's carbon dioxide emissions. Setting clear and measurable goals for reduction is the next step.

Inventory Methods

This inventory provides an index of climate change emissions from Montgomery Township, expressed in a common unit as carbon dioxide equivalent (eCO₂). So, while emissions of other greenhouse gases such as methane and nitrous oxides are considered, they are expressed as a function of their heat trapping capacity as eCO₂. The results are intended to help the township (1) establish an index for future emissions reduction efforts; (2) evaluate the nature of emissions sources in Montgomery and identify efficient and effective reduction strategies; (3) produce a useful comparison with similar communities in New Jersey and nationally.

This inventory is separated into two distinct parts:

- (1) Community Inventory – A municipality-wide assessment of major energy uses and waste production in Montgomery Township and their resulting greenhouse emissions.
- (2) Municipal Operations – An evaluation of energy use and emissions caused by municipal buildings and operations. Emissions from municipal operations are included in the commercial sector of the overall inventory.

This separation is intended to provide clarity and to empower policymakers and township managers to more effectively identify immediate changes in township operations that may result in greater efficiency and reduced greenhouse emissions. In addition, it is hoped this separation may facilitate the identification of broader changes in ordinances, enforcement policies, and practices that can contribute to efforts to reduce Montgomery Township's overall contribution to climate change. The Township can therefore set an example of responsible energy use and climate stewardship for residents and businesses in Montgomery while also shaping policies that encourage similar reductions in the community overall.

This inventory is conducted for the year 2008, therefore providing a general index of annual climate changing emissions. Data was not available for an inventory of past emissions or historical trends. However, known state-wide growth rates of emissions sources and estimates based on survey data were utilized to define projections of future emissions.

It is important to note that this inventory focused on direct emissions assessments that can be used to shape municipal operations and policy and in fact excludes significant sources of greenhouse

emissions from Montgomery residents and businesses. So, while this report provides a useful index to measure future changes, it does not represent a complete measure of all emissions resulting from residents and businesses in Montgomery. For example, this inventory does not measure the emissions resulting from any commercial or retail consumption in Montgomery or by Montgomery residents. The purchase of any product entails a certain carbon 'backpack', the result of the energy and resources used to manufacture the item. In fact, consumer purchases can account for a full third of an individual's contribution to climate change. However, because of the difficulty in measuring (and regulating) these secondary and tertiary emissions, they are not included in this inventory. As an example, while beef production is a major contributor to methane, a potent greenhouse gas, beef consumption in Montgomery is not included in this report.

Data for this evaluation was collected from multiple sources, including: energy providers, Montgomery Township offices, New Jersey state offices, and extensive surveys and assessments conducted by SCI students at The Richard Stockton College of New Jersey in the Spring and Summer of 2008 and proceeding periods. Data was analyzed by Stockton College students under the supervision and guidance of Professor Patrick Hossay and facilitated through the use of specialized software designed and developed by Local Governments for Sustainability (ICLEI).

Following the inventory is a list of suggested policy options derived from these findings and diagnostic evaluations conducted through community surveys. These suggestions are intended to help identify useful first steps in the definition of the Township's reduction strategies.

Inventory Results

Residential Emissions

Greenhouse gas emissions from township homes are principally the result of the use of electricity, natural gas, heating oil, propane, and fuel wood. This energy use in Montgomery is responsible for the equivalent of 109,143 tons of carbon dioxide (eCO₂) annually.

Electricity

Electricity use data was provided by PSE&G, the sole provider of electric power in Montgomery. PSE&G reports that 94,616,157 Kilowatt-hours (kWh) were used by Montgomery homes in 2007. Assuming the township matches the state-wide 1.4% annual increase in energy use, and correcting for the township's population increase, this indicates a total usage for 2008 of 95,940,783 kWh. The resulting residential electricity use per capita is 3,753 kWh. The 2000 Census reports a statewide mean of 2,997 kWh. This number may be projected to 2008 using a growth rate of 1.4 percent annually to produce a current statewide mean of 3,304 kWh. Hence, the mean residential electricity use in Montgomery Township is considerably above the state average. A comparison of residential energy use in similar townships with comparable housing types and income indicates that residential electricity use in Montgomery Township is slightly above its expected level.

Residential solar photovoltaic electricity generation is not widely utilized in Montgomery. Approximately 241,192 kWh of electricity is produced by residential photovoltaic arrays on Montgomery homes annually, a number somewhat below state norms.

According to the state Clean Energy Program, only sixty-one homes in Montgomery Township have chosen to purchase green energy. Presuming their electricity use to align with the mean for the township, this represents a relatively meager 741,089 kWh of green electricity purchased annually. However, participation levels in Montgomery township is somewhat above the state mean.

Natural Gas, Propane and Heating Oil

PSE&G, the sole provider of natural gas in Montgomery, reports a total consumption of 7,735,155 therms of natural gas used in Montgomery homes in 2007. Adjusted for the estimated increase in 2008, annual overall natural gas use is roughly 1,159 therms per customer.

Use of fuel oil was not as easily measured due to the multiple suppliers of fuel oil in the region. However, a reasonable estimate was developed. Fuel oil was utilized in a total of 820 housing units in Montgomery according to the 2000 census. Assuming no new homes were built to utilize fuel oil or kerosene in the past eight years, and utilizing the township mean energy usage of 1,159 therms for home heating; when adjusted for the mean efficiency of fuel oil heating, we can extrapolate an estimated 696 gallons per home or a total usage of 570,720 gallons of fuel oil used in the township.

Use of propane is similarly difficult to measure, but may be estimated in a similar fashion. The 2000 Census indicates that 56 homes in Montgomery utilize propane; projecting for population growth in the region, we estimate 73 homes currently using propane for home heating. Presuming these homes have similar heating demands and efficiency profiles as homes heated with natural gas, we estimate 1,267 gallons of propane use annually and 92,491 gallons used in Montgomery overall.

Fuel Wood

Use of fuel wood was estimated using state and EPA data on fuel wood use and type in New Jersey as well as census data. Roughly 1.3 percent of Montgomery residents utilize fuel wood for some level of home heating. Presuming they utilize this wood at the same rate as New Jersey residents overall, and that they largely utilize the most commonly available types of fuel wood in the region, we estimate 510 cords of fuel wood utilized annually in Montgomery.

Overall Residential Emissions

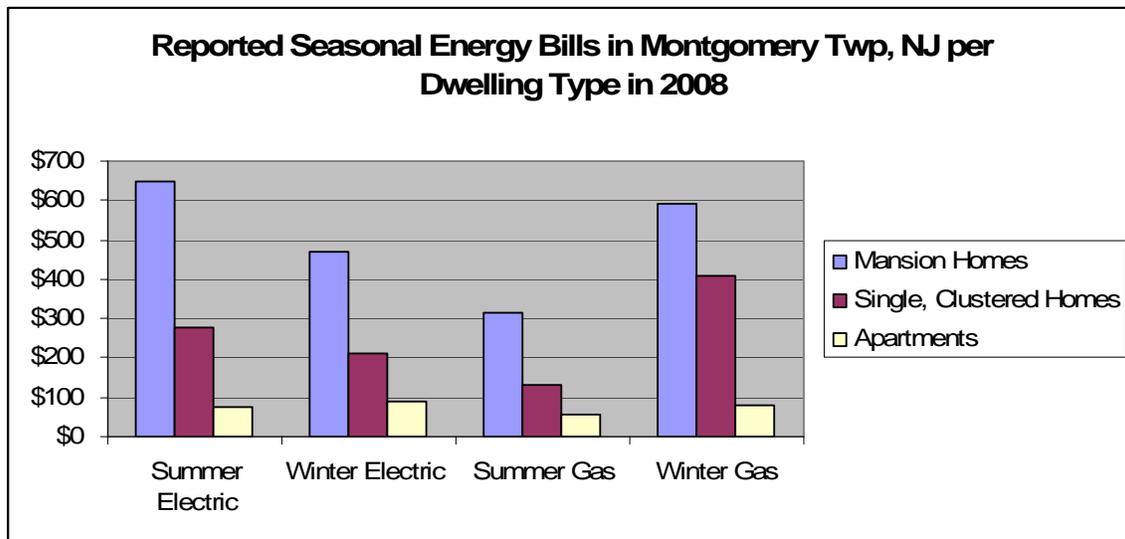
The above data and estimates indicate a total residential energy use of 1,216,351 million British thermal units (MMBtu). The resulting greenhouse gas emissions are 108,472 tons eCO₂. An

additional 671 tons of eCO2 emissions was estimated to result from landscaping and lawn care in the township., based on the township’s typical landscaping and the results of surveys.

In addition, the above residential energy use is responsible for the following pollutants annually:

Pollutant	Emissions (lbs)
NOx	312,181
Sox	593,332
CO	192,859
VOC	32,378
PM ₁₀	63,570

The cost of the high rate of residential energy use for the residents of the Township is significant. These cost exceed self-reported numbers collected in similar townships and indicates a rising pressure on the home budgets of Montgomery Townships working families. It is also clear that large, single family homes are the largest unit consumers of energy. The following chart compares the reported energy bills of large single-family homes, single-family clustered housing, and apartments throughout the year, as collected through door to door surveys within Montgomery Twp during the summer of 2008.



The table below represents the numerical data used in the chart above. It is apparent that large, single family homes consistently require more energy because of their size and relative

inefficiency. Single-clustered homes can be approximated to use roughly forty percent less energy in all categories, with the exception of winter gas, where clustered housing usage was slightly under one-third less.

Dwelling Type	Summer Electric	Winter Electric	Summer Gas	Winter Gas
Large, S-F (Mansion) Homes	\$650	\$470	\$317	\$592
Single, Clustered Homes	\$277	\$213	\$130	\$408
Apartments	\$73	\$87	\$58	\$79

Commercial Emissions

Estimates of energy usage were also conducted for 164 businesses in Montgomery Township.

The total electricity use for the Montgomery commercial customers was 114,329,898 kWh.

Natural gas use by commercial customers was 2,751,045 therms. In addition, the clean energy produced by the 505 kW solar array at Johnson & Johnson produces approximately 1,032,220 kWh annually, marking a significant reduction in the Township’s potential emissions.

Commercial use of propane and heating oil were not available, but assumed to be small and calculated as zero. The resulting estimated energy consumption is 668,832 MMBtu, resulting in 79,721 eCO₂ tons of greenhouse gas emissions. In addition, the following emissions of criteria air pollutants result from Montgomery’s commercial sector:

Pollutant	Emissions (lbs)
NO _x	225,855
SO _x	688,409
CO	78,813
VOC	9,986
PM ₁₀	54,047

Transportation

Data from the New Jersey Department of Transportation were combined with data collected by the research team to identify total vehicle miles traveled (VMT) for the township on all road types.

Data was collected from observations at various locations across the municipality, at multiple times of day, and on various types of roads. This data reveals an average occupancy factor (passengers per vehicle) for personal vehicles to be 1.16, which is significantly lower than the national mean of 1.59. In addition, Montgomery was found to have a greater proportion of light trucks, SUVs and pickups than the national norm, and a lower proportion of compact cars, as shown below.

Vehicle Profiles		
	Montgomery	National*
Auto – Compact	11.8%	33.0%
Auto – Midsize	30.3	18.7
Auto – Full size	10.0	8.5
Light Truck/SUV/Pickup	42.8	32.4

According to survey data reported by residents, differences in vehicle type and usage are indicated by the findings below, specified by housing type.

Dwelling Type	Mean # of Cars per Household	Mean MPG	Mean Annual Miles Traveled
Large S-F Homes	2.3	19	20,000
Single, Clustered Homes	2	24	13,000
Apartments	1	25	12,000

It was determined that Montgomery contains approximately 72 miles of collector and local roads, 6 miles of major arterial roads (Route 206), and 67 miles of limited access and residential roads. For each of these road categories, a mean average annual daily traffic (AADT) was calculated

using traffic data from the NJ DOT, Montgomery Township Police Department, and our own data. The resulting average annual daily totals (AADT) follow:

	AADT
Collector and Local Roads	5,359 miles
Major Arterials	18,607
Limited Access Roads	852

Because traffic in Montgomery was observed to decrease somewhat in volume on weekends, a multiplier of 340 (rather than 365) was used to convert this data to annual figures. The result is a total vehicle miles traveled (VMT) for Montgomery of 188.6 million.

This VMT is considerably higher than comparable townships. This is likely the result of a higher than average traffic volume and vehicle use in Montgomery, more dispersed residences, commercial centers, and community services, the high proportion of residents who work outside the Township, and the Township’s proximity to population centers such as Princeton and Trenton.

The emissions resulting from transportation in Montgomery is significant. A total of 142,103 tons of eCO₂ are emitted as a result of normal transportation. In addition, normal vehicle use results in the following annual emission of criteria air pollutants:

Pollutant	Amount (lbs)
NO _x	749,966
SO _x	44,476
CO	6,837,780
VOC	680,478
PM ₁₀	18,983

In addition, significant additional transportation-related emissions were calculated individually, including residential waste pick-up, residential recycling pick-up, and school bus use. Traffic data was adjusted so as not to include these vehicles in overall estimates, allowing for a more careful and separate evaluation of these significant emissions sources.

Trucks collecting municipal waste travel roughly 62,500 miles annually collecting residential solid waste in Montgomery, and achieving a mean of 2.8 miles per gallon. An additional 55,000 miles are traveled to haul commercial waste. The resulting greenhouse gas emissions from all municipal solid waste management is estimated to be 13,803 tons eCO₂ annually. An additional 5,861 tons of eCO₂ are emitted annually from residential recycling pick-up. The emission resulting from commercial recycling was found to be too small to be worth separate calculation.

School busses are also a distinct and significant source of greenhouse emissions. Fifty-four school busses service Montgomery's schools as well as seven passenger vans, with a mean route length of 8.2 miles. The resulting emissions, for 180 annual school days, are 836 tons eCO₂.

The resulting greenhouse gas emissions from all transportation related emissions in Montgomery Township total 162,599 tons of eCO₂.

Solid Waste

Waste disposal is a significant source of greenhouse gas emissions. This analysis evaluates the total production of waste, its greenhouse gas potential as a result of its organic content, and the disposal method in estimating the carbon intensity of waste production in Montgomery.

Waste production estimates were provided by Raritan Valley haulers and further corroborated by site inspections of hundreds of homes on trash day to develop estimates of waste volume and content. These figures were grouped by housing type to produce weighted measures for the township's waste overall. Total residential waste from Montgomery Township, including single-family homes and apartments is 9,699 tons annually.

Methane is produced from the decomposition of organic material, such as paper or food waste. This is a potent greenhouse gas, some twenty-five times more effective at trapping heat than carbon dioxide.

Residential Waste Composition in Montgomery Township

Housing type	Waste Per Unit (lbs)	Waste Content (percent)					
		Paper	Food	Yard	Textile/Wood	Recyclable	Other
Large S-F Homes	71	30	19	5	4	20	22
Clustered	66	36	23	<1	3	18	19
Apartment	34	33	21	<1	7	22	17
Twp Overall	57	33	21	1.9	4.7	20	19.5

The eCO₂ emissions by category are shown below, wherein single-family homes includes all types: small rural residential, clustered, and large homes. The total emissions for residences in Montgomery Township is 10,450 tons eCO₂.

Dwelling Type	eCO ₂ Emissions per year (tons)
Single-Family Homes	9,780
Apartments	670
Total	10,450

Commercial waste pick-up in Montgomery Twp is arranged through private haulers. Using estimates provided by Raritan Valley, we were able to determine the average weight of several dumpster sizes. Additional on-site inspections of commercial operations in Montgomery Township provided estimates of dumpster size and waste content. With this information, we were able to estimate that each business in Montgomery produces an average of 1,600 pounds of waste per week. In total, the 164 commercial operations in this township produce approximately 6,825 tons of solid waste per year. Comprised of 53.9% methane-producing paper and cardboard, waste from the commercial sector contributes 5,240 tons eCO₂ per year, much of which could be prevented by more rigorous recycling practices.

In sum, the total waste produced in Montgomery Township is 16,524 tons annually. Taking into account the operation of the managed landfill servicing Montgomery's waste, this results in 15,690 tons of eCO₂ annually.

Of course, this analysis does not account for the emissions resulting from waste inefficiency or unnecessary consumption. For example, the secondary greenhouse emissions resulting from inadequate recycling of aluminum cans (thus resulting in greater energy use in the production of new cans from raw material rather than recycled stock) are not considered in this analysis.

All surveyed residents reported 100% compliance in the recycling of plastic bottles, aluminum cans, glass bottles, newspapers, and cardboard. Inspection of residential waste contents, however, showed that 20% of all items thrown away are in fact recyclable. Plastic bottles and cans made up about 5% of the residential waste stream, while cardboard and newspaper made up the other 15%. Another 33% of all waste could be reduced as well if the township were to increase paper recycling compliance through public education and enforcement. In total, over 50% of Montgomery's waste volume is composed of products that could be recycled.

Sewage

The treatment of municipal wastewater is energy intensive, and thus a significant source of greenhouse emissions. Based on 2007 budgetary data provided by municipal staff, Montgomery sewage is treated at six different sewage plants operated by the township. The combined electrical use of the facilities totals 3,846,788 kWh annually, or 13,129 MMBtu. The breakdown of these figures by plant is as follows:

Plant	Description	kWh
Sewer A	Skillman Village/Burnt Hill/HS	34,414
Sewer B	StageII/Mtg Woods/Mtg SC	1,293,396
Sewer D	Riverside/Montgomery Green	403,141
Sewer E	Pike Brook/Grayson/Pike Run	1,440,729
Sewer F	Cherry Valley Plant	283,852
Sewer G	Oxbridge Plant	391,256

Additionally, the treatment of sewage from Montgomery Township contributes 2,115 tons of eCO₂ each year, as well as the following criteria air pollutants:

Pollutant	Emissions (lbs)
NO _x	5,902
SO _x	19,969
CO	2,309
VOC	255
PM ₁₀	1,694

Municipal Operations

Annual energy use and the eCO₂ emissions resulting from Montgomery Township facilities and normal operations were measured and evaluated for 2008. These are rough estimates due to difficulty locating a number of monthly bills in the township files; they will, however, prove quite useful in understanding the emission patterns for municipal operations.

Municipal Government Electricity and Gas Use

Total electricity use for Montgomery township facilities and operations was found to be 7,661 MMBtu and responsible for 917 tons of eCO₂ annually. Electricity use for traffic signals was calculated independently and found to be 11,340 kWh, or 39 MMBtu, responsible for 6 tons of eCO₂ emissions.

Electricity consumption by category is as follows:

Use	Total (kWh)	Emissions (eCO ₂ tons)
Municipal Complex	659,456	450
Traffic Signals	11,340	6
Police Department	706	0
Police Trailer	45,192	25
Gazebo	474	0
Other	603,764	442
Total	1,320,932	923

In addition, electricity consumption by township operations and facilities was responsible for the following criteria air pollutants emissions:

Use	NOx (lbs)	SOx (lbs)	CO (lbs)	VOC (lbs)	PM10 (lbs)
Municipal Complex	1,260	3,433	457	57	298
Traffic Signals	17	59	7	1	5
Police Department	1	4	0	0	0
Police Trailer	69	235	27	3	20
Gazebo	1	2	0	0	0
Other	1,239	3,146	439	57	275
Total	2,587	6,879	930	118	598

A rough estimate of natural gas usage based on the limited available data is also included in the totals above, specifically 14,141 therms for the municipal complex and 17,776 therms in other operations. Although it would be helpful to categorize the municipal electricity usage into more substantive categories, a more detailed analysis was not possible because of the large number of separate PSE&G bills the Township receives each month and difficulty obtaining a number of months on file.

Municipal Vehicle Fleet

The municipality’s vehicle fleet includes 136 vehicles, using approximately 6,052 gallons unleaded gasoline and 7,424 gallons diesel annually. Total fuel usage is identified by category below:

Municipal Department	Usage (MMBtu)	Emissions (eCO2 tons)
Health Department	158	13
Parks Division	433	37
Roads Division	665	57
Sewer Utility	385	33
Police Department	26	2

Total

1,667

142

According to the data provided by the township, this fleet consumes a total of 1,667 MMbtu and emits 142 tons of eCO₂ each year. In addition, these vehicles produce the following criteria pollutants annually:

NO _x (lbs)	SO _x (lbs)	CO (lbs)	VOC (lbs)	PM ₁₀ (lbs)
1,012	61	4,117	437	33

Projections

While historical data was not readily available, projections for future energy use were established using known state growth rates of major emissions sources, adjusted to the patterns of current growth in similar townships in the state. Projections were produced for 2020, the target year for the first phase of state greenhouse gas emissions reductions. Future emissions estimates include normal traffic (not including public services and school busses), base residential energy use, base commercial energy use, and municipal solid waste. These numbers assume no change in current policy, a set increase in renewable energy use per capita, and the continuation of township growth rates established over the past five years. The estimates were adjusted to reflect likely changes in projected energy consumption based in future energy price fluctuations.

	Normal Transportation		Residential Energy Use		Commercial Energy Use		Waste
	MMBtu	eCO ₂	MMBtu	eCO ₂	MMBtu	eCO ₂	eCO ₂
2008	1,755,373	142,103	1,216,351	108,472	668,832	79,721	15,690
2020	2,088,894	169,103	1,423,131	126,912	775,845	92,476	20,240
Increase	19 %		17%		16%		29%

Creative and proactive policy changes will be needed to ensure that these increases do not occur and Montgomery is able to achieve its share of the twenty percent reduction in emissions to which the state of New Jersey is committed by 2020.

Suggested Measures

The following options are intended to help catalyze and shape policy changes and alterations in township practices that could most effectively result in a reduction of greenhouse gas emissions from the township.

Residential Energy Use

1. *Energy Education and Awareness Campaign:* In conducting our surveys, we found that most residents consider the environment a top priority (96% ranked it a 9 or above in importance on a ten-point scale). However, residents seem to have trouble reflecting this concern in their every day lives. A Township education effort, through local publications, presentations to community organizations, and participation and displays at community events may help provide the energy education which is needed and for which many residents have expressed an interest.

The importance of energy conservation and its connection with cost savings and energy independence could be emphasized in these efforts as well. Over 99% of all surveys conducted ranked saving money and achieving energy independence as a 9 or above in importance value. It appears residents were more receptive to these concepts than that of a “better environment,” so education efforts should keep this in mind. Our surveys indicate that the education efforts that would likely find a receptive audience among township residents include demonstrations of home weatherizing, energy efficient appliances, and proper home energy management. In this vein, it is important to note that a typical American home can reduce energy bills by fifteen percent with basic weatherization. Proper energy management and upgrades can reduce energy bills by a full third. Our survey results indicate that a large proportion of Montgomery residents have not enacted basic weatherization techniques, thus typical savings in the township are likely to be on the high side of these estimates.

2. *Local Promotion of State and Federal Clean Energy Opportunities:* The Municipality could do a great deal to make residents more aware of the incentives for clean energy and the support for energy audits. For example, the New Jersey Board of Public Utilities and New Jersey's Clean Energy Program offers certain state residents access to certified home improvement contractors that deliver energy efficiency improvements to their home. State and federal incentives for

alternative energy use can also be promoted through municipal efforts. Similarly, federal tax incentives for Energy Star appliances can be promoted to residents.

The installation of a visible alternative energy system, most probably a photovoltaic array at the main township complex or other visible location, could help promote alternative energy and substantially reduce the greenhouse emissions from Township operations.

Some residents were excited by the idea of solar panels, but felt limited by their Homeowner's Associations. Therefore, it is also recommended that Montgomery encourage these associations to accept solar panel installations on homes. Many renters in Montgomery Twp expressed interest in energy saving technologies, but less than half said they were willing to pay more in rent to support such new developments.

3. Promotion of Clean Power Choice: Relatively few Montgomery residents have chosen to purchase clean power for their domestic energy use. When asked about this option, most residents were not aware that it was available. Those residents that did know about CPC had many questions. The municipality could use public recognition programs and creative incentives to promote this program among township residents. Each household that participates in the program can reduce Montgomery's greenhouse emissions by over 10,000 pounds per year. Growth in participation to five percent of the township's homes would reduce Montgomery's overall climate emissions by 1,946 tons annually.

4. Landscaping Emission Reduction: The overall greenhouse emissions from off-road gas powered equipment in Montgomery are estimated to be 671 tons annually. This figure can be significantly reduced through local incentives and education toward the promotion of low maintenance landscaping and native plantings. Such practices would have an even larger impact on criteria air pollution emissions. The California Air Resource Board has found that a lawnmower can produce nearly 100 times the smog producing emissions of a new car, and ten times the carbon monoxide. In addition to low-maintenance landscaping, electric lawnmowers are another affordable option worth promoting in Montgomery Township.

Commercial Energy Use

1. *Utilize Light Emitting Diode (LED) in Traffic Signals:* Traffic signals in Montgomery Township result in six tons of greenhouse gas emission annually. LEDs, or light emitting diodes, are extremely energy efficient alternatives to the incandescent halogen bulbs in many traffic lights. They not only save energy, but also increase visibility, last for years, and are attractive to law enforcement officials because they cause less glare. We have found that each LED intersection would offer about \$140 in energy cost savings each year.

The average LED traffic light replacement can cost \$35.00 to \$150.00 for each lamp, depending on the size of the lamp, the color and whether there is a pedestrian crossing. The Clean Energy Program provides upfront rebates in some instances. Pay back of initial expenses is expected to occur in as little as three years.

2. *Community Energy Education:* A great deal can be done to promote energy conservation among the township's businesses. A program of public recognition through municipal awards and ceremonies can help reward businesses that have undertaken identified conservation measures. Our general surveys of township businesses indicate that perhaps one-third have not undertaken even basic energy saving strategies; and more than half of the Township's businesses could reduce their energy use significantly through simple conservation measures. For these businesses, the payback period for early conservation measures is likely to be less than a year, making such practices beneficial for the business owner's bottom line, as well as the environment. If one-third of Montgomery businesses adopt practices that reduce their energy use by a mere fifteen percent (a conservative target), this would reduce the township's overall greenhouse emissions by as much as 30,289 tons annually.

3. *Weatherization Inspections:* Basic inspection of a business's weatherization features could be incorporated with existing township inspections, such as recycling inspection, initiated as a cooperative project with student teams from nearby school districts and colleges, or initiated as a new municipal program. Such inspections could be voluntary, take less than fifteen minutes on site, and result in a five to fifteen percent energy reduction. Township staff or student teams could offer basic weatherization evaluations and suggestions to business owners. The further provision of estimated cost, payback period, and return on investment (ROI) for basic conservation efforts could help encourage business owners to adopt conservation measures.

4. *Green Building Incentives:* The Township should consider implementing incentives for new commercial construction that meet the US Green Building Council's Leadership in Energy and Environmental Design (LEED) standards. Such standards have already been incorporated into the redevelopment plans for the Skillman Village site and may be considered for the township overall. As the LEED program expands to include Homes (H), Neighborhood Development (ND), Commercial Interiors (CI), schools and other buildings, a proactive and creative incentive program could define Montgomery Township as a leader in the state. Incentives may also be put in place to promote and reward LEED standards for the operation and maintenance of existing buildings (LEED EB). Trained LEED Accredited Professional (LEED AP) on the Montgomery Township professional staff could help builders identify energy saving and green options. This training would be relatively inexpensive. The township itself can set an example by assuring that all its new constructions and renovations meet a set LEED standard or achieve LEED certification, and that the operation and maintenance of existing buildings are similarly certified. Research by the USGBC indicates that basic certification of a new construction can result in significant energy savings of the lifetime of the building and typically adds less than one percent to the cost of construction.

Transportation

In Montgomery, the majority of all vehicles traveled in are large SUVs, light trucks, and full-size cars. The modal number of passengers per car, observed during our traffic profiling, was one. The township's vehicle occupancy factor is significantly lower than the national norm, indicating that Montgomery residents are less likely to ride share or carpool than the state or national average. Sports utility vehicles and pickups were found to be over ten percentage points more prevalent in Montgomery than the national norm. The result is the relatively high carbon emission and criteria air pollutants from transportation within the township. However, several options could help reduce the greenhouse gas intensity of transportation in Montgomery:

1. *Adopt Carpooling Incentives:* The Township could facilitate and reward carpooling among its employees. An on-line ride sharing /car-pooling board for Montgomery Township employees could make carpooling easier. A cash incentive or reward for employees who carpool at least one day a week could also help. Subsequently, the municipality may also offer recognition and

incentives to Montgomery businesses that adopt similar policies or facilitate telecommuting when feasible.

The potential for reduction is clear. The average Montgomery resident commutes just under fifteen miles one way to work, shops nine miles from home on average, regularly travels more than ten miles for shopping, and drives up to 20,000 miles each year. There is a clear potential to decrease these numbers. A program that results in a mere five percent reduction in commute among Montgomery residents would result in roughly 4,000 tons less greenhouse gas emissions annually.

2. Fuel Efficient Municipal Fleet: It is unlikely that the municipality will be successful in shaping cultural preferences toward smaller cars among all residents. However, the municipality can choose fuel-efficient vehicles and optimal vehicle sizing for its own vehicle use. Optimal vehicle sizing in the fleet would ensure that the smallest vehicle necessary for the task is purchased and utilized. By determining the need of the vehicle and purchasing the most fuel-efficient vehicle that meets that need, Montgomery can reduce its climate impact and save money.

3. Enhance Township Alternative Transportation Infrastructure: The municipality could benefit from prioritizing bikeable and walkable pathways connecting residential and commercial centers to help reduce traffic-related greenhouse gas emissions. Safe pathways and sidewalks could increase biking and walking along those corridors considerably.

Biking is often viewed only as a recreational pastime, particularly in dispersed, semi-rural regions such as Montgomery. However, as the township continues to develop and define commercial and residential centers, enhanced bike and pedestrian connectivity can help achieve emissions reductions and the promotion of healthy lifestyles. Our surveys indicate that up to a third of residents would be likely to walk or ride a bike to shopping or other services on a regular basis if a safe path were available, and that concern for personal safety is one of the leading reasons residents choose not to bike or walk when making local trips.

4. Enhance Community Transit: Policies and practices that encourage the use of mass transit such as shuttle buses will reduce the township's climate impact. Research indicates that one bus can take twenty cars off the road and produce one-tenth the climate changing emissions. Ensuring attractive, safe, and convenient transit stops and efficient transit routes is vital to this

effort. Safe and sheltered stops for local buses help promote a favorable image of public transit and make each trip more pleasant. An ongoing evaluation of transit needs and transportation patterns of the community could help ensure that the community's changing transit needs are met in the most efficient way possible.

Our surveys indicate that about a third of all residents are in favor of a shuttle system, while about 15% showed interest in an improved bus program. About 85% of all surveyed residents claimed their average shopping experience was less than 10 miles away and visited about twice a week.

We project that public transportation options will not reduce emissions immediately, but instead that these reductions would most likely occur over time. Some Montgomery residents expressed a bias toward public transportation, saying it was inconvenient, costly, or unsafe. This opinion was expressed mostly toward bus systems traveling distances further than 10 miles, but some even felt this way about community shuttles. It will take some effort on the part of the Township to shift the public opinion. It will potentially be the least costly option in the short term to develop community shuttles for targeted residents and focused routes. Improving bus systems should still be pursued in the future, because this option has a great potential to reduce emissions from transportation.

5. Encourage a Safe Routes to School Programs: Several counties in New Jersey participate in the Safe Routes to School program in an effort to encourage more students to walk and bike to school. Cutting down on the number of parents who must drive their children short distances to school on a daily basis promises a healthier alternative for our children and the environment. Extra police protection and crossing guards can help ensure safety.

6. Pursue Smart Development: In the broader sense, the municipality must begin to evaluate its growth strategies and plans in order to reduce the energy and transportation intensity of new construction. Smart growth techniques that prioritize clustering and mixed use development can help encourage energy efficiency and make continued growth compatible with existing transportation infrastructure and the township's emissions reduction commitments.

Smart growth initiatives encourage the revitalization or creation of town centers, mixed residential and commercial land use, and the clustering of development toward already-developed areas and away from greenfields. Such policies are in line with Open Space preservation

priorities and can help develop healthier, safer, and more livable communities, with a greater sense of community identity and civic engagement. Pursuing smart growth is important for the protection of the global climate, but it's also particularly important for small towns like Montgomery that have limited buildable space. Smart growth strategies can help ensure Montgomery's continued economic development while simultaneously reducing the township's greenhouse emissions.

Waste

1. *Enhance Enforcement of Existing Recycling Ordinance:* The Township must establish and enforce recycling requirements for local businesses. On-site evaluations of local businesses indicate that relatively little recycling is done by Montgomery's businesses. Cans and bottles were rarely separated from normal waste, recycling containers were sometimes filled with Styrofoam or other non-recyclable materials, and cardboard was often mixed with the trash even when a separate dumpster was present. It is important to note, however, that because of generally low compliance levels across the state, recycling compliance was higher in Montgomery than in some similar townships in New Jersey.

The township can help facilitate greater cooperation toward compliance, provide rewards for businesses that meet their obligations, and enforce penalties for those that do not. Enhanced inspections of township businesses would help facilitate this effort. Because current performance is not effective, the potential for reduced emissions even through modest recycling improvements is great.

2. *Recycling Education:* Montgomery Township should ensure that residents are aware of their recycling obligations and understand recycling options. Most residents seemed to recycle bottles and cans fairly well, but do not recycle cardboard and paper effectively; doing so could help reduce waste by up to 50%. If such a program were to reduce the amount of paper in the waste stream by half, down to 17%, this would considerably reduce the township's annual greenhouse emissions, as the biodegrading of paper emits methane, a potent greenhouse gas.

3. *Green Purchasing:* As stated in the introduction, this study did not evaluate purchasing patterns. However, green purchasing (established preferences for recycled materials, energy efficient appliances, or other green options) or the reduction of purchasing through efficiency and

conservation measures can significantly reduce the greenhouse gas emissions resulting from Township operations. (These reductions can be quantified and counted toward the township's reduction commitments even if they are not included in this baseline assessment.) A green purchasing program could also set an example for township businesses and schools.

4. *Community Gardens*: These areas give residents a common area in which they can grow crops and flowers during the warmer months of the year. Community gardens can be placed anywhere with decent soil – raised beds with ecosoil make this requirement even less necessary. Community gardens are a great way to reach residents of all ages, both young and old, and it is an excellent opportunity to connect people more closely with the food they eat.

Community gardens have the potential to be combined with a local farmer's market, reducing emissions associated with food significantly. The energy needed to grow, package, and transport food has associated CO₂ emissions. Promoting locally grown, Jersey Fresh, and Certified Organic produce can help reduce these emissions .

Carbon Sequestration

Although this inventory did not evaluate the carbon sequestration potential of Montgomery's forested areas, any change in the quality or size of these areas or flora in the township more generally could be included in future emissions inventories as a positive or negative factor. Hence, a central element in meeting the township's reduction commitments must be the protection and enhancement of open space and forested areas.

1. *Establish a Municipal Tree Planting Program*: Several sorts of programs can encourage the planting of trees in public spaces. Programs might include incentives for the planting of trees by local homeowners or businesses, cooperation with a local nursery that makes low cost or free native trees available to residents, or a public-private partnership that enables local businesses to sponsor tree plantings in the township.

2. *Planting Municipal Lawns in Attractive Natural State*: Manicured lawns can be significant contributors to climate change. Inefficient engines on trimmers, leaf blowers, mowers, and the other machinery used to maintain a lawn contribute significantly to climate change and local air pollution. Hour for hour, a lawnmower emits more than ten times the hydrocarbon of a typical

car, and an inefficient two-stroke engine on a leaf blower emits three times more per hour than a lawnmower. Frequent watering is energy intensive as well, and fertilizers and pesticides require a great deal of energy in production.

Montgomery can set an example for township homeowners by planting naturalized landscapes at its facilities. Naturalized plantings of shrubs, trees, native grasses and wildflowers can provide a beautiful, unique setting, without the intensive use of fossil fuel. They require less, if any, watering and minimal chemical inputs.

The planning of a rain garden may also help these efforts. Rain gardens serve to manage excessive storm water runoff that can often flood sewers and interfere with municipal systems. Rain gardens are typically placed in areas experiencing high levels of runoff, utilizing aquatic plant life to absorb incoming water. Toxins traveling from impervious surfaces like parking lots can also be absorbed by these plants. The Stockton SCI can provide guidance in the development of demonstration gardens at public or private facilities

3. Enforce Municipal Ordinances Protecting of Existing Trees: Municipal tree ordinances typically specify protection and preservation obligations based on categories of tree and property type. Often, a native tree list or protected tree list can be used to specify obligations for environmentally important species. Any such policy must also address indirect threats to trees such as damage to root systems, compaction of soil, or changes to existing grade that could adversely affect growth. A more general ordinance can protect any tree of a designated size (for example, 32 inches in circumference at the base of the trunk). However, no such ordinance is useful if it is not actively and vigilantly enforced. Such an ordinance may be coupled with incentives for planting of native species and naturalized landscapes.

4. Develop A Community Forest Plan: Development of a Community Forest Plan is a positive first step in the stewardship of township forested areas and trees. A municipal tree inventory should gather information on the diversity, health, location, and numbers of species in the urban forest. A good inventory is a necessary starting point to any conservation or forest expansion plan. Forested areas can be evaluated and ranked, based on biodiversity and carbon storage capacity, to help set conservation priorities. An inventory can also help identify problems, like a prevalent pest or common hazard. It can help prioritize conservation efforts, and in the long run,

it can save money by helping to make municipal conservation efforts and street crews more efficient and effective.

5. Promote and Protect Open Space: Efforts to protect open space are vital to the long term reduction of greenhouse gas intensity in Montgomery. These practices may be effectively coupled with the township's efforts to promote smart development. In the short term, performance standards may be reviewed to ensure they are as effective as they can be. In the longer term, multiple policy options and incentives are available to local municipalities to protect existing open space and encourage the permanent protection of state farmlands and forests.