Stockholm Environment Institute

Climate Solutions Accelerator
of the Genesee-Finger Lakes Region

Genesee - Finger Lakes Emissions Scenario Analysis

SEI report
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Executive summary

Human-caused climate change endangers the future of our planet. Limiting climate change's worst impacts while creating a sustainable planet for all requires urgent action across all sectors and scales. These climate impacts already pose threats to the Genesee-Finger Lakes Region (the "region") in several ways, such as heat waves, floods and fluctuating precipitation patterns. Meanwhile, climate action provides multiple benefits, including improving energy affordability and reliability, particularly for our lowest-income households, reducing health issues caused by air pollution such as respiratory illnesses, and boosting economic vitality through new businesses and jobs.

The Climate Solutions Accelerator of the Genesee-Finger Lakes Region (CSA), in partnership with the Stockholm Environment Institute's (SEI's) US Center, has been assessing the region's climate footprint and identifying regionally appropriate climate actions by consolidating input from a broad cross-section of communities and industries. The project's purpose is to help guide the development and implementation of climate actions across the Genesee-Finger Lakes Region that have the most significant potential to cut greenhouse gas emissions while improving the region's vibrancy, equity, resiliency and health. The final output of this project is an emissions reduction target for the region and a set of corresponding measures and actions to achieve this goal, all documented in a **Climate Action Strategy for the Genesee-Finger Lakes Region**. This strategy was developed through a phased approach, starting with a baseline emissions assessment of the region's historical sources of emissions (Phase 1), followed by a scenario analysis evaluating potential emission reduction measures and pathways (Phase 2), and finally, the development of a short-term climate action strategy outlining the way forward (Phase 3). This report is Phase 2, a summary of the scenario analysis.

Report overview

The baseline emissions assessment includes an analysis of the major sources of emissions in each of the region's counties and estimates emission projections into the future (the "baseline scenario") based on historical emission rates. The scenario analysis builds on the emissions inventory and baseline emissions projections to assess the long-term emissions reduction potential for the region under alternate climate mitigation pathways. This report documents each step of the scenario analysis, which includes the following activities:

- Consulting a wide range of stakeholders across different demographic segments, communities and economic sectors on their long-term vision for the region
- Compiling stakeholder responses to identify common themes and emerging emission reduction priorities for the region
- Reviewing relevant municipal, regional, state and federal climate action policies and plans for emission reduction measures relevant to this study
- Developing multiple scenarios, each with their own set of emission reduction measures, representing varying degrees of emission reduction potential
- Calculating the emission reduction potential under each scenario

- Reviewing scenario results and measures with key stakeholders for feedback
- Establishing a set of long-term emission reduction measures for the region, and an associated regional emissions target
- Providing a starting point for discussing potential short-term actions needed to achieve the emission reduction target for the region

Highlights of stakeholder engagement activities

To ensure a climate action strategy that is driven by community needs, the Climate Solutions Accelerator conducted a series of stakeholder engagement activities throughout 2021 and the beginning of 2022, including a survey, place-based and sector-based focus groups, and a workshop. These activities were led by the Climate Solutions Accelerator, with technical support and guidance from SEI as needed.

Survey findings: the Climate Solutions Accelerator conducted an online survey in April 2021 with 450 fully completed survey responses. The survey respondents had broad coverage across counties, gender and income, and most respondents identified as 'White or Caucasian' (83%), roughly in line with the current demographic composition of the region. The survey findings show that the top priorities for residents of the region are affordable housing, clean water, and criminal and racial justice. Most respondents were somewhat or very knowledgeable about climate change and climate solutions. Over 73% of respondents were very willing to adopt climate solutions. Residents also expressed a preference for renewable energy, energy efficiency, public transit, and walkable and bikeable neighborhoods as solutions to address climate change. Respondents supported more solar and wind farms at rates of 83% and 78%, respectively, whereas almost half the survey participants opposed expanding nuclear.

Focus groups: Following the survey, 16 focus groups were arranged between May and October 2021 across different community segments. Shared values identified across each group include connectedness, community, collaboration, equity, justice, affordability, inclusion and accountability. All the groups shared common elements in their vision for the region, including close-knit walkable and bikeable communities with more green space and year-round, affordable, locally grown foods. Renewable energy and affordable, energy-efficient housing for all is also key to reducing greenhouse gas emissions, participants said, however in addition to financial support, significant training and growth of the clean energy workforce is necessary for this to happen. Many groups also mentioned aligning land-use planning with transit and agricultural needs, requiring extensive collaboration across sectors, neighborhoods, municipalities, counties and businesses.

Scenario analysis workshop: After most of the focus groups were held, SEI led a scenario analysis workshop in August 2021. The output from the focus groups suggested that housing, transport, food and energy were top interests for the region. Access to nutritious food, affordability in housing, transport, food and energy, reducing urban sprawl, and increasing

equity were key factors cutting across all interest areas. We conducted a 3-hour online workshop with participants from various sectors and community groups to understand which solutions to prioritize for each interest area. Many of these solutions were used in the scenario analysis.

Mitigation measures and scenarios

We used the output from the survey results, focus groups and scenario workshop to determine potential emission reduction measures in line with communities' needs and concerns. We also examined existing policy on local, regional, state and federal levels for mitigation measures that already exist with financial support for their uptake. Finally, we identified measures that addressed priority areas for emission reductions according to the baseline emissions inventory. In total, 42 technical mitigation measures were identified, and 23 were quantified in the model developed during Phase 1 to assess the amount of emissions reduction that could potentially be achieved by these actions (summarised in Table ES-1 below).

Table ES-1*: Summary of technical mitigation measures by sector*

Sector	Measures that were quantified	Measures that were not quantified
Energy system	• Carbon-free grid	
Residential	• Building shell energy efficiency • Space heating electrification • Thermal energy network • Water heating electrification • Electrification of other energy services	• Appliance efficiency • Water efficiency • High-density development • Smart landscaping/native species
Transport	• Shift to active transit and working from home • Shift from light duty vehicles to public transit • Federal fuel economy standards • Electrification of light-duty vehicles • Electrification of medium- and heavy-duty vehicles • Electrification of public buses	• Electrification of school buses • Carpooling and ridesharing • Low-carbon fuel • Regional rail systems
Commercial	• Building shell efficiency • Building electrification	• LED street lighting • Schools as community hubs
Industrial	• General efficiency measures • Electrification of non-fossil equipment	• Process emissions
Agricultural	• Manure management • Alley cropping • Fertilizer management • Alternative fertilizer • Cover crops	• Alternative livestock feed • Reduced tillage practices • Community gardens/year-round greenhouses • Plant-based diets • Reduction in food waste at the production side

Sector	Measures that were quantified	Measures that were not quantified
Waste	• Landfill gas capture	• Reducing consumption • Waste diversion
Land	• Afforestation of former agricultural land	• Parks and green space/urban trees

We also identified non-technical measures to facilitate emission reduction as follows:

- Land use planning
- Reducing inequality
- Education and awareness on climate change
- Supporting clean energy businesses and workforce development programs
- Funding
- Codes and standards

We combined measures to create a scenario. We adopted an integrated framework that avoids double-counting emission reductions from each measure. Three scenarios were analyzed, in addition to the baseline scenario created in the baseline emissions inventory. The scenario descriptions are as follows and Table ES-2 provides the level of ambition of each mitigation measure under each scenario:

Scenario 1 – Existing policy scenario: Based on our analysis of the various mitigation measures, we assembled a suite of measures that each county could undertake, with active participation from businesses, residents, and partner institutions and jurisdictions. This first scenario assumes emission reductions over the baseline scenario if current federal, state and regional targets and plans are met in full.

Scenario 2 – Existing policy plus low ambition scenario: Our second scenario (low ambition) postulates further actions by each county beyond the first scenario that seem politically and socially feasible in the short term. We have based our understanding of the feasibility of these measures from the focus group outputs – specifically the values and visions of the local communities and specific challenges identified, as well as what is outlined as feasible in the NY Draft Climate Scoping Plan document (NY Climate Action Council, 2022). The target goal for this scenario is to meet the 85% reduction in emissions by 2050 outlined in New York State's Climate Leadership and Community Protection Act (CLCPA) (N.Y. Legis. Assemb., 2019).

Scenario 3 – Existing policy plus high ambition scenario: Our third scenario (high ambition) consists of more ambitious measures with an aim to exceed an 85% reduction in emissions by 2050. This scenario helps to elucidate the maximum emission reductions that the region could achieve.

Table ES-2*: Scenario details by mitigation measure (simplified)*

Sub-sector	Scenario 1: existing policy scenario	Scenario 2: low ambition policy scenario (goal: meeting 85% emission reduction by 2050)	Scenario 3: high ambition policy scenario (goal: exceeding 85% emission reduction by 2050)
Generation capacity	A carbon-free grid by 2040.	A carbon-free grid by 2035.	A carbon-free grid by 2030.
Fuel economy standards	All vehicles will meet the National Highway Traffic Safety Administration's (NHTSA's) Corporate Average Fuel Economy (CAFE) Standards.	Same as existing policy scenario.	Same as existing policy scenario.
Electric light-duty vehicles (LDVs)	100% of all new sales of passenger cars and trucks from 2035 onwards will only be battery electric vehicles (BEVs).	100% of passenger and truck sales from 2035 onwards to be BEVs, and 10% of LDVs will undergo early retirement before 2030.	100% of passenger and truck sales from 2035 onwards to be BEVs, and 25% of LDVs to undergo early retirement before 2030.
Heavy-duty vehicles	100% of new sales of medium- and heavy-duty trucks from 2045 onwards will only be electric vehicles (EVs).	100% of new sales of medium- and heavy-duty trucks from 2040 onwards will only be EVs.	100% of new sales of medium- and heavy-duty trucks from 2035 onwards will only be EVs.
Electrification of public buses	25% of the Regional Transit Service (RTS) bus fleet will be EVs by 2025 and 100% by 2035.	Same as existing policy scenario.	Same as existing policy scenario.
Bus transit improvements	Same as baseline scenario.	By 2030, vehicle miles traveled (VMT) by light-duty vehicles (LDVs) will decrease by 2.5% because of an expansion of bus transit service and technology enhancements that improve the efficiency of buses. This will increase to 5% by 2050.	By 2030, VMT by LDVs will decrease by 5% because of an expansion of bus transit service and technology enhancements that improve the efficiency of buses. This will increase to 10% by 2050.

Sub-sector	Scenario 1: existing policy scenario	Scenario 2: low ambition policy scenario (goal: meeting 85% emission reduction by 2050)	Scenario 3: high ambition policy scenario (goal: exceeding 85% emission reduction by 2050)
Biking/walking/working from home	Same as baseline scenario.	By 2030, VMT by LDVs will decrease by 10% due to an increase in biking, walking and working from home. This will increase to 20% by 2050.	By 2030, VMT from LDVs will decline by 25% due to an increase in biking, walking and working from home. This will increase to 35% by 2050.
Residential building shell efficiency	By 2030, 4% of homes will undergo basic shell upgrades and another 3% will undergo deep shell upgrades. By 2050, 10% of homes will undergo basic shell upgrades and 5% will undergo deep shell upgrades.	By 2030, 10% of homes will undergo basic shell upgrades and 3% will undergo deep shell upgrades. By 2050, 56% of homes will undergo basic shell upgrades and 12% will undergo deep shell upgrades.	By 2030, 18% of homes will undergo basic shell upgrades and 7% will undergo deep shell upgrades. By 2050, 66% of homes will undergo basic shell upgrades and 26% will undergo deep shell upgrades.
Residential space heating electrification	31% of households will be electrified by 2030. It is assumed that households will electrify at the same pace to 2050. Only air-sourced heat pumps (ASHPs) are assumed.	50% of households will be electrified by 2030. It is assumed that households will electrify at the same pace to 2050. The heating equipment share will be 70% ASHPs, 10% ASHP with fuel backup and 20% ground-sourced heat pumps (GSHPs).	70% of households will be electrified by 2030. It is assumed that households will electrify at the same pace to 2050. The heating equipment share will be 77% ASHP and 23% GSHP.
Thermal heating network	5% of households will be connected to thermal heating networks by 2030.	Assumes the households with GSHPs per the above scenario will be connected to thermal heating networks.	Assumes the households with GSHPs per the above scenario are connected to thermal heating networks.
Residential water heating electrification	31% of households will be electrified by 2030. It is assumed that households will electrify at the same pace to 2050.	50% of households will be electrified by 2030. It is assumed that households will electrify at the same pace to 2050.	70% of households will be electrified by 2030. It is assumed that households will electrify at the same pace to 2050.

Sub-sector	Scenario 1: existing policy scenario	Scenario 2: low ambition policy scenario (goal: meeting 85% emission reduction by 2050)	Scenario 3: high ambition policy scenario (goal: exceeding 85% emission reduction by 2050)
Electrification of other residential energy services	31% of households electrified by 2030. It is assumed that households will electrify at the same pace to 2050.	50% of households will be electrified by 2030. It is assumed that households will electrify at the same pace to 2050.	70% of households will be electrified by 2030. It is assumed that households will electrify at the same pace to 2050.
Commercial building shell efficiency	By 2030, 4% of commercial buildings will undergo basic shell upgrades and another 3% will undergo deep shell upgrades. By 2050, 10% of commercial buildings will undergo basic shell upgrades and 5% will undergo deep shell upgrades.	By 2030, 10% of commercial buildings will undergo basic shell upgrades and 3% will undergo deep shell upgrades. By 2050, 56% of commercial buildings will undergo basic shell upgrades and 10% will undergo deep shell upgrades.	By 2030, 18% of commercial buildings will undergo basic shell upgrades and 7% will undergo deep shell upgrades. By 2050, 66% of commercial buildings will undergo basic shell upgrades and 26% will undergo deep shell upgrades.
Commercial building electrification	2% of commercial buildings will be electrified by 2030 and 3.5% by 2050.	11.5% of commercial buildings will be electrified by 2030 and 94% by 2050.	27% of commercial buildings will be electrified by 2030 and 99% by 2050.
Industrial efficiency measures	There will be a 10% increase in industrial efficiency by 2025.	There will be a 10% increase in efficiency by 2025 and 30% by 2050.	There will be a 20% increase in efficiency by 2030 and 40% by 2050.
Industrial electrification	Same as baseline scenario.	4% of industrial natural gas use will be electrified by 2030 and 33% by 2050.	4% of industrial natural gas use will be electrified by 2030 and 83% by 2050.
Alternative fertilizer	Same as baseline scenario.	By 2030, 25% of fertilizer will be derived from organic sources including dried manure and activated sewage, and 50% by 2050.	By 2030, 50% of fertilizer will be derived from organic sources including dried manure and activated sewage, and 80% by 2050.

Sub-sector	Scenario 1: existing policy scenario	Scenario 2: low ambition policy scenario (goal: meeting 85% emission reduction by 2050)	Scenario 3: high ambition policy scenario (goal: exceeding 85% emission reduction by 2050)
Manure management	Same as baseline scenario.	By 2030, 50% of emissions from manure will be captured and 76% by 2050.	Same as low ambition scenario.
Alley cropping	Same as baseline scenario.	Alley cropping will result in a reduction of 0.140 $MMtCO_2e$/year[1]	Alley cropping will result in a reduction of 0.174 $MMtCO_2e$/year
Fertilizer management	Same as baseline scenario.	Fertilizer management will result in a reduction of 0.052 $MMtCO_2e$/year	Same as low ambition scenario
Cover crops	Same as baseline scenario.	Cover crops will result in a reduction of 0.215 $MMtCO_2e$/year	Cover crops will result in a reduction of 0.221 $MMtCO_2e$/year
Reforestation of former Aa land	Same as baseline scenario.	Reforestation will result in a reduction of 0.989 $MMtCO_2e$/year	Reforestation will result in a reduction of 1.272 $MMtCO_2e$/year
Landfill gas/biogas management	Same as baseline scenario.	There will be a 5% reduction per year in methane leakage from landfills.	There will be a 10% reduction per year in methane leakage from landfills.

[1] $MMtCO2_e$/year is million metric tons of carbon dioxide equivalent per year

Scenario analysis results

The possible emissions reduction in each scenario is measured against the targets set forth in the CLCPA of a 40% reduction of gross emissions by 2030 compared to 1990 emissions, 85% reduction of gross emissions by 2050 and net zero emissions by 2050. The Genesee-Finger Lakes region is estimated to have emitted 30 million metric tons of carbon dioxide equivalent ($MMtCO_2e$) in 1990. To stay in line with CLCPA targets, by 2030, gross annual emissions need to be around 18 $MMtCO_2e$ and by 2050, 4.5 $MMtCO_2e$.

In accordance with the CLCPA, results are reported using 20-year global warming potential (GWP20), which emphasizes methane-related warming in the upcoming 10 to 30 years. The calculation of gross emissions includes upstream fossil fuel production emissions and biogenic carbon dioxide (CO_2) released during the combustion of biofuels or biomass.

Scenario 1: Existing policy scenario

As shown in Table ES-3 and Figure ES-1, existing plans and policies can potentially eliminate 212 $MMtCO_2e$ of emissions by 2050 compared to the baseline scenario, equivalent to an average annual reduction of 6.6 $MMtCO_2e$ per year. Despite a 34% reduction of emissions in 2050 compared to the baseline, existing policies are insufficient to meet the 2030 and 2050 CLCPA targets.

Because no agricultural policies currently exist, the share of agricultural emissions is likely to rise from 22% in 2018 to 40% by 2050.

Figure ES-2 shows the emissions reduction potential from individual mitigation measures in 2050. The transportation sector accounts for about 20% of emissions reductions, including the implementation of national fuel efficiency standards and the state requirement that all car sales be electric vehicles from 2035. This is followed by an 8% emissions reduction from decarbonizing the grid and 4% from the electrification of residential space heating equipment.

Table ES-3: *Sectoral emissions under the existing policy scenario (scenario 1)*

Sector	-Historical-				-Scenario Projection-			
	2010		2018		2030		2050	
	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total
Residential	4.67	16	4.66	16	3.40	15	1.76	9
Commercial	2.37	8	2.60	9	2.29	10	2.21	11
Industrial	3.62	12	2.00	7	1.75	8	1.85	9
Transportation	9.39	32	9.57	33	5.21	23	2.65	13
Agriculture	5.49	19	6.34	22	6.85	30	8.08	40
Waste	3.75	13	3.22	11	3.40	15	3.42	17
Losses	0.21	1	0.17	1	0.08	0	0.01	0
Gross emissions total (scenario 1)	**29.50**	**100**	**28.57**	**100**	**22.97**	**100**	**19.98**	**100**
Net emission removal	-1.69		-1.64		-1.57		-1.48	
Biogenic CO_2	0.92		0.98		0.69		0.53	

Sector	-Historical-				-Scenario Projection-			
	2010		2018		2030		2050	
	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total
Net emissions total (scenario 1)	**26.89**		**25.95**		**20.71**		**17.98**	
Gross emissions total (baseline)	29.50		28.57		28.77		30.42	
Avoided emissions compared to baseline	0.00		0.00		-5.80		-10.43	

Note: Fuel-related emissions include upstream emissions outside of New York State using 2020 emissions factors. Gross emissions include biogenic CO_2.

Figure ES-1*: Sectoral Emissions under the Existing Policy Scenario (Scenario 1)*

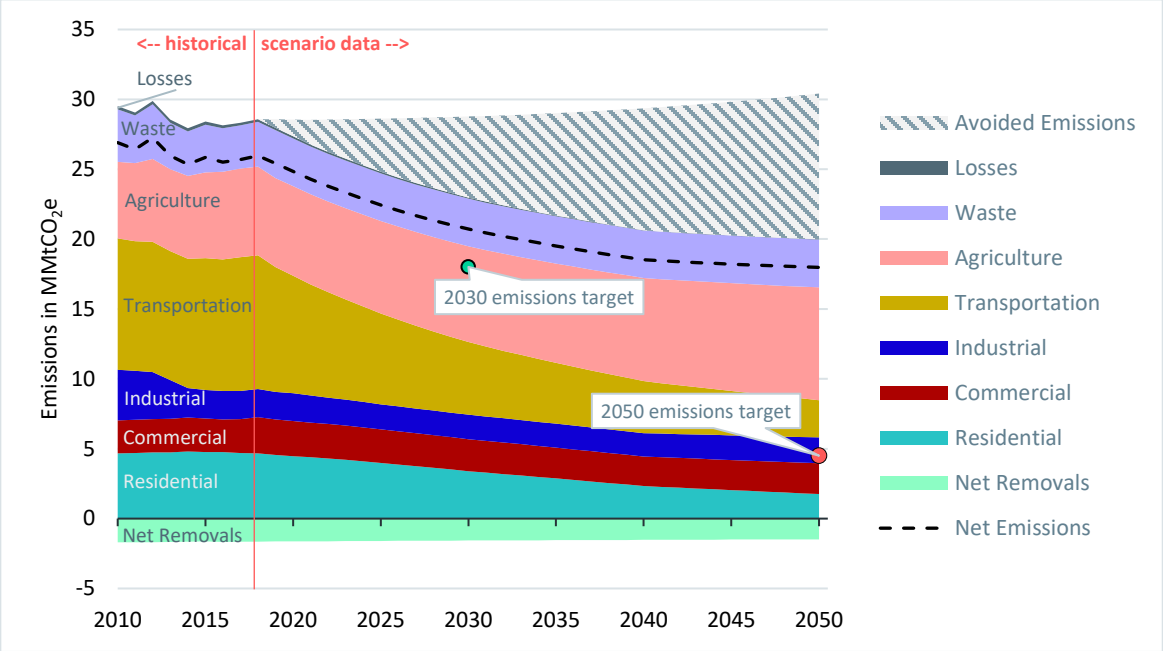
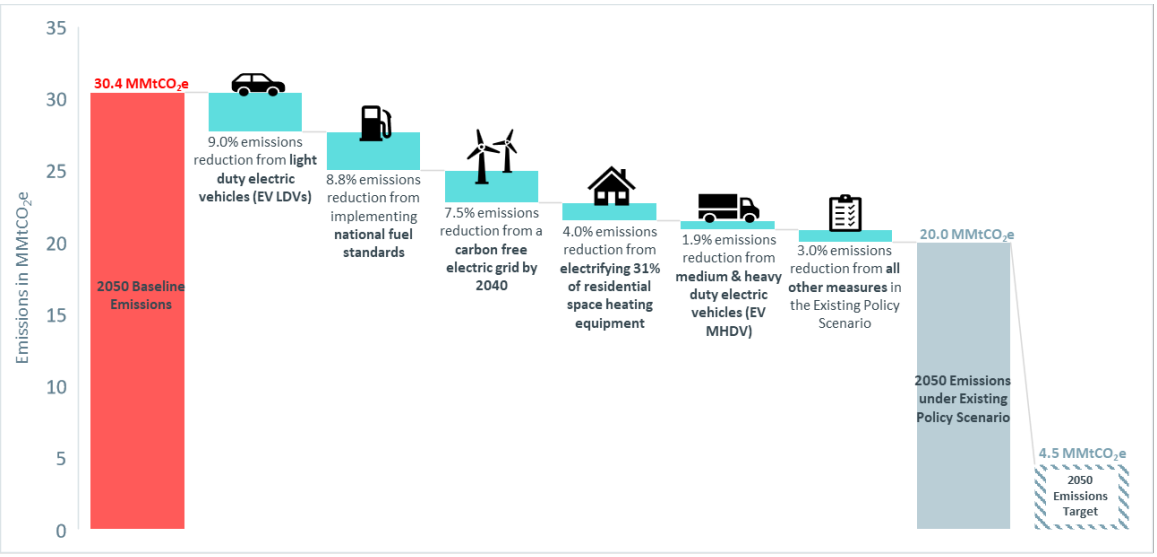


Figure ES-2: *Top Mitigation Measures in 2050 Under the Existing Policy Scenario (Scenario 1)*



Scenario 2: Existing policy + low ambition scenario

Under the existing policy plus low ambition scenario, the total annual emission reductions could be 19.1 $MMtCO_2e$ by 2050 (see Table ES-4 and Figure ES-3 for details). This is equivalent to a 63% reduction in emissions compared to 1990 emissions, meaning that the CLCPA's goal of an 85% reduction by 2050 is still not achievable with slightly more ambitious policies.

On a sectoral level, a decarbonized grid by 2035, combined with electrification, results in near-zero emissions from residential and commercial buildings by 2050. Compared to Scenario 1, in which agricultural emission reductions were limited, the agricultural sector contributes about 14% of the emissions reductions in this scenario, largely due to manure management (see Figure ES-4). In most state-level policies, the transport and the residential sectors receive most of the attention, since agriculture only accounts for 6% of state-wide emissions. Because agriculture has a much larger impact in this region particularly, agricultural mitigation measures merit additional emphasis.

Table ES-4: *Sectoral emissions under the existing policy plus low ambition scenario (scenario 2)*

Sector	-Historical-				-Scenario Projection-			
	2010		2018		2030		2050	
	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total
Residential	4.67	16	4.66	16	2.51	13	0.15	1
Commercial	2.37	8	2.60	9	1.97	10	0.01	0
Industrial	3.62	12	2.00	7	1.59	8	1.17	10
Transportation	9.39	32	9.57	33	4.65	24	2.34	21
Agriculture	5.49	19	6.34	22	5.50	29	5.49	48
Waste	3.75	13	3.22	11	2.91	15	2.21	19
Losses	0.21	1	0.17	1	0.06	0	0.00	0

Sector	-Historical-				-Scenario Projection-			
	2010		2018		2030		2050	
	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total
Gross emissions total (Scenario 2)	**29.50**	**100**	**28.57**	**100**	**19.19**	**100**	**11.37**	**100**
Net emission removal	-1.69		-1.64		-1.57		-1.48	
Biogenic CO_2	0.92		0.98		0.58		0.39	
Net emissions total (Scenario 2)	**26.89**		**25.95**		**17.36**		**10.49**	
Gross emissions total (Baseline)	29.50		28.57		28.77		30.42	
Avoided emissions compared to Baseline	0.00		0.00		-9.58		-19.04	

Note: Fuel-related emissions include upstream emissions outside of New York State using 2020 emissions factors. Gross emissions include biogenic CO_2.

Figure ES-3: *Sectoral Emissions Under the Existing Policy plus Low Ambition Scenario (Scenario 2)*

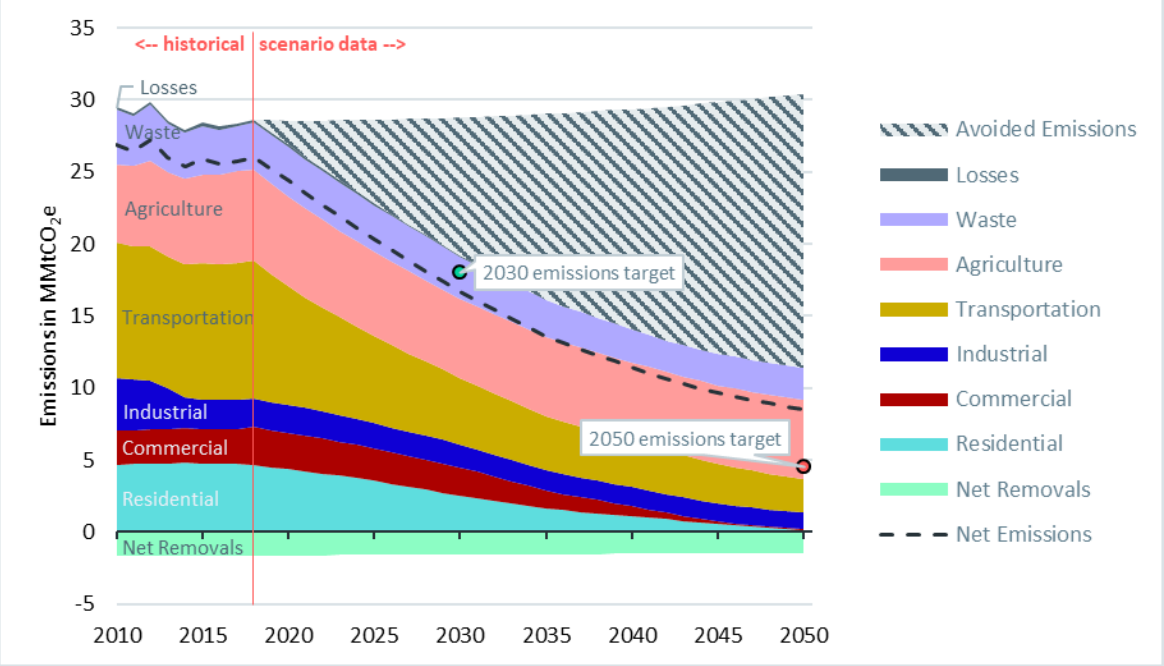
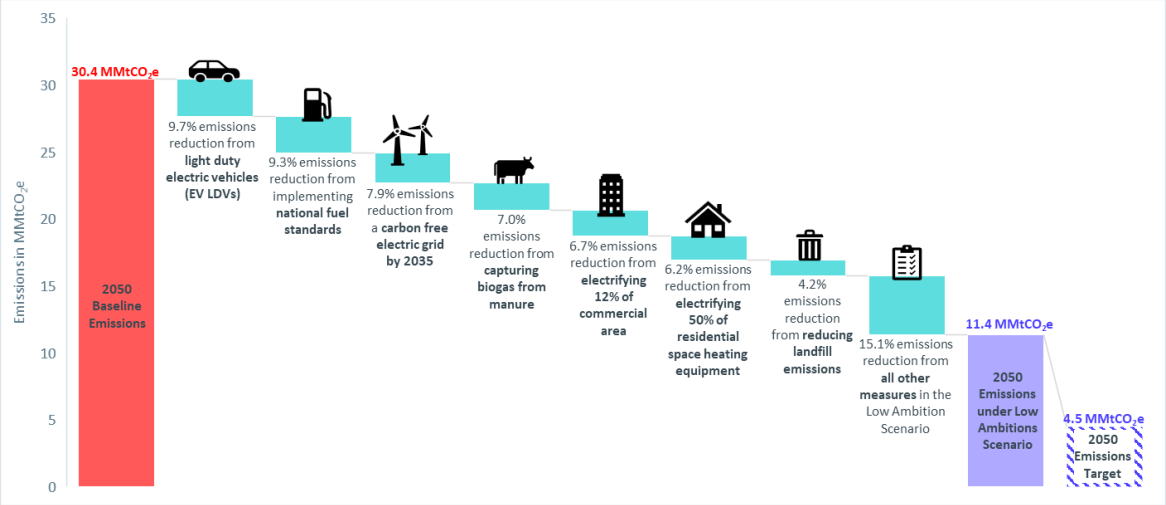


Figure ES-4: *Top Mitigation Measures in 2050 Under the Existing Policy plus Low Ambition Scenario (Scenario 2)*



Scenario 3: Existing policy + high ambition scenario

As shown in Table ES-5 and Figure ES-5, under the existing policy plus high ambition scenario, the total possible annual emission reductions is 20.2 $MMtCO_2e$ by 2050. This is equivalent to a 67% reduction in emissions compared to 1990 levels. As such, even with more ambitious policies, the CLCPA target for 2050 will be difficult to attain, requiring an additional 18% of emissions reduction. Around 75% of the remaining emissions in 2050 are from solid waste (landfill) and agricultural sources. The region hosts the largest landfills in the state with waste coming in from all over New England, Canada and New York. Despite significant landfill gas capture, methane leakage still occurs that might be difficult to contain simply due to the landfill size. For the agricultural sector, the emissions that remain are primarily from enteric fermentation processes of dairy cows. While research continues into alternative feed and diets to reduce enteric fermentation emissions, they are not available on a commercial scale, and it is unclear whether they will be widely adopted.

Transport emissions will also continue to represent a large portion of emissions in 2050, because a lot of trucks, private buses and rail trains will still run on fossil fuels. The emissions reduction potential of alternative fuels had not yet been assessed because hydrogen-powered vehicles are not yet available at a commercial scale in the US, and the characteristics of vehicles that run on renewable natural gas and renewable distillate vary. In years to come, these fuels may provide an additional method of reducing remaining on-road emissions.

Table ES-5: *Sectoral emissions under the existing policy plus high ambition scenario (scenario 3)*

Sector	-Historical-				-Scenario Projection-			
	2010		2018		2030		2050	
	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total
Residential	4.67	16	4.66	16	1.38	9	0.11	1
Commercial	2.37	8	2.60	9	1.37	9	0.00	0

Sector	-Historical-				-Scenario Projection-			
	2010		2018		2030		2050	
	$MmtCO_2e$	% of total	$MmtCO_2e$	% of total	$MmtCO_2e$	% of total	$MmtCO_2e$	% of total
Industrial	3.62	12	2.00	7	1.37	9	0.51	5
Transportation	9.39	32	9.57	33	4.07	25	2.09	20
Agriculture	5.49	19	6.34	22	5.41	34	5.33	52
Waste	3.75	13	3.22	11	2.42	15	2.21	22
Losses	0.21	1	0.17	1	0.01	0	0.00	0
Gross emissions total (Scenario 3)	**29.50**	**100**	**28.57**	**100**	**16.01**	**100**	**10.26**	**100**
Net emission removal	-1.69		-1.64		-1.57		-1.48	
Biogenic CO_2	0.92		0.98		0.49		0.38	
Net emissions total (Scenario 3)	**26.89**		**25.95**		**13.53**		**7.13**	
Gross emissions total (Baseline)	29.50		28.57		28.77		30.42	
Avoided emissions compared to Baseline	0.00		0.00		-12.76		-20.15	

Note: Fuel-related emissions include upstream emissions outside of New York State using 2020 emissions factors. Gross emissions include biogenic CO_2.

Figure ES-5: *Sectoral Emissions under the Existing Policy plus High Ambition Scenario (Scenario 3)*

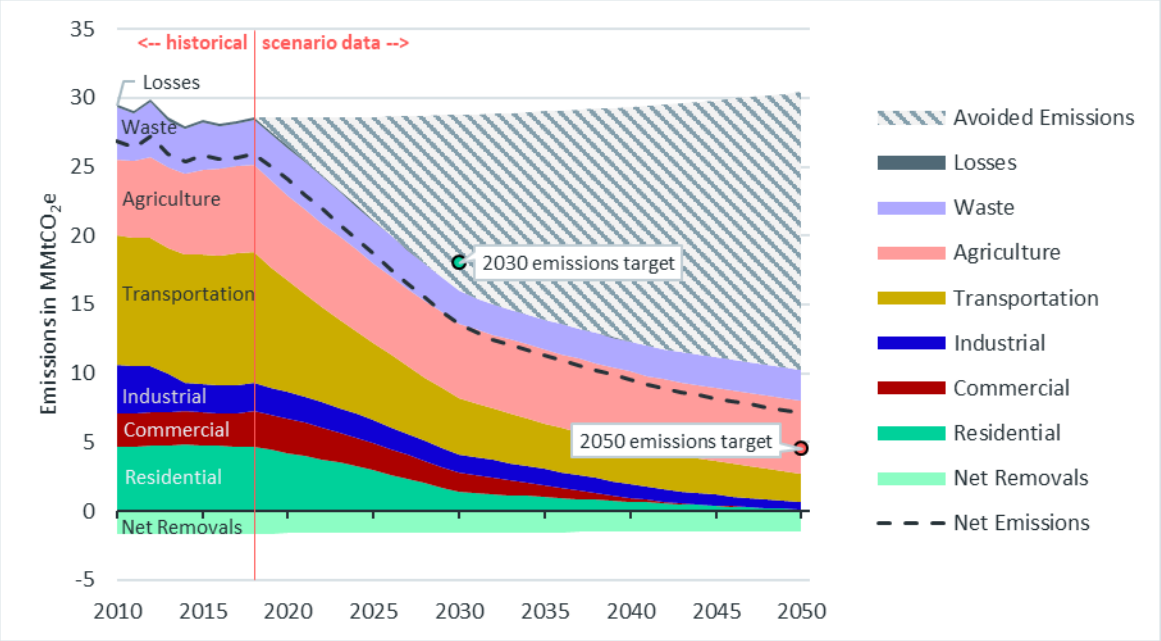
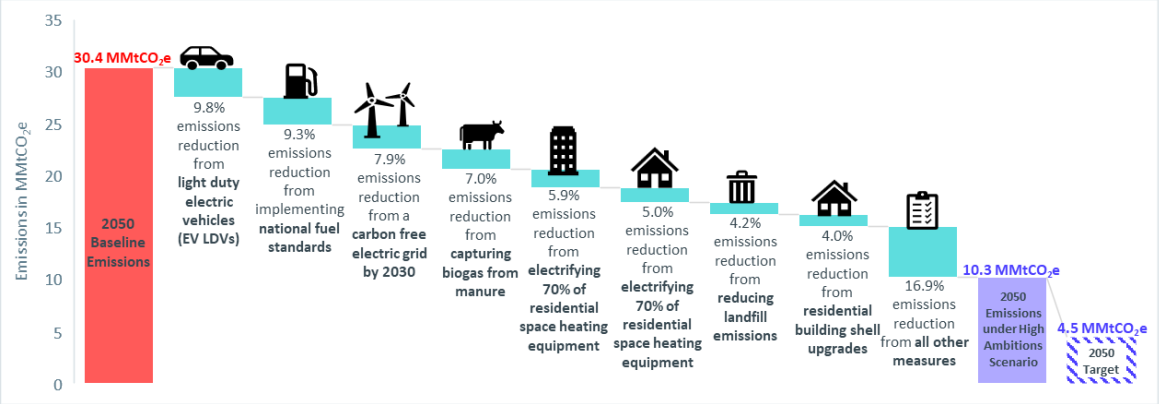


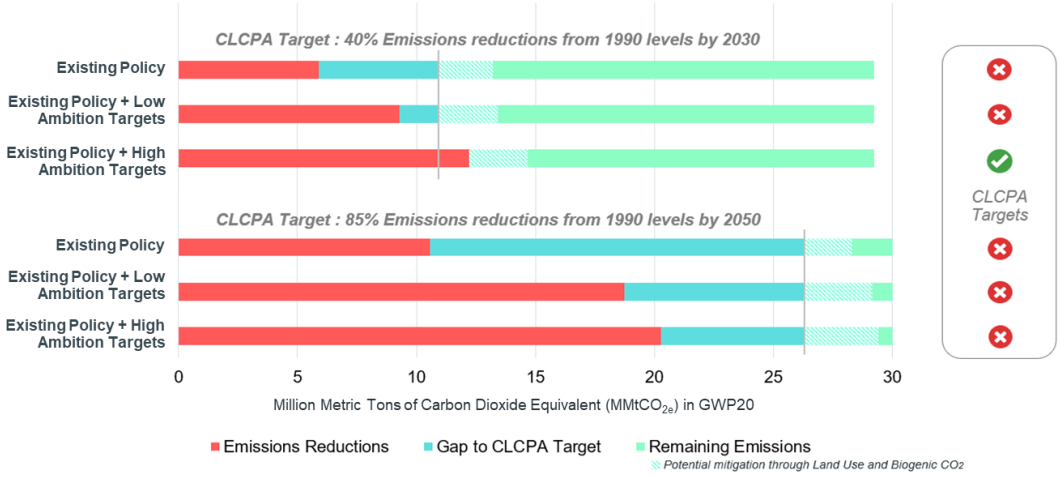
Figure ES-6: *Top Mitigation Measures in 2050 Under the Existing Policy plus High Ambition Scenario (Scenario 3)*



Comparison of scenarios to CLCPA targets

A summary of the findings from the scenarios is presented in Figure ES-7. The existing policy plus high ambition scenario achieves the intermediate 2030 target from the proposed set of emission reduction measures in Table ES-2. As mentioned above, there are several scenarios that we were unable to quantify at this time. It is possible that the CLCPA goals could be achieved if additional data is made available to enable the quantification of all proposed measures.

Figure ES-7: Comparison Between Regional Greenhouse Gas Emissions Mitigation Scenarios



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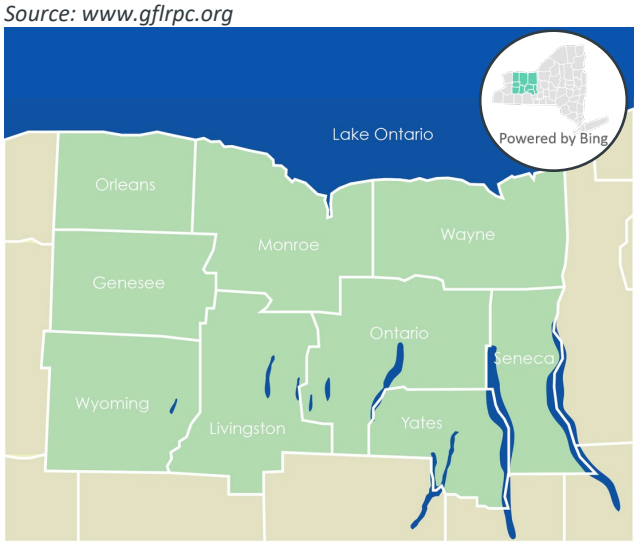
Project overview

Climate change caused by human activities is endangering the future of our planet. Limiting the worst impacts of climate change while creating a sustainable planet requires urgent action across all sectors and scales. These climate impacts already pose threats to the Genesee-Finger Lakes Region (the "region") in multiple ways, such as heat waves, floods and fluctuating precipitation patterns. Meanwhile, climate action yields multiple benefits, including improving energy affordability and reliability (particularly for our lowest-income households), reducing health issues like respiratory illnesses caused by air pollution, and increasing economic vitality through new businesses and jobs.

Figure 0-1: Map of the Genesee-Finger Lakes Region
Source: www.gflrpc.org



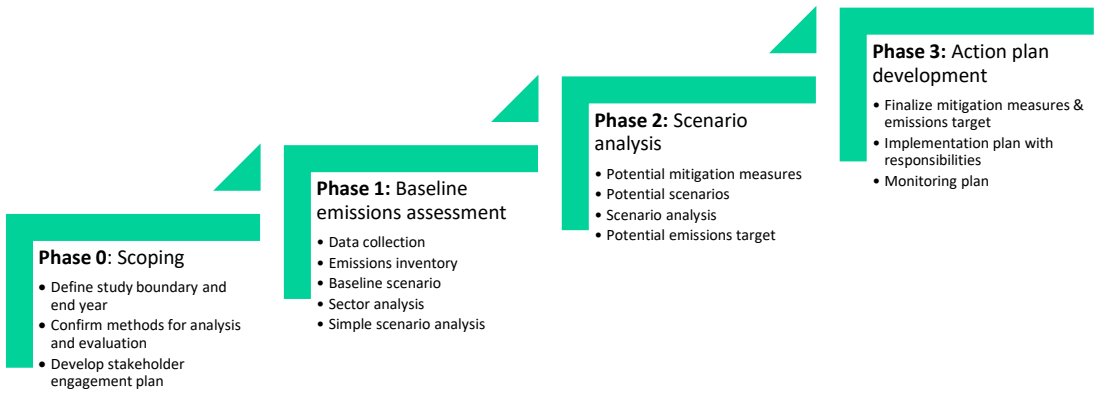
The Climate Solutions Accelerator of the Genesee-Finger Lakes Region (CSA), in partnership with the Stockholm Environment Institute's (SEI's) US Center, has been assessing the region's climate footprint and identifying regionally appropriate climate actions by consolidating input from a broad cross-section of communities and industries. The project's purpose is to help guide the development and implementation of climate actions across the Genesee-Finger Lakes Region with the greatest potential to cut greenhouse gas (GHG) emissions while improving the region's vibrancy, equity, resiliency, and health. The final output of this project is an emissions reduction target for the region and a set of corresponding measures and actions to achieve this goal, all documented in a **Climate Action Strategy for the Genesee-Finger Lakes Region** (the "Strategy"). The Strategy seeks to align with the state-wide emissions targets outlined in New York's historic Climate Leadership and Community Protection Act (CLCPA) (N.Y. Legis. Assemb., 2019), also taking into account the wide-ranging technological improvements since the Finger Lakes Sustainability Plan in 2013 (GFLRPC, 2013). The objectives of the Strategy are:

1. to develop a database of emissions and existing climate change-related plans and policies in the Genesee-Finger Lakes Region,
2. to foster dialogue among regional stakeholders from different sectors, government entities and community groups to determine what kind of mitigation strategies are plausible and desirable for the Finger Lakes Region,
3. to analyze potential GHG emission reduction measures and the social and economic implications of those measures, with particular emphasis on equity, inclusion and climate resiliency,
4. to develop a range of scenarios to guide a climate action strategy,

5. to set an emissions target for the region and prioritize measures that are environmentally, socially, technically, and economically feasible,
6. to identify implementation actors, requirements, timing and constraints,
7. to develop a plan to monitor progress towards the emissions target, and
8. to strengthen the capacity of local and regional stakeholders to carry out updates to the climate action strategy in the future.

The project approach includes four phases: scoping, baseline assessment, scenario analysis, and action plan development, with stakeholder engagement with implementation agencies, industry, and civil society organizations playing a key role in the process. A summary of the four-phase project approach is shown in Figure 0-3:

Figure 0-2: Phases of the Genesee-Finger Lakes Climate Action Strategy



This report describes the results from Phase 2: emissions scenario analysis.

1 Scenario analysis methodology

The scenario analysis builds on the emissions inventory and baseline emissions projections developed during Phase 1. The scenario analysis assesses the long-term emissions reduction potential for the Genesee-Finger Lakes region under alternate climate mitigation pathways. To achieve this goal, the scenario analysis includes the following activities:

- Consulting a wide range of stakeholders across different demographic segments, communities and economic sectors on their long-term vision for the region
- Compiling stakeholder responses to identify common themes and emerging emission reduction measures of priority for the region
- Reviewing relevant municipal, regional, state and federal climate action policies and plans for emission reduction measures relevant to this study
- Developing multiple scenarios, each with their own set of emission reduction measures representing varying degrees of emissions reduction potential
- Calculating the emission reduction potential under each scenario

- Reviewing scenario results and measures with key stakeholders for feedback
- Establishing a set of long-term emission reduction measures for the region, and an associated regional emissions target
- Providing a starting point for discussion on potential short-term actions needed to achieve the emissions reduction target for the region

SEI maintains the emissions inventory and scenario analyses data in the Low Emissions Analysis Platform (LEAP) with plans to create a publicly available tool to view the emissions data and potential emissions reduction under different scenarios. LEAP provides the structure for organizing data, calculations, and results for an emissions inventory and scenario analysis. Projections in the LEAP model are arranged into scenarios. A scenario is an internally consistent, physically plausible storyline that describes how the economy, energy system, pollutant emissions, and costs might evolve over time – in other words, a possible future. In LEAP, scenarios are constructed in a hierarchy, allowing each scenario to inherit assumptions from another. In this way, a scenario can mirror a pre-existing scenario except for a few key parameters, isolating the effects of these changes.

The core scenario is the baseline scenario. The baseline scenario in Phase 1 extends to 2050, consistent with the end date specified for the statewide emissions reduction targets in the CLCPA. The baseline envisions a future in which no significant new mitigation policies are enacted and historical trends in energy use and emissions continue. In this way, the baseline provides a reference point for assessing the impact of potential policies. Individual climate measures and scenarios are created by modifying baseline data to represent a particular set of policies. The effect of each measure is then assessed in comparison to the baseline. The Phase 1 report includes all the data and technical assumptions used to build the baseline scenario.

Two types of mitigation scenarios are considered: scenarios that add one discrete mitigation option to the baseline (“mitigation measures”) and scenarios that combine multiple mitigation measures into a portfolio of mitigation options (“combined mitigation scenarios”). This arrangement facilitates the analysis of particular mitigation measures in isolation, as well as their potential interactions with other options.

This report documents each step of the scenario analysis, including the methodology and data sources used to assess county-level emission reductions by major economic sector and source. Assumptions are used where data is scarce and these assumptions are noted in this report. Similar to the emissions inventory exercise, this is meant to be an initial assessment of potential emission reduction measures from large sources of emissions and large emitters. This exercise should not be a one-time activity. We hope to establish a process for continually updating the emissions inventory and scenario analysis as more data becomes available, as new technologies come into play, stakeholder suggestions are made, and to track emissions reductions over time.

2 Highlights of stakeholder engagement activities

To ensure a climate action strategy that is driven by community needs, the Climate Solutions Accelerator conducted a series of stakeholder engagement activities throughout 2021 and the beginning of 2022, including a survey, place-based and sector-based focus groups, and a workshop. These activities were led by the Climate Solutions Accelerator, with technical support and guidance from SEI as needed. This section gives an overview of each activity.

2.1 Online Survey (April 2021)

As the first step for community engagement, an 18-question survey was sent to residents across the Genesee-Finger Lakes region in April 2021. The survey aimed to understand climate awareness by residents in the region, their challenges in adopting sustainable lifestyles, and favorable climate solutions. The survey was distributed online through newsletters and social media. It was anonymous and included questions about the respondent's gender, race, income bracket, and education level. Survey questions are provided in **Appendix A**.

In total, 648 responses were recorded; however, only 450 respondents fully completed the survey. The survey respondents had broad coverage across gender and income. The coverage across each county roughly aligns with that county's share of the regional population. A small percentage of respondents said they were located outside the region. Among the respondents that indicated their race, the majority identified as 'White or Caucasian' (83%). This is comparable to the racial composition of the region, which is 76% 'White' according to the 2020 Census (US Census Bureau, 2022b). Further details on the survey respondents are in **Table 2-1**.

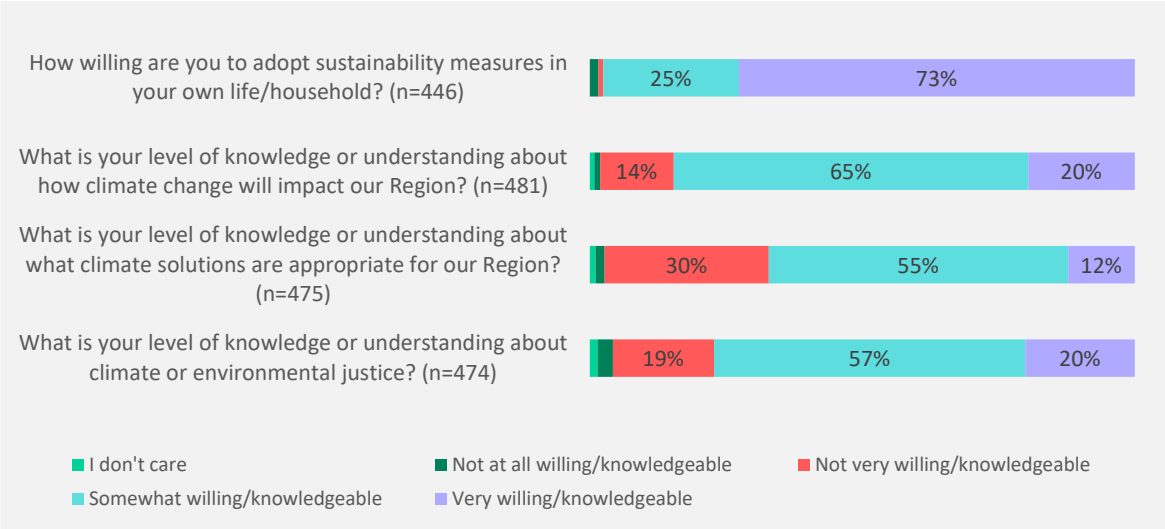
***Table 2-1**: Survey Respondent Demographics*

Gender (n=429)	**Income** (n=405)	**Education** (n=429)
• Woman (54%) • Man (39%) • Non-Binary (2%) • Prefer not to answer (4%) • Prefer to self-identify (1%)	• <$25K (5%) • $25-$50K (20%) • $50-$75K (16%) • $75-$100K (23%) • $100-$125K (15%) • >$125K (21%)	• Grade school (1%) • High School (6%) • Associates or trade degree (8%) • Bachelor's degree (36%) • Advanced degree (48%)

Race (n=429)	**County** (n=423)	
• White or Caucasian (83%) • Hispanic or Latino (5%) • Other (4%) • Multiracial/Biracial (3%) • Black/African American (2%) • Asian or Pacific Islander (2%) • Native American or Alaskan Native (0.2%)	• Monroe (65%) • Genesee (13%) • Ontario (10%) • Livingston (2%) • Orleans (2%)	• Seneca (2%) • Wayne (1%) • Yates (0.7%) • Wyoming (0.2%) • Other (4%)

Most respondents were somewhat or very knowledgeable about climate change and climate solutions (Figure 2-1). Over 73% of respondents were very willing to adopt climate solutions and 25% were somewhat willing. Only 3% of respondents were not at all willing.

Figure 2-1: *Climate change awareness in the Region*



Popular answers from the survey questions are indicated in Table 2-2 below. Excel's "Data Analysis" feature was used to distinguish priorities when multiple answers were chosen for a given question. For more subjective questions, we searched for key phrases to capture the top 3 ideas/concepts emerging from respondents' answers. Responses to Question 12 "*In your opinion, which of the following technologies are appropriate for our region*" are provided in Figure 2-2. A word cloud was created from the written comments on Question 18 "*If you could implement one solution to address a community need, what would it be?*" (see Figure 2-3).

Table 2-2: *Priority areas identified from online survey ('n' equals the number of respondents)*

Top 3 survey answers per question
Top 3 priorities for the region[1]
• Affordable Housing (*126 ranked as priority #1*) • Access to Clean Water *(79 ranked as priority #1)* • Criminal Justice/Police Reform (*74 ranked as priority #1*)
Top 3 solutions reduce greenhouse gas emissions and provide community benefits[2]
• Agricultural practices that can increase agricultural yield and the availability of nutritious food while improving water quality of nearby waterways (*121 ranked as the top solution*) • Clean energy job opportunities that improve our infrastructure and provide above average wages and benefits (*98 ranked as the top solution*) • Active transit opportunities (e.g. bike lanes and sidewalks) that improve air quality by reducing the need for fossil fuel vehicles and improve the walkability of our communities (*84 ranked as the top solution*)

Top 3 survey answers per question
Top 3 measures for residential energy efficiency
• Increase financial incentives for weatherization (e.g. insulation and air sealing) and clean heating and cooling technologies (i.e., heat pumps). (*n=203*) • Require landlords to meet energy efficiency standards to receive a certificate of occupancy for a property. (*n=100*) • Educate property owners about the importance of reducing energy use and the availability of programs that can help them reduce energy usage. (*n=65*)
Top 3 preferred transit measures for the region
• Expanding the geographic reach and efficiency of public transit (*n=217*) • Expanding access to electric vehicle charging stations (*n=109*) • Expanding sidewalks and pedestrian plazas to create safer, more walkable communities (*n=68*)
Top 3 preferred land and development measures for the region
• Inter-municipal and regional community planning that designates priority development and conservation areas, curbs inefficient development and over-development, revitalizes cities and villages, and preserves open space and agriculture (*n=262*) • Overhaul current zoning codes and rules to increase flexibility, innovation, and access (*n=66*) • High-density development that makes alternative transit (e.g., walking, biking, and public transit) more feasible, and preserves open space and agricultural lands (*n=61*)
Top 3 preferred agricultural practices for the region
• Provide payment to farmers for ecosystem services (e.g., carbon sequestration, soil health, pollinator services, improving water quality) (*n=148*) • Co-developing agricultural land for renewable energy projects (e.g., solar and wind projects) and agricultural production (e.g., sheep farming, beekeeping, fruit and vegetable production) (*n=138*) • Convert waste to energy by using animal and crop waste to create biogas for electricity (*n=49*)
Top 3 perceived barriers to the implementation of climate solutions
• Public perceptions that the costs associated with addressing climate change exceed the benefits of taking action. (*n=153*) • Lack of political will and community leadership in prioritizing climate change in our community. (*n=147*) • Lack of knowledge about local climate change impacts and potential solutions. (*n=95*)
Top 3 preferred sources of funding for climate solutions in the region
• Corporations should pay a carbon fee or taxes for greenhouse gas emissions. (*n=216*) • The government should prioritize funding for climate solutions without raising taxes. (*n=106*) • The government should raise taxes to fund climate solutions. (*n=45*)
Top 3 changes required to address climate change in the region
• Education. People do not understand what needs to be done to address climate change. (*n=137*) • Laws. People will not take action to address climate change unless required. (*n=106*) • Leadership. People are hesitant to take action because they do not want to be the first in their communities to do so. (*n=82*)
Top 3 barriers to implementing sustainability measures in one's own lifestyle/ household

Top 3 survey answers per question

- I do not have the necessary financial resources to implement sustainability measures. (*n=169*)
- I already take advantage/implement the full range of sustainability measures. (*n=112*)
- I do not have the necessary knowledge to implement sustainability measures. (*n=102*)

[1] Renewable energy development and racial justice received the top votes overall, but very few ranked these as priority #1.

[2] Land use planning decisions received the most votes overall, but few ranked it as priority #1.

Figure 2-2: *Responses to survey question Q12 "Which of the following technologies are appropriate for our Region?"*

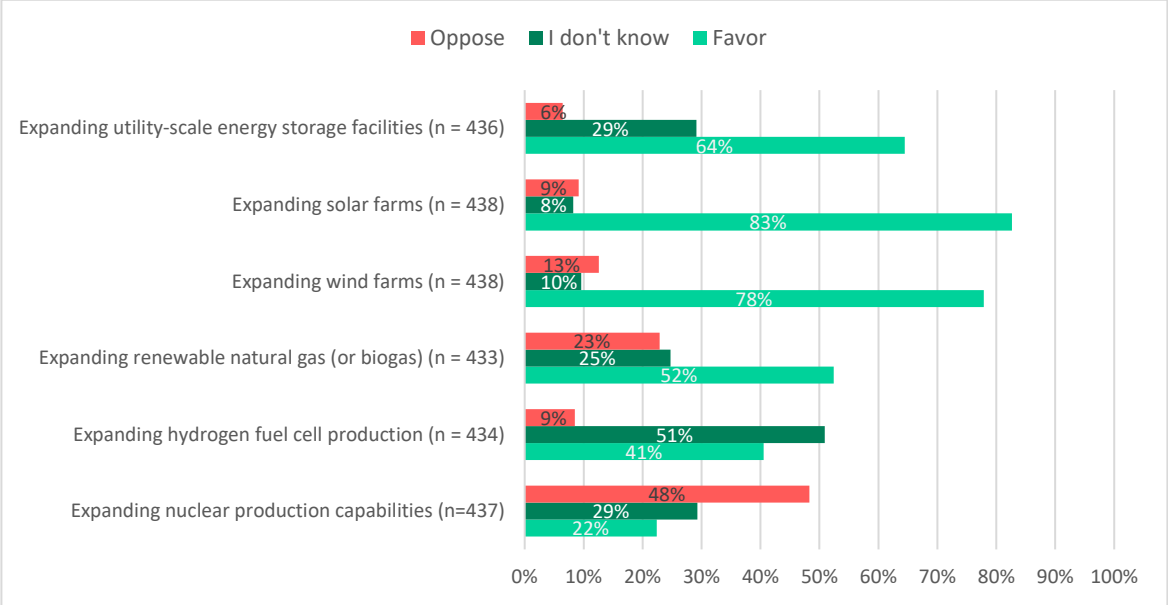
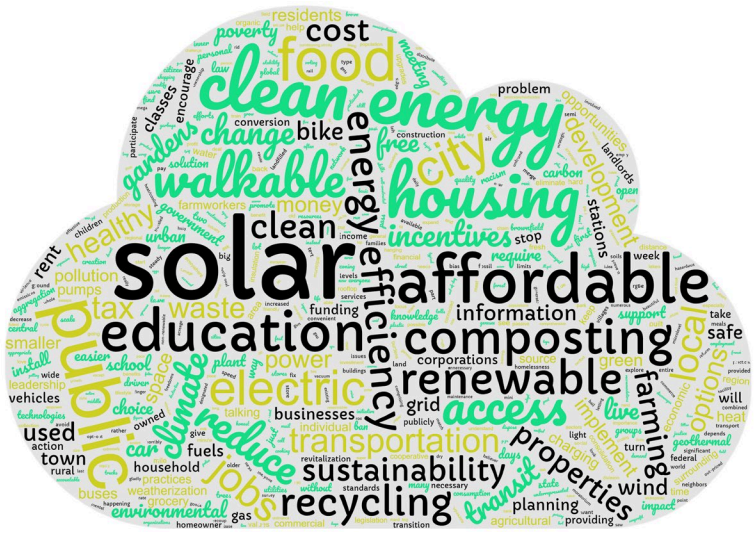


Figure 2-3: *Key words from written answers to survey question Q18 "If you could implement one solution to address a community or neighborhood need, what would it be"*



The findings of the survey show that affordable housing, clean water, and criminal and racial justice are top priorities for residents of the region. Affordable housing came up many times in the written comments, including more energy efficiency initiatives led by landlords to reduce energy cost burdens on renters. Other priorities include access to nutritious food and access to active and public forms of transport.

Residents also expressed a preference for renewable energy, energy efficiency, public transit, and walkable and bikeable neighborhoods as solutions to address climate change. Respondents supported more solar and wind farms at rates of 83% and 78%, respectively, whereas almost half the survey participants opposed expanding nuclear. This is interesting given the R.E. Ginna Nuclear Power Plant located in Wayne County. Many residents feel that more education and awareness are needed on climate change and solutions. As more residents view climate change as a priority, it could influence governments to prioritize climate action. Many residents believe there is currently a lack of political will in this regard.

Survey participants believe integrated planning for the environment and climate alongside other regional priorities need to be improved. Many regional priorities, especially equity and jobs, connect to environmental issues, so looking at them together could help consolidate efforts. Lack of financial support for individuals and communities to take climate action was identified as a key concern. Many respondents felt that corporations should pay a carbon fee or taxes for greenhouse gas emissions and for that to be a source of funding for climate action.

2.2 Focus groups (May – October 2021)

The Climate Solutions Accelerator organized several focus groups for input on potential solutions to climate change. Members of the project's Steering Committee identified which sector-specific and population-specific focus groups to conduct, and potential participants of the focus groups. The Steering Committee consists of a combination of rural and urban participants, representatives from large organizations, as well as grassroots organizers, and individuals with diverse lived experiences. Steering Committee representation includes membership from: resident and youth consultants, agriculture, business, community development, social and racial justice, housing, workforce development, renewable energy, transportation, planning, health, higher education, and philanthropy.

The following sector-specific and population-specific community groups were consulted to get input for the climate action plan. Each group was prompted to discuss existing community assets, their vision for an equitable and sustainable community, potential solutions and the barriers that exist that prevent implementation of these solutions (technical, political, behavioural or financial).

1. Color Your Community Green Group (May 15th, 2021)
2. Rural residents (June 22nd, 2021)
3. College Students (July 1st, 2021)
4. Health experts (July 13th and July 27th, 2021)

5. Urban Black community members (July 17th, 2021)
6. Clean Tech/Manufacturing organizations (July 20th, 2021)
7. Equity and Non-Profit focused civil society groups (July 26th, 2021)
8. Economic Development Workforce (July 27th, 2021)
9. High School Students (July 28th, 2021)
10. Urban Latino community members (August 4th, 2021)
11. Housing experts (August 16th, 2021)
12. Indigenous community members (August 18th, 2021)
13. Farmworkers (September 17th, 2021)
14. Transportation experts (October 1st, 2021)
15. Municipal Leaders (October 18th, 22nd and October 25th, 2021)
16. Farmers (February 17th, 2022)

The focus group discussions were transcribed and coded to determine each group's vision for the community, values, what they said as viable solutions for the area as well as perceived challenges. The results from the focus groups were taken into consideration when selecting solutions for our climate scenarios. For instance – because many groups perceived public transportation and electric vehicles (Evs) as viable solutions, our mitigation scenarios for Evs and public transportation were more aggressive than existing policies and statewide ambitions.

Highlights from the focus groups are provided in Table 2-3. Shared values identified across each group include connectedness, community, collaboration, equity, justice, affordability, inclusion, and accountability. All the groups shared common elements in their vision for the region, including close-knit walkable and bikeable communities with more green space and year-round, affordable, locally grown foods. Renewable energy and affordable, energy efficient housing for all is also key to reducing greenhouse gas emissions, participants said, however in addition to financial support, significant training and growth of the clean energy workforce is necessary for this to happen. Many groups also mentioned aligning land-use planning with transit and agricultural needs, requiring extensive collaboration across sectors, neighborhoods, municipalities, counties, and businesses.

Table 2-3*: Summary from focus groups*

Visions	Values	Potential Solutions	Potential Challenges/Concerns
Urban Latino Community Members (August 4th, 2021; 6 attendees)			
• Safe and walkable / bikeable neighborhoods • Healthy air; reduction of respiratory illnesses from air pollution • Attractive community (parks, green spaces, artwork)	• More stable and secure society • Cleanliness and respect for nature • Accountability • Inclusivity and representation • Building community	• Energy efficiency • Redevelopment of vacant lands • Build more parks and green spaces • Smart landscaping • EV charging stations • Bicycle lanes • Glass bottle exchange over plastic bottles • Reduce light pollution	• Funding for energy efficiency • Landlords don't have incentive for energy efficiency • Fear of walking because of safety • Lack of community engagement • Need to offer climate communications in multiple languages
Urban Black community members (July 17th, 2021; 7 attendees)			
• Fossil free society • Better public transportation • Access to healthcare and local/home-grown nutritious food • Connected community • Clean air and water • Access to education, decent and affordable housing • See night sky, hear nature, be around nature and green spaces • Quality time with family and friends • Feel safe	• Justice • Peace • Accountability through love, particularly by police • Collective consciousness, shared beliefs / ideas / moral attitudes • Sharing food, resources – building community	• Partner with community to solve problems, for example create a Standing Office of Neighborhood Safety • Provide living wages • Improve public transport • Cheaper Evs	• Affordability concerns • Lack of access • Structural inequalities such as racism • Extreme weather events (flooding, drought, polar vortex, extreme heat)
Transportation experts (October 1st, 2021; 9 attendees)			
• Quality, higher density housing and mixed-use districts near transit nodes and corridors • Bikeability and walkability	• Equity • Land use planning, including limiting job sprawl, aligning with public transit needs	• Mandatory infrastructure for biking and walking • Cheaper public transit and bikeshare	• More gov't funding for biking, walking and public transit infrastructure

Visions	Values	Potential Solutions	Potential Challenges/Concerns
• Safe bike routes • Public transit system that is nearby, affordable, accessible, frequent and robust. Provides similar travel times as driving. • Healthy air	• Regional, municipal and sectoral collaboration. Align planning across different levels. • Public transit has similar priority to Evs	• EV buses • Expand electric car share • Improving bus / transit shelters • Public relations to support public transport uptake • More staff; engineers and architects • No new gas stations • Prioritize corridors where bus routes can be aligned • Limit economic development outside transit corridors via tax incentives. • Identify metrics and goals for public / active transport	• More funding and staff for inspection and enforcement of regulations • Will EV funding divert funding from public transportation? • NIMBY-ism towards higher density • Gentrification concerns • Car-culture in the area • Fear of renters / landlords affecting zoning of higher density areas • Reversing red-lining
Rural residents (June 22nd, 2021, 10 attendees)			
• Forests and carbon removal through trees • Protection of natural resources and lands including water bodies and forests • Alternate transit options (bikeability, walkability, snow mobiles) • Regionally- connected communities, such as through trail towns • Farm-to-table • Regenerative farming	• Close-knit community • Agriculture as part of the community and environmental / climate stewards • Land use planning revolving around building community	• Geothermal heat pumps • Light-rail to Rochester; train to Letchworth • Plant trees • Water efficiency measures (low-flow fixtures) • Electrification of homes • More local events	• Algal bloom • Sprawl • Abnormal weather events (i.e., droughts, late snow) • Tree removal (deforestation) for agricultural land • Land acquisition for renewable energy • No big movement towards regenerative farming • Car-centric culture
Color Your Community Green (May 15th, 2021)			

Visions	Values	Potential Solutions	Potential Challenges/Concerns
• Elimination of poverty • Green jobs, education and apprenticeship programs • Everyone is well informed on climate issues and solutions • Grow your own food or access to local farms with healthy food • Dense urban areas with walkable commons and liveable centre; less cars • Mixed urban areas with trees and native plants everywhere • Solar panels everywhere • Dedicated community services • Community gatherings (festivals, markets)	• Equity • Environmental Justice • Longevity and sustainability • Inclusivity • Local • Connectedness • Building community	• Electric school buses • Clean energy for buildings • Sustainability and climate change in curriculum • Carbon price or social cost of carbon included in price of goods • Connect with UofR engineering/health programs to get kids involved	• Existing school bus contracts limits ability to change to EV • Green gentrification • Partisanship and politics • NIMBYism • People do not see climate change as a problem or see it as someone else's responsibility • People do not see how climate goals align with other community goals
College Students (July 1st, 2021; 10 attendees)			
• Frequent, reliable, affordable, accessible public transport • More bikeability and access to bike trails and paths • Renewable energy (solar PVs, wind turbines, geothermal) and electric (Evs, planes) • Less resource waste through recycling, composting, rainwater harvesting, or natural plastics • More trees, green spaces and biodiversity	• Peace of mind – no fear of climate apocalypse • Collective responsibility – less individualism • Diversity • Equal opportunities • Accessibility	• Functioning bus stop apps • Biodiverse yards with pollinators • Building biking infrastructure (such as bike paths) • Sidewalks for walking • Approve fewer permits for new buildings in places of thriving ecosystems • Clean and sanitary buses • UofR Office of Sustainability	• Politics; need more representative government • Individualistic attitude • Car-centric culture • Public transit is not affordable for all • Public transit does not go everywhere – people are unable to get to the doctor's • Food desert (lack of access to food for people without cars)

Visions	Values	Potential Solutions	Potential Challenges/Concerns
• Access to local food from community gardens			
Health experts (July 13th and July 27th, 2021; 8 attendees)			
• Affordable housing with proper heating and cooling systems for climate change • Safe, accessible rural transportation systems to cities to access healthcare services • Public transit, bike paths, sidewalks, snowmobile paths • Access to low-cost, local, organic, nutritious foods, such as through community gardens • Community hubs for climate resiliency for all (emergency, off-grid power and heating/cooling centres)	• Proactive – addressing climate change reduces health issues • Climate resiliency • Community resiliency • Cross-sector collaboration • Access to healthcare by all	• Emergency power systems (off-grid solar or charging stations) • Create bike lanes and sidewalks during road repair • Media coverage and general awareness linking climate and health • Use schools as community hubs during extreme weather events • Better pay for healthcare workers	• Climate impacts on health (extreme heat or cold). Extreme heat linked to poor mental health, lower distress tolerance. • Consolidation of health services – less community resiliency. • Lack of access to primary care. Poor public transit. Adverse weather affects ability to travel to appointments. • Air quality concerns on health (asthma, allergies) • Lack of funds • Need institutional leaders / decision-makers to be part of the climate conversations.
Clean Tech/Manufacturing organizations (July 20th, 2021; 7 attendees)			
• The region is a clean-tech manufacturing hub (heat pumps, energy storage, solar panels, etc.) • Products that are based on recycled or renewable resources, and are biodegradable. Closed loop systems; circular economy. • More renewable energy (solar, biogas, RNG)	• Holistic climate solutions • Collaborative – organized supply chain; businesses working together • Circular economy • Working within the existing market • Regenerative community	• Regenerative agriculture • Put solar on available rooftops, canopy parking, other underutilized spaces, agrovoltaics • Provide technical/legal/financial services to help with grid interconnection. • Cap grid interconnection costs • Social media, education awareness on climate solutions	• Grants, incentives, subsidies • Payment for carbon capture doesn't include composting, landfill gas capture, etc. • All solar projects need to connect to the grid. Interconnection is difficult, lots of paperwork, costly. • Composting in anaerobic digesters has emissions related

Visions	Values	Potential Solutions	Potential Challenges/Concerns
• Efficient, sustainable industrial processes • Natural climate solutions for carbon removal (e.g., soil carbon sequestration)		• Rainwater harvesting • Carbon pricing/tax on fossil fuels • Lifecycle assessment of RE and other solutions • Set standards for RE companies • Local heat pumps or solar panels; organize supply chain for RE • Landfill capturing methane • 2 turbine systems in every SUNY school • PACE financing for RE	to trucking compost – needs to stay local • Certifications and regulatory concerns with products • Concerns that solar panels on farms will put runoff into creeks and water bodies – need to consider site design.
Equity and Non-Profit civil society groups (July 26th, 2021; 9 attendees)			
• Create clean energy jobs in the region for heating, cooling, solar installations, etc. • Affordable housing with proper heating and cooling system, especially for disabled homes • Equitable transit system with better coverage • Food security through climate resilient food production and distribution system; affordable and nutritious food available for all • Access to information, transportation, healthcare, medication and housing needs for most vulnerable communities and people, especially during climate-related emergencies	• Equity and access • Climate equity and justice • Climate resiliency • Emergency preparedness • Disability justice • Community networks and coordination • Public and community-centred land use • Everyone has what they need (food, medication, healthcare, education, housing, etc.)	• Community energy – lowers energy bills, revenue back to community • Partner with community gardens to have another avenue for local food • Go to the community and share knowledge, rather than waiting for people to come to us – tables on the street, parks, markets, etc. • Utilize existing, yet unused, rail lines. For example, electric trains. • Improve transfer system on buses. Balance between more stops and more direct buses. • Improve school curriculum to include climate change • Government funding for affordable housing	• Rooftop solar is cost prohibitive. • Underfunding of schools and communities/people vulnerable to climate change • Heavy reliance on donations from local farmers for food; concerns that climate change will affect agricultural yields • Caregiver shortage within disabled community • Gentrification • People don't believe in climate change; marginalized people are not included in conversation

Visions	Values	Potential Solutions	Potential Challenges/Concerns
Economic Development Workforce (July 27th, 2021; 5 attendees)			
• Access to resources to start businesses, particularly in low-income neighborhoods • Everyone has job security and have equal opportunities to jobs that are accessible • Employers assist employees with childcare, transportation, encourage time off • Access to affordable, accessible retraining programs • Everyone has access to basic needs to live without worrying (basic income, living wage, technology,	• Equitable solutions • Equitable processes (inclusion and engagement) • Social justice • Widespread awareness and opportunities • Collective investments by communities and neighborhoods • Leverage next generation of leaders	• Tax credits to help homeowners "green" their homes with green tech (solar panels, new windows) • Pay a living wage to everyone ($20-$25 per hour) • Set up governing bodies among neighborhoods to allocate savings from green energy. For example, a green energy training funded by community solar revenue • Affordable training programs – "earn as you learn" or use federal funding to pay people to do training • Generate awareness on clean energy job opportunities; target low-income neighborhoods and individuals from non-traditional educational backgrounds • Feeder programs from schools to jobs • Alleviate technological divide – free laptop and wifi for every person • Carpooling incentives, such as special parking spots • Require developers to build energy efficient buildings (building code)	• General misconception about clean energy jobs – people think that they have to go to RIT to learn this • Training programs are not affordable. Systemic disincentives for training (cost, transportation, childcare)
High School Students (July 28th, 2021; reps from 8 schools)			
• More trees, parks, gardens, cleaner areas	• Sense of togetherness • Collaboration	• Bike/skateboard paths	• Climate change is already happening here. Changes in

Visions	Values	Potential Solutions	Potential Challenges/Concerns
• Fossil free society, more solar, wind and hydropower • Alternative transport (bikes, electric longboards) that is safe and accessible • Improved public transit with shorter distances, subway • Jobs along transit corridor and downtown • Programs for youth	• Empathy • Caring • Safety	• Courses for helping the community and environment, and green jobs • Colleges with environmental clubs • Gardens in prisons • Tailor school curriculum towards individual interests, including climate change and climate jobs • All electric vehicles	weather, cold spells, more hot days • Stigma against 'green'; people with privilege don't want to change • Lack of jobs downtown • Public transportation is inefficient – need to go downtown first to go elsewhere
Housing experts (August 16th, 2021; 8 attendees)			
• Everyone has access to affordable, habitable, democratically managed, public housing. The housing is also close to grocery stores, public transit, green space, bike paths, schools, etc. • Everyone is aware of climate solutions for their homes. • Energy efficiency in all rental properties • Availability of training programs in clean energy and energy efficiency. • Sufficient number of local contractors are trained in clean energy and energy efficiency and have access to materials (plumbers, HVAC, electricians, engineers, etc.)	• Community ownership • Affordability (affordable housing) • Healthy standard of living • Health and safety of renters/tenants	• Use lessons from lead safety policies for implementing energy efficiency programs • Codes/standards for energy efficiency, including insulation and heat pumps on all rental properties. • Standards for maximum energy usage per square foot as part of renewing certificate of occupancy • Relief from heat considered as a standard (heat sequestering to lower heat index in concentrated urban areas) • Assess models of ownership and governance include public housing, community land trusts, cooperative housing, and mutual housing associations	• Low-income households often don't use heating and cooling – worried about high energy bills, • Renters often live in homes with poor insulation. Renters rely on landlords to buy energy efficient equipment, improve weatherization, insulation, etc. • Insufficient contractors • Is the grid capacity sufficient to handle additional electricity load from electrification? • Shortage of housing and affordable housing. Will need additional housing for migrants and climate refugees

Visions	Values	Potential Solutions	Potential Challenges/Concerns
		• Use ARP dollars (or other subsidies) to make homes more efficient. Heat pumps for all.	
Indigenous community members (August 18th, 2021; 5 attendees)			
• Live our promise to take care of Mother Earth for the future. Have a pristine environment. Protect the water. Protect ancestral lands. • Live off the land. Agriculture is self-sustainable; community food supply year-round • Decentralized energy sources, or use of renewable resources like geothermal • Buildings are designed to have natural, passive forms of heating and cooling (like an Earth ship)	• Connection to nature, hands-on learning • Indigenous mindset • Social justice • Peace • Healing • Kindness • Empathy • Appreciation • Community • Inclusion	• More people grow their own food, greenhouses • Water restrictions (like Genesee County) • Every house on/off reservation to use solar and geothermal energy • Proper assessment for siting of solar farms, wind turbines and industries – no siting near ancestral territories or another's territory. • Protect Great Lakes – violation if water from Great Lakes goes out of state. • Water permits to limit water-taking from large companies and prevent toxic dumping in water bodies. • Children education is more hands-on, in nature, to motivate them to want to protect it.	• Those that live off the land are vulnerable to climate impacts • Higher probability of zoonotic diseases as animals live closer to humans due to land use change • Politicization of environmentalism • Disbelief in climate science • Disbelief in science comes from deep hurt from past colonization, residential schools • Capitalism – who benefits from solar energy, etc. focus on reducing energy consumption
Farmworkers (September 17th, 2021; 12 attendees)			
• Protected environment – take care of land like its your house • Recycle and reuse materials, less meat consumption, water use (especially bottled water), material consumption	• Worker rights • Justice for immigrants • Less materialism and consumerism • Work-life balance; spend time with family and friends • Slow down	• Encourage people to fix broken items, instead of replacing them • Employers to encourage better work-life balance; reduce work hours to spend time with family	• Convenience-based, materialistic lifestyles which creates waste • Rely on children/next generation to make changes • Owners do not fix homes

Visions	Values	Potential Solutions	Potential Challenges/Concerns
• Renewable energy • Less pesticides and chemical fertilizers and related cancer • Liveable wage to cover health costs and other basic needs • Affordable, decent housing • Better transit, bikeability • Access to public spaces, more public spaces • More leisure time	• Representation • Inclusiveness • Empathy	• Quality over convenience – reduce waste.	• More allergies, possibly related to environmental issues (water, climate) • Work more to provide good life for family; no time to spend with family – vicious cycle
Municipal Leaders (October 18th, 22nd and October 25th, 2021; 19 attendees)			
• Bikeability (comfortable, safe) • Walkability (safe routes) • Communities across the region share resources and ideas • Proper land use planning for development. Prime agricultural lands are not converted.	• Sustainability as a priority • Shared goals • Accountability • Collaboration	• Development of a climate plan that has clear metrics and measures • Make it easy for town board to take action through up-front research/knowledge exchange • Convert gov't fleet to EV • LED street lighting • Streetscapes • Canal trail programs • Community Choice Aggregation • Education and awareness on climate change issues in the region	• More climate discussions need to occur at the county level • Lack of support for small towns <50,000 people (technical, financial, admin) • Many aren't convinced climate change is an issue; sees money spent as wasteful • Urban Sprawl • Need funding for EV chargers • Unsure about viability of electrification
Farmers (February 17th, 2022; 10 attendees)			
• Improved soil health and access to water • Net zero by dairy industry; energy producers • Land use planning for development. Prime agricultural lands are not	• Value soils • Farmer justice – farmer control over control by large corporations • Farmer welfare • Look at all sectors together	• Peer-to-peer farmer education on soil health practices • Connect farmers to consumers • Payment for ecosystem services & other incentivization mechanisms for soil health practices	• Consider net zero for dairy industry before thinking about just transition. • Farmers need more financial support for manure management practices

Visions	Values	Potential Solutions	Potential Challenges/Concerns
converted. Land is affordable for young/minority farmers. • Urban support for local farms		• Pilot community composting; subsidies for composting • Use cover crops as feed	• More support for small farmers • Concern that soil health does not have same priority as RE

2.3 Scenario analysis workshop (August 2021)

A scenario analysis workshop was conducted in August 2021 after the majority of focus groups were held. The output from the focus groups suggested that housing, transport, food and energy were top interests for the region. Access to nutritious food, affordability in housing, transport, food and energy, reducing urban sprawl and increasing equity were key factors cutting across all interest areas.

We conducted a 3-hour online workshop with participants from various sectors and community groups to understand which solutions to prioritize for each interest area. During the workshop we presented highlights from our focus group discussions including overlapping visions, values and solutions. We then split the participants into breakout groups for each interest area – housing, transport, food and energy. The participants in each group discussed solutions for the region for their specific interest area. The breakout groups were then mixed together, and the new breakout groups discussed cross-cutting solutions – equity, access, affordability and sprawl – with a goal to provide coherent next steps for the region that addressed all areas of interest. A summary of the discussion is summarized below:

2.3.1 Housing

Opportunities/solutions

- Increase housing density – the region can increase its population, take in climate refugees, migrants, and others through higher density housing.
    - Address vacant infrastructure. Fix houses/buildings instead of demolishing them. For example, convert unused office buildings to residential units to promote vertical growth.
    - Consider zoning. Build housing along transportation hubs and corridors (e.g., bus stations, rail stations). Consider mixed residential zoning in areas traditionally limited to single family homes. Improve tax credits for mixed use areas. Build amenities into mixed use density, e.g., access to health care, community spaces, or gyms to increase walkability.
    - Promote co-owning and coop living.
- Addressing affordability and gentrification
    - Limit/cap rent increases by landlords.
    - Prioritize ownership. For example, provide public assistance for rent-to-own housing. Banks can also relax qualifying criteria for a mortgage.
- Increase green space for heat islands, neighborhood attractiveness, biodiversity/wildlife and to grow food locally
    - More public green spaces in urban areas
    - Develop community-owned gardens to address food deserts and increase green space. Encourage schools/students to build gardens/become gardeners. Convert vacant corner lots to community gardens or parks. Provide longer-term permits (i.e., 1-year) for community gardens. Promote rooftop gardens.

    - Reconfigure streets to make them more ecologically attractive, providing shade, reducing stress. Plant trees along streets.
- Energy efficiency and renewable energy to reduce energy demand and cost burdens
    - Set energy standards for existing buildings.
    - Fix tax credits for green rehabilitation and green building codes
    - Align incentives for landlords and city, like tax credits for affordable housing and energy efficiency improvements.
    - Create jobs and training opportunities in green construction for housing
    - More weatherization
    - Consider radiant heat under streets and households
    - Solar roofs and battery storage on all possible houses
    - Encourage residents to join community solar programs to reduce bills
    - Retrofit homes (especially in the suburbs) with EV chargers

Tensions

- School taxes shouldn't be tied to property ownership – creates an equity issue between schools and in education
- Upfront investment costs of rooftop solar and other energy improvements. (Pay as you save model). Currently weatherization grants are tied to income level
- Higher density housing needs changes to zoning laws and might prevent development.
- A "climate sanctuary city" might lead to a threat of displacement and gentrification if development does not occur equitably, such as by giving preference to current residents.
- Employment opportunities are created by the housing/development upgrades – how to ensure that the workforce is able to get to these jobs as they become available?

2.3.2 Transport

Opportunities/solutions

- Walkability/Bikeability
    - Set a target of 50% (or other) of all trips to be made by biking or walking.
    - Most roads are local and don't need bike lanes. Focus on traffic calming, especially around schools.
    - Consider elevated walkspaces at major intersections
    - For multi-lane streets, reduce the number of lanes for vehicles to include a bike lane, offer a turning lane that prioritizes cyclists, provide crosswalks for pedestrians
    - Increase bike paths through parks
    - Widen walkways and add sidewalks
    - Mixed-density housing increases walkability

- Improve public transit within cities and towns, particularly in low-income neighborhoods
    - Set a target for 50% (or other) for jobs to be accessible within 30 minutes by transit. Connect neighborhoods to public transit. Favor transit web over existing hub network to create redundancy.
    - Increase frequency of buses especially between economic drivers and poorer communities
    - Connect people from houses to jobs, such as through shuttle programs.
    - Ensure a level of comfort and safety on the network to grow ridership. For example, protected bus cubes and shelters for comfortable ridership.
    - Focus on growing and enhancing our bus system before implementing rail
    - Streamline routing for schools to improve direct connections
    - Normalize and incentivize bus ridership. Start an RTS download-the-app campaign. Give a free ride to public market or specific events
- Distributed nature of villages/towns and farms make it difficult to build resilient, affordable, and useful transportation networks. Rural areas are more reliant on cars and are harder to provide public transit options that can reduce emissions. Need to provide better public transport options across the region.
    - Shorter distances between residents and goods
    - Access to rural areas. Explore other connections to other stops on rail Empire Corridor (Lyons, Batavia, others) such as through regional bus stops.
    - Finish NY State High Speed Rail project to connect rural areas to the city. Link Toronto to NYC via Western NY Cities. Have an east-west rapid rail (connecting other regions) vs. north-south commuter rail (connecting urban and rural in this region).
- Increase Evs
    - Increase EV charging station infrastructure
    - Vehicle share
- Continue to maintain safe and accessible roads for vehicles.
    - Make on-ramps for historically marginalized communities.
- Trail towns

Tensions

- Local farmers travel a long way to reach customers.
- Weather is a challenge – biking, waiting at bus-stops are more uncomfortable during winter
- Car ownership is expensive

2.3.3 Food/Agriculture

Opportunities/solutions

- Organic / sustainable locally sourced foods to reduce the distance food travels to get

to our plates, reduces emissions, increase access to healthy food and lower food scarcity.
    - Improve connections between farmer and consumer. Allow schools and hospitals to establish better connections to local farmers.
    - Bulk purchase from local farmers, e.g., Geneva city schools purchase from local farmers & Hobart & Williams Smith
    - Co-op model for local agriculture. Community gardens.
    - Increase markets for local farmers tied to performance metrics for carbon sequestration.
- Have farmers own the supply chain and control how they get, grow and process their food. Farmers can't grow crops if there's not a local place to process them.
    - Decentralized food production/processing.
    - In particular, there are supply chain issues with meat supply (current bottleneck of local slaughterhouses). Need smaller, local processing centers.
- Access to food
    - Need to add more grocery stores/produce carts/stands in mixed density neighborhoods (via neighborhood associations)
    - Keep the Food Stamp program as part of the USDA to be able to use them at farmers markets to buy food.
    - Continue funding to the Public Market to provide healthy food access in a food desert.
- Agrovoltaics – By using agricultural land for solar energy, farmers can both grow food and generate electricity for their homes or the grid
- Compensate farmers that undertake sustainable agricultural practices. Sustainable farmers are not making money. If farmers are not getting a living wage, then they are not going to implement mitigation measures.
    - Identify what crops we can grow locally (not oranges) and help local farmers grow more of those crops. Reduce subsidies for commodity crops.
    - Ensure some means of compensating farmers for ecosystem services based on a carbon plan for each farm. For payment for ecosystem services (PES), farmers get paid for sequestering carbon.
    - Develop individual carbon farm plans.
    - Need to pay farmers for farm tours, etc. and for the teaching of other farmers & funds for implementation
- Soil management practices
    - Develop farmer to farmer learning/relationships and demonstrations
- Increase production, in part through farmland protection – including access to land both in urban and rural areas.
    - Bulk procurement from local farmers
    - Have zoning allow for subsistence agriculture
    - Density vs. greenspace. Rooftop gardens, cooperative models, etc.
- Farmers need better access to markets. Small farms are often in the middle of nowhere and have to travel a long way to reach customers. How to get produce when its ready to the consumers? Find innovative ways to get food to customers.

    - One truck that travels to different farms to pick up produce and bring to markets, instead of each farmer having to do it themselves.
    - Change inter-regional truck patterns.
- Migrant farmworkers
    - Celebrate farms that provide equitable pay for their employees and model that for others who use migrant workers.
    - Advocate for migrant farm workers to have access to good housing and healthcare.

Tensions

- Transport emissions for farmers. Are farmers markets efficient for delivering food given the amount of miles traveled to deliver food?
- Farmers markets do not always "work" for farmers
- Dairy farms and animal agriculture are a major source of greenhouse gas emissions. Big crops are subsidized (corn/soy) but some of this goes towards animal agriculture.
- There are no health benefits for farmers. A farm typically has to have a spouse with full-time employment w/healthcare.
- PES is complicated and hard to grasp. Difficulty quantifying ecosystem services.
- Concern for potential to take lands and dedicate them to carbon sequestration.
- Difficult to maintain community gardens especially with multiple jobs
- Location for alternative energy sources often has an impact on agriculture if those are placed on farmland, but it can also provide financial benefits to struggling farms.

2.3.4 Energy

Opportunities/solutions

- Energy efficiency via multiple strategies (housing density, geothermal systems, etc.)
- Carbon neutrality as soon as possible
    - Genesee River for hydroelectric power
    - Consider expanding geothermal, such as through district heating networks.
    - More wind and solar
    - Bus fleet needs to be electric
- Small-scale distributed renewable energy reduces emissions and improves reliability
    - Solar panel on every roof and battery-storage. Put roofs on parking lots and add EV charging stations.
    - Community solar energy projects
    - Agrovoltaics
- Ensure a diversity of energy sources
    - There are a variety of biofuels (not just corn) that can provide economic opportunity for farmers.
- Energy independence and grid reliability
    - Meet demands through distributed grid and energy storage

    - Reduce imported electricity
    - Municipally-owned utilities
- Clean energy workforce development
- Qualitative and quantitative metrics for evaluating new projects
    - Environmental assessments
    - Siting and zoning review
    - Stakeholder consultation
- Community benefits agreement, or a contract between a private developer and community groups, in which the private developer funds or furnishes a clean energy project in exchange for community support for the project. The agreement can include guarantees to hire local workers for the project, pay living wages, provide local workforce training and educational guarantees, contribute to local trust funds, finance community developments (i.e. parks, community centers, etc.), and more.

Tensions

- Lack of transparency about how decisions are being made; municipal leaders in rural areas receiving templated solutions from state
- Rural areas are seen as places of extraction, not as a resource. Concerns about siting – preserve aesthetic values. Need to value the way the land is being used now. Do not just see it as a space to put large energy facilities. Do not site on cultural or religious sites. Increase distributed energy generation – move away from large-scale utility generation/distribution. Solar/wind developments can potentially take over farmland, therefore consider agrovoltaics instead.
- Decommissioning of solar installations need to be done in a way that allow for the land to return to productive use.
- No meaningful consultation or consideration for Indigenous communities. For example, in the past, hydro has flooded Indigenous lands. Some large-scale utility projects encroach on sacred grounds.
- Biofuels and waste-to-energy facilities while considered carbon neutral by some, can cause pollution from methane, nitrous oxide, and other pollutants
- Solar and battery storage has upstream mining pollution concerns. Trace metals may come from mines that use child labor.

3 Regionally relevant climate policies and plans

In addition to solutions identified by stakeholders, existing policies and plans were reviewed for solutions already in place to lower emissions in the region. Relevant local, regional, state-level and federal climate policies are summarized below. Although the policies differ in some ways, such as target dates and how they are implemented, they appear to complement each other and move toward the same objective: reducing carbon emissions.

3.1 Local/County

City of Rochester's Climate Action Plan (2017): The City of Rochester's Climate Action Plan was endorsed by the city council in May 2017. The goal of the plan is to reduce greenhouse gas emissions by 40% by 2030. To do so the plan has identified implementation actions that align with the 2013 Finger Lakes Regional Sustainability Plan.

City of Rochester's Climate Vulnerability Assessment (2018): The City of Rochester conducted a climate vulnerability assessment to investigate baseline and projected climate conditions in the area and understand how climate change will affect the community, infrastructure and natural resources.

City of Rochester's Climate Resilience Plan (2019): The City of Rochester's Office of Energy and Sustainability developed a community-wide Climate Change Resilience Plan to enhance the city's ability to withstand the impacts of climate change. This plan builds on the findings from the Climate Vulnerability Assessment.

Village of Fairport's Sustainability Plan (2010): The Village of Fairport's sustainability plan outlines strategies for the village government and community to maximise their resources and increase the quality of life in the village.

Green Genesee/Smart Genesee Plan and Resiliency Plan (2021): The Green Genesee/Smart Genesee is a science based, community led sustainable land use planning project that can be used to strengthen comprehensive planning and land use regulation in Genesee County.

Monroe County Climate Action Plan (ongoing): The Monroe County Climate Action Plan provides steps to reduce emission and improve resiliency towards climate change in Monroe County. The plan calls for climate change planning to be integrated into other planning and decision-making processes in the county.

Brighton Climate Action Plan (ongoing): The Brighton Climate Action Plan (CAP) aims to identify climate resilience initiatives in alignment with New York State's Climate Smart Communities objectives in order to maximize positive outcomes for the Town of Brighton. The CAP will identify greenhouse gas and energy reduction goals for the community as well as activities to achieve these goals.

3.2 Regional

Finger Lakes Regional Sustainability Plan (2013): The Finger Lakes Regional Sustainability Plan outlines actions for improving the long-term sustainability of the nine-county region. The plan identifies current greenhouse gas emissions and natural resource use and then outlines strategies for greenhouse gas emission reduction and the deployment of renewable energy sources. The plan also identifies sustainability goals for energy supply, water and waste management, housing, etc. as well as actions to achieve these goals and barriers to implementation.

Genesee Finger Lakes Transportation Plan (2021): The Long Range Transportation Plan for the Genesee-Finger Lakes Region 2045 (LRTP 2045) establishes transportation priorities and provides directions for transportation policy, planning, and investment decision making for the Genesee-Finger Lakes Region. The plans seek to advance regional transportation needs such as improved safety and expanded accessibility while safeguarding environmental resources.

Regional Transit Service Comprehensive Strategic Plan 2021-2024 (2021): According to the Regional Transit Service (RTS) 2021-2024 Comprehensive Strategic Plan, 25% of the RTS bus fleet to be Evs by 2025 and 100% by 2035.

3.3 State-level

Regional Greenhouse Gas Initiative (2009): New York is a participant in the Regional Greenhouse Gas Initiative (RGGI) along with 11 other states in Northeastern US. RGGI is a cap-and-trade program to reduce CO_2 emissions from power plants. RGGI requires that all fossil fuel-fired power plants with a capacity of 25 MW or higher be required to obtain an allowance for every ton of carbon dioxide that they emit annually. Each of participating states has set a goal of reducing emissions an additional 30% compared to 2020 levels by 2030.

Clean Energy Standard (2016): New York adopted a clean energy standard which requires 50% of the electricity consumed in the state to come from renewable energy sources by 2030.

Climate Leadership and Community Protection Act (CLCPA) (2019): New York state has set statutory targets to reduce greenhouse gas emissions to 40% below 1990 levels by 2030 and no less than 85% below 1990 levels by 2050 through Senate Bill S6599, also known as the CLCPA. The targets also aim for net-zero greenhouse gas emissions by 2050 and that 70% or all electricity generated in New York be renewable by 2030. The CLCPA also set up a Climate Action Council tasked with developing a Climate Action Plan for New York to achieve its CLCPA targets.

Zero emissions cars and trucks (2021): New York adopted assembly bill A.4302/S.2758 that states that 100% of all new sales of passenger cars and trucks will be zero-emissions from 2035, medium-duty and heavy-duty vehicles by 2045 and off-road vehicles and equipment by 2035.

Building electrification (2022): In January 2022, Governor Hochul announced plans for 1 million electrified homes and 1 million electrification-ready homes by 2030 (approximately 3 million households in NY State) and zero-emissions construction by 2027.

Climate Action Plan Scoping Report (Draft released 2022) – New York States Climate Action Council released a Draft Scoping Plan for how the state can achieve the targets outlines in the CLCPA. The plan calls for eliminating the use of fossil fuels in new home construction by 2025 and prohibiting fossil fuels in commercial buildings and multi-family homes by 2030.

3.4 Federal

NHTSA's Corporate Average Fuel Economy (CAFE) Standards: National Highway Traffic Safety

Administration's (NHTSA's) Corporate Average Fuel Economy (CAFE) standards regulate the average distance vehicles must travel on a gallon of fuel. As per the 2021 rule, the standards require an industry-wide fleet average of approximately 49 miles per gallon (mpg) for passenger cars and light trucks in model year 2026 which is to be achieved by increasing fuel efficiency by 8% annually for model years 2024 and 2025, and 10% annually for model year 2026.

EPA's Greenhouse gas emission standards for passenger cars and light truck 2021-2026: The final rule (effective Feb 2022) puts in place standards that increase in stringency year-over-year by 10% in model year (MY) 2023, 5% in MY 2024, 6.6% in MY 2025, and by more than 10% in MY 2026. This would effectively mandate that electric vehicles increase their market share from 7% in 2023 to about 17%.

USDA's Climate-Smart Agriculture and Forestry Strategy: The USDA's Climate-Smart Agriculture and Forestry Strategy outlines practices to decrease wildfire risk, source sustainable bioproducts and take conservation actions that reduce carbon emissions and increase carbon sequestration. Techniques includes ruminant feed management, cover crops, irrigation efficiency, and more.

US Nationally Determined Contribution (NDC): Under the USA's Nationally Determined Contribution to the UN Framework Convention on Climate Change (UNFCCC), there is an economy-wide target of reducing the country's net greenhouse gas emissions by 50-52 percent below 2005 levels in 2030.

DOE Better Buildings, Better Plants: Better Plants is a voluntary partnership program run by the Department of Energy (DOE). Better Plants works with leading U.S. manufacturers and wastewater treatment agencies to set energy, water, and waste reduction goals, and to commit to reducing energy intensity by 25% over a 10-year period. In return, partners receive technical assistance, tools, resources, and national recognition.

Clean Air Act (proposed by the EPA): In 2021, the EPA proposed new rules that would support the use of cost-effective technology in reducing methane emissions. The impact of the rules would be a reduction in 41 million tons of methane emissions from 2023 to 2035.

USDA Conservation Reserve Program: The USDA's Conservation Reserve Program (CRP) is a land conservation program run by the Farm Service Agency (FSA). Farmers enrolled in the program commit to removing environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality instead. In exchange they receive a yearly rental payment.

Inflation Reduction Act of 2022: The Inflation Reduction Act (IRA) seeks to curb inflation through deficit reduction, prescription drug price decreases, implementation of energy efficiency and clean energy initiatives. Specifically, it proposes $370 billion in energy investments. Since the IRA was released in August 2022, after the completion of this study, it was not integrated in the study itself. However, it is important to mention because it will have

significant influence on the implementation of some of the proposed actions.

4 Priority areas for emission reductions

The baseline emissions inventory estimated emissions across each sector both historically between 2010-2018 and in the future to 2050 based on historical emission trends. A summary of the top 15 sources of regional emissions in 2018 are given in Table 4-1 reflecting 82% of the region's emissions. Climate action around these sources of emissions should be prioritized.

Table 4-1*: Top 15 sources of emissions in 2018 (in GWP20)*

Sector	Subsector	Emissions ($MMtCO_2e$)	Share of Emissions (%)
Transport	Light passenger trucks	4.3	16
Agricultural	Enteric fermentation (animal digestive processes)	3.3	12
Residential	Space Heating	3.2	12
Transport	Cars	2.6	10
Agricultural	Manure management	2.1	8
Commercial	Natural gas consumption	1.1	4
Transport	Heavy duty combination trucks	0.9	3
Waste	Seneca Meadows Landfill	0.8	3
Residential	Water heating	0.7	3
Residential	Other end uses	0.7	2
Waste	High Acres Landfill and Recycling Center	0.6	2
Commercial	Electricity consumption	0.5	2
Waste	Wastewater	0.5	2
Transport	Rail	0.4	2
Commercial	Propane consumption	0.4	1
Total		**22.0**	**82**

Note: In accordance with the New York State's Climate Leadership and Community Protection Act (CLCPA), results are reported using 20-year global warming potential (GWP20) which puts emphasis on methane-related warming in the upcoming 10 to 30 years. The calculation of gross emissions includes upstream fossil fuel production emissions and biogenic carbon dioxide (CO_2) released during the combustion of biofuels or biomass.

5 Potential mitigation measures

Climate mitigation measures are actions that reduce greenhouse gas emissions. To identify potential mitigation measures, we used the output from the survey results, focus groups and scenario workshops to determine potential emission reduction measures in line with communities' needs and concerns. We also examined existing policy on local, regional, state

and federal levels for mitigation measures that already exist with financial support for their uptake. Finally, we identified measures that addressed priority areas for emission reductions according to the baseline emissions inventory.

Based on this review, the project team identified a number of potential mitigation measures. We divided the measures into technical and non-technical categories. Technical actions were further evaluated in the model developed during Phase 1 to estimate the emissions reduction potential that these actions could achieve. However, many technical mitigation measures could not be quantified either because they have not been tried before so their impact on emissions is unknown and it is unclear to what degree they will be successful in this region (for example, shift to plant-based diets, reduced urban sprawl, etc). Many measures could not be quantified simply because the data did not exist or are not readily available. In total, 42 technical mitigation measures were identified, and 23 were quantified.

The remainder of this section summarizes the mitigation measures that were identified for each sector, details on how the measures were quantified, and if they were quantified. As described in Section 1, the climate mitigation measures assessed in Phase 2 inherit baseline data and are then modified to represent a particular set of policies. The Phase 1 report includes all the data and technical assumptions used to build the baseline scenario. This report section describes the changes made to the baseline data to model the mitigation measure.

5.1 Technical measures

5.1.1 Energy Systems

Carbon-free grid (quantified): According to the Phase 1 Baseline Emissions Inventory report, around 40% of the region's electricity comes from fossil fuels (natural gas, coal and oil). Most of the region's major utilities meet their electricity demands through the wholesale electricity market run by the NY Independent Systems Operator (NYISO). NYISO selects the energy mix for utilities based on what is least cost and available at the time (Independent Power Producers of New York (IPPNY), n.d.), and despite Upstate NY's clean energy mix much of the region's energy utilities use energy from the gas power plant's located Downstate[1]. As a result, decarbonization of the state's entire grid is important. In addition, the electrification of buildings and vehicles means that there will be increased demand for electricity from the grid in the future. The use of more energy efficient equipment can offset some of the added demands. However, decarbonization of the grid is important to meeting emission reduction goals.

This mitigation measure assesses the emissions reduction potential if the state meets the CLCPA goal for a 100% carbon free grid. Carbon free electricity includes renewable energy

[1] According to the NYISO Power Trends report, in 2021, 92% of Upstate NY's energy use was derived from zero emissions sources (New York Independent System Operator (NYISO), 2021)

production, such as rooftop solar, battery storage, community energy, widespread community choice aggregation[2], and other technologies and policy instruments. However, the current model does not include specific technologies as it is focuses on energy *demand*, not *supply*. Instead, we gradually reduced the emission factors for electricity (per Table 1-3 of the Phase 1 report) to 0 by 2030, 2035, or 2040 depending on the scenario (see Table 6-1 for scenario details).

5.1.2 Residential

Residential building shell energy efficiency (quantified): Energy efficiency is the reduction in energy consumption from improvements in infrastructure or technologies. This mitigation measure evaluates the emissions reduction potential from improvements to the building shell of a house or residential building. Improvements typically include replacing old windows with thermal windows, replacing or adding roof and wall insulation to reduce air leakage and heat loss, or weatherstripping around doors and windows. These building shell improvements lead to a reduction in heating and cooling needs, which lowers energy consumption. We used the same assumptions as the NY Climate Action Council's Draft Climate Scoping Plan, where households either make basic or deep shell improvements, resulting in specific levels of reduction in heating and cooling demands[3]. We used the average reductions in our analysis:

- **Basic Shell Definition**: 27-44% reduction in space heating and 14-27% AC demands
- **Deep Shell Definition**: 57-90% reduction in space heating and 9-57% AC demands

Table 1-9 of the Phase 1 report lists the heating and cooling technologies assessed in this analysis. We obtained the baseline energy intensity for each space heating and cooling technology from the U.S. Energy Information Administration's (US EIA's) 2015 Residential Energy Consumption Survey (RECS) (US EIA, 2018). The baseline emissions projection is adjusted to account for the effects of climate change on space heating and cooling demands, as estimated from changes to the number of heating and cooling degree days. Heating and cooling degree day data for Rochester, NY, between 2010 and 2020 were taken from Oikolab's climate explorer. The average annual change in cooling and heating degree days was calculated relative to 2015, the year of the RECS survey used for this analysis, and applied to the energy intensity of space heating and air conditioning technologies in the residential sector. To implement this scenario in the model, we adjusted energy intensity by weighting the energy intensity of

[2] Community choice aggregation (CCA) enables local governments to procure energy supply for eligible customers in their community. For example, starting in 2022, Rochester's CCA automatically provided all residential and eligible commercial customers with 100% renewable energy (though anyone can opt out).

[3] Note that the Draft Climate Scoping Plan does not specify the type of interventions under a basic shell retrofit compared to a deep shell retrofit. For example, a basic shell might mean double-pane windows versus triple-pane windows in a deep shell retrofit. The cost differences between the two options would be significant; however, the study did not include a cost analysis.

inefficient households to households undertaking either basic shell improvements or deep shell improvements. The number of households undertaking building shell improvements changed under different scenarios, as described in Table 6-1.

Residential space heating electrification (quantified): Based on the Phase 1 Baseline Emissions Inventory report, residential space heating, largely from natural gas, contributes 12% of the region's emissions. This mitigation measure evaluates the emissions reduction potential from shifting away from fossil-fuel-based space heating. Common alternative heating technologies include air-source heat pumps, ground source heat pumps (fuelled by geothermal energy), electric resistance heaters, or electric furnaces. We obtained the baseline shares of different space heating technologies from the US EIA's 2015 Residential Energy Consumption Survey (US EIA, 2018). In the scenario analysis, we adjusted the shares of air- and ground-source heat pumps under various scenarios, as outlined in Table 6-1.

Thermal energy network (quantified**):** A thermal energy network (also known as "community thermal systems" or "district energy systems") is a centralized heating system that distributes steam or hot water to multiple buildings through a network of insulated underground pipes and radiators. District heating systems are widespread in many European countries. In July 2022, Governor Hochul signed Assembly Bill A10493, the Utility Thermal Energy Network and Jobs Act (N.Y. Legis. Assemb, 2022), authorizing utilities in New York to own and operate thermal energy networks and immediately initiate pilot programs across utility territories.

District heating systems are more efficient than individual space heating units as they use less fuel to produce the same amount of heat. For example, a geothermal district heating system has an average coefficient of performance (COP) of 5, which is significantly more efficient than an electric air-source heat pump with an average COP of 1.5 to 2.5. In addition, the networked nature of district heating means that it is also easier to access renewable resources such as geothermal and solar energy, which can otherwise be a barrier to some homes due to space limitations, physiographic features, and costs. This measure assesses the emissions reductions from geothermal district heating systems by increasing the share of households using these systems under different scenarios per Table 6-1.

Residential water heating electrification (quantified): Residential water heating, largely from natural gas, contributes to 3% of the region's emissions based on the Phase 1 Baseline Emissions Inventory report. This mitigation measure evaluates the emissions reduction potential from shifting to efficient electric heat pumps for water heating. We obtained the baseline shares of different water heating technologies from the US EIA's 2015 Residential Energy Consumption Survey (US EIA, 2018). To assess the effect of the mitigation measure, we modified the share of households using an electric water heater under different scenarios per Table 6-1.

Electrification of other residential energy services (quantified): Emissions from other residential end uses, like clothes washing or drying, cooking, refrigeration, and electronics, represent 2% of the region's emissions, according to the Phase 1 Baseline Emissions Inventory

report. Therefore, this mitigation measure evaluates the potential emissions reduction from shifting away from fossil fuels to electricity for all other residential end uses. To implement this mitigation measure, we reduced the share of fossil fuels used for other residential end uses depending on the scenario (per Table 6-1) and made an equivalent increase in the share of electricity demands.

Appliance efficiency (not quantified): Federal appliance efficiency standards apply to all new appliances. However, the current model does not separate other types of energy services into specific appliances, and the ages and efficiencies of those appliances are not readily available. As a result, there is insufficient data to measure the potential reduction in emissions from improving appliance efficiency at this time.

Water efficiency (not quantified): While electrifying water heating reduces emissions by shifting from fossil fuel-based equipment to non-fossil fuel-based equipment, water efficiency measures can reduce energy demands for water heating and pumping and treating water in water utilities. It can also help save on water bills. Water efficiency measures include low-flow toilets, low-flow fixtures, or efficient washing machines and dishwashers. However, the current model does not include data on the number and type of water fixtures in an average household. Therefore, we did not measure water efficiency improvements at this time.

High density development (not quantified): The current model cannot quantify the impact of high-density development on energy efficiency as residential sector demands are not disaggregated by building type – i.e., single detached homes, semi-detached homes, low-rise buildings, and high-rise buildings.

Smart landscaping / native species (not quantified): This measure involves assessing the emissions reduction potential from smart landscaping and reintroducing native species in residential neighborhoods. Evaluating this would require data on the share of total green space in the region that uses smart-landscaping techniques compared to the percentage that does not and an understanding of how much emissions reduction is possible from shifting to a new type of landscaping.

5.1.3 Transport

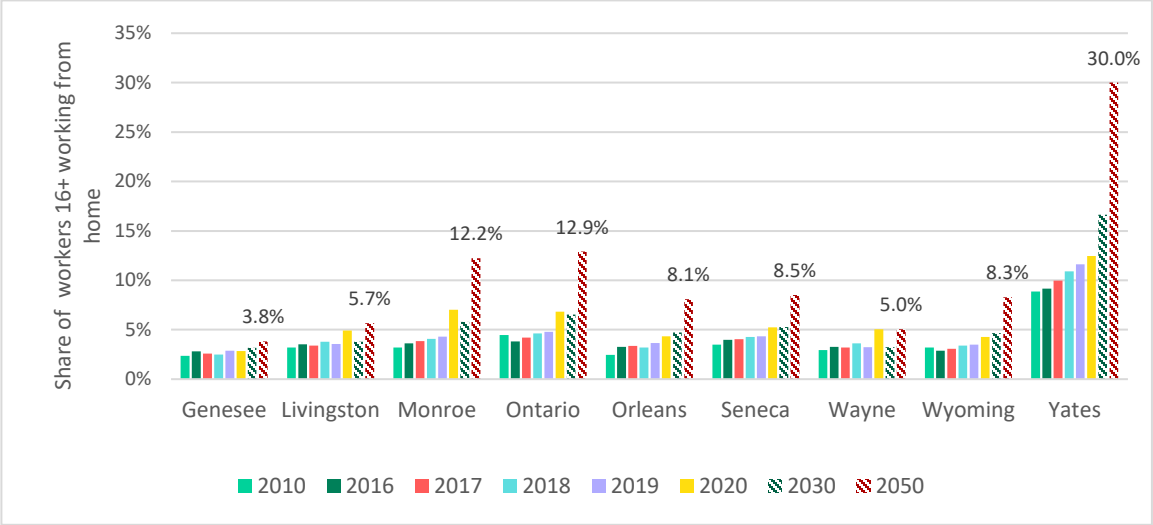
Shift to active transit and working from home (quantified)**:** Active transit options such as walking, biking, and skateboarding improve air quality by reducing the need for fossil fuel-based vehicles. In addition, the vast majority of participants in the survey, focus groups, and scenario workshop would like to see more walkable and bikeable communities by building sidewalks, pedestrian plazas, bike paths, and trail towns and locating houses and workplaces closer to each other through higher-density development. Sandag's Mobility Management VMT Reduction Calculator Tool (Sandag, 2019) shows the potential reduction of vehicle miles traveled (VMT) under various active transit and teleworking strategies, including:

- Maximum 44% VMT reduction from teleworking

- Maximum 1.4% VMT reduction from sidewalks
- Maximum 5% VMT reduction from bike networks (lands, paths, tracks)
- Maximum 0.3% VMT reduction from bikeway addition
- Maximum 0.1% VMT reduction from bikeshares

Using Sandag's estimates, these transit strategies can potentially reduce VMT by a maximum of 50.8%, mainly due to teleworking. While during the COVID-19 pandemic there was a decrease in commuting as more people worked from home, according to the Bureau of Transportation Statistics (BTS), commuting has returned to normal levels or higher in many states (BTS 2022). However, even before this spike, most counties have had a general increase in teleworking since 2016, according to the American Community Survey (US Census Bureau, 2022a). Figure 5-1 shows the estimated share of people working from home if past trends continue. As such, this measure evaluates the potential emissions reductions shifting from driving to active transit options or working from home. Table 6-1 indicates the amount of passenger cars and truck VMT reduced under different scenarios. The baseline vehicle miles traveled are taken from the US Department of Transportation and New York State Department of Transportation, as detailed in the Phase 1 report.

Figure 5-1: *Share of workers 16+ working from home (data from American Community Survey)*



Shift from light duty vehicles to public transit (quantified): Many focus groups expressed the need for an expansion of public transit. However, studies show that the impact of investing in bus systems on reducing VMT by passenger vehicles is relatively low because these investments aim to serve commute trips (Priebe, 2015). A 2015 study showed that in the US, commuting accounts for only 27 percent of total VMT by car (Federal Highway Administration, 2020). During the COVID-19 pandemic, commuting decreased as more people worked from home, and that trend persists, as shown in Figure 5-1. As non-commute trips are much less likely than commute trips to use transit, transit investment might only displace a fraction of VMT.

This measure evaluates the potential emissions reductions by shifting from light-duty vehicles to public transit for commutes through transit initiatives and improved land-use planning. In a study from 2004, transit service expansion can reduce VMT by 0.03% for small cities with populations less than 500 000 and 0.13% for larger cities (Transportation Research Board & National Academies of Sciences, Engineering, and Medicine, 2004). A newer study by Smart Growth America notes a 0.5% reduction in VMT for every 1% increase in transit frequency and a corridor-level VMT reduction of 1-2% through bus rapid transit systems (as cited in Stantec & North Caroline Department of Transportation, 2021). Sandag's Mobility Management VMT Reduction Calculator Tool (Sandag, 2019) shows deeper VMT reduction potential under different transit strategies, including:

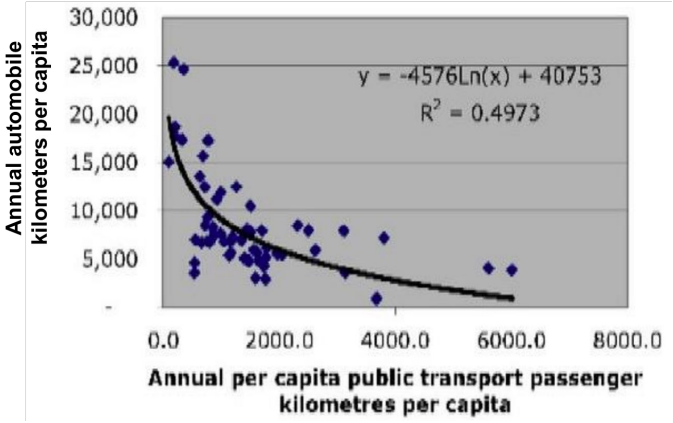
- Maximum 5.9% VMT reduction from transit service expansion (compared to 0.03%-0.13% VMT reduction in the 2004 National Academies of Sciences study)
- Maximum 8.2% VMT reduction from increasing transit frequency (compared to 1-2% VMT for 1% increase in frequency per the Smart Growth America study)
- Maximum 0.4% VMT reduction from transit supportive treatment such as signal modifications
- Maximum 1.2% VMT reduction from fare reduction
- Maximum 14.4% VMT reduction from transit-oriented development

Based on Sandag's estimates, transit strategies can potentially reduce VMT by 29.6%. For our scenario analysis (detailed in Table 6-1), we use the lower estimates of average VMT reduction to be conservative.

While these strategies reduce VMT from car travel, they will increase VMT for buses. According to the U.S. Department of Energy's Alternative Fuels Data Center (2021), the national average occupancy rate of public buses is 7.7 passengers, well under the full capacity of the buses in the RTS bus fleet (American Public Transportation Association, 2020). As such, the VMT for buses will not increase due to increased occupancy but from longer, expanded routes and increased bus frequency. We could not find data on the increase in bus VMT for the abovementioned strategies. Instead, several studies report the link between LDV VMT reduction to the increase in bus VMT. For instance, a recent 2021 study by Cambridge Systematics (2021) assumed an increase in bus vehicle VMT by 13% to 26% of the decrease in automobile VMT for its scenario analysis. In a study by Newman, Kenworthy and Glazebrook (2008), one passenger kilometer of transit use was assumed to replace between 3 and 7 passenger kilometers of car use. This assumption is represented in Figure 5-2 which shows the exponential negative relationship between automobile and public transit kilometers.

In the scenario analysis, we calculate the change in LDV VMT between the baseline scenario relative to an increase in public transit VMT in a given scenario (per Table 6-1) using the equation in Figure 5-2. Then, we converted the formula result to an index value and applied it to the baseline bus VMT in the model. The baseline bus VMT is taken from the U.S. Federal Transportation Administration's National Transit Database (2022).

Figure 5-2*: Car versus Public Transit Kilometers*



Source: Figure 5 of Litman (2022) using data from Newman, Kenworthy and Glazebrook (2008)

Federal fuel economy standards (quantified): This mitigation measure evaluates the emission reduction potential from the NHTSA's Corporate Average Fuel Economy (CAFE) standard. The fuel economy—or the average distance vehicles travel on a gallon of fuel (i.e. miles per gallon [mpg])—for gasoline and diesel vehicles was modified according to the targets set in the CAFE standard. We obtained baseline fuel economy values from the U.S. Environmental Protection Agency (EPA) and the US Department of Transportation (DOT). Table 5-1 provides a summary of the fuel economy for different vehicle types, fuels and years.

Table 5-1*: Projected fuel economy by vehicle and fuel type in accordance with NHTSA CAFE Standard*

Vehicle Type	Fuel	2010	2025	2030	2050
Car	Gasoline	22.97	33.87	37.98	42.63
	Diesel	28.23	52.60	58.61	65.00
Passenger Truck	Gasoline	17.18	24.80	28.30	33.32
	Diesel	19.37	20.32	22.25	25.54
Commercial Truck	Gasoline	10.57	24.80	28.30	33.32
	Diesel	17.91	20.32	22.25	25.54
Medium Truck	Gasoline	10.93	20.70	23.73	28.36
	Diesel	10.96	12.09	13.17	14.88
Heavy Duty Truck	Gasoline	5.80	8.81	10.00	10.00
	Diesel	5.02	8.10	9.00	9.20

Electrification of light-duty vehicles (quantified): This measure seeks to quantify the rule set forth under New York assembly bill A.4302/S.2758, which requires 100% of all new sales of passenger cars and trucks to be zero-emissions from 2035 (N.Y. Legis. Assemb, 2021). The proportion of new vehicles in each year from 2035 onwards is estimated using typical passenger car and truck sales rates for NY state from the NY Draft Climate Scoping Plan. The annual average sales rate of new cars is 6.6% and 6.0% for passenger cars and passenger/ commercial trucks, respectively (NY Climate Action Council, 2022). We estimated the early retirement rate

of existing vehicles for each scenario, as shown in Table 6-1. It is important to note that for this mitigation measure to succeed, there will need to be an expansion of electric vehicle charging stations (both private and public) and incentives for lower-income individuals to purchase new vehicles and chargers, such as through subsidies or tax credits.

Electrification of medium- and heavy-duty vehicles (quantified): Following the New York assembly bill A.4302/S.2758, this measure assumes that 100% of all new sales of medium- and heavy-duty trucks will be zero-emissions from 2045 (N.Y. Legis. Assemb, 2021). The proportion of new vehicles in each year from 2045 onwards is estimated using typical medium- and heavy-truck sales rates for NY state of 5.0% per the NY Draft Climate Scoping Plan (NY Climate Action Council, 2022). We estimated the early retirement rate of existing vehicles for each scenario as shown in Table 6-1. For this mitigation measure to be successful, there will need to be substantial investment in electric vehicle charging stations.

Electrification of public buses (quantified): This measure follows the target outlined in the Regional Transit Service (RTS) 2021-2024 Comprehensive Strategic Plan, which calls for 25% of the RTS bus fleet to be electric by 2025 and 100% by 2035.

Electrification of school buses (not quantified): Several participants throughout the stakeholder consultation mentioned the electrification of school buses. However, since we do not have information on the proportion of private buses that are school buses, we are unable to determine the emissions reduction from electrifying school buses.

Carpooling and ridesharing (not quantified**):** Sandag's Mobility Management VMT Reduction Calculator Tool (2019) shows that the maximum potential VMT reduction from microtransit (i.e., carshares, rideshares) is 0.1%. At this time, there is not enough data on the proportion of light-duty vehicles used for carpooling or ridesharing with multiple passengers from different households to analyze their emissions reduction potential. Ridesharing with multiple passengers from a single household is not considered an emission reduction measure.

Low carbon fuel (not quantified): Renewable natural gas (RNG), renewable distillate and hydrogen are considered low carbon fuels. We did not assess the emissions reduction potential from these fuels at this time because there is limited availability and adoption of hydrogen vehicles at this time, and the characteristics (i.e. fuel economy, pollutant emissions) of vehicles that use RNG and renewable distillate vary.

Regional rail systems (not quantified): Many focus group participants mentioned the possibility of utilizing or repurposing existing, and in some cases, unused, rail lines for public transit systems across the region. Analyzing this option requires information on the length of the rail line that could be repurposed or reinstated for public transit, as well as how much VMT would be shifted away from on-road vehicles if this occurred. It is worth exploring this option's technical and financial viability in the future.

5.1.4 Commercial

Commercial building shell efficiency (quantified): This mitigation measure evaluates the emissions reduction from improvements to the building shell of commercial buildings (offices including government offices, retailers, restaurants, grocery stores, healthcare centers, educational facilities, lodging, and warehouses). Building shell improvements typically include replacing old windows with thermal windows, replacing insulation to reduce air leakage and heat loss, or weatherstripping around doors and windows. These building shell improvements lead to a reduction in heating and cooling needs, which reduces energy consumption.

Our analysis uses the same assumptions as the NY Climate Action Council's Draft Climate Scoping Plan for residential buildings, namely that households either make basic or deep shell improvements resulting in specific levels of reduction in heating and cooling demands (see Section 5.1.2 for assumptions). We first estimated commercial heating and cooling energy demands to apply these reductions. To do this, we found the number of commercial establishments by NAICS code from the US Census Bureau's County Business Patterns Survey (2021). We then used NYSERDA's 2018 *Commercial Statewide Baseline Study of New York State* to obtain the average square footage for each commercial building type in Upstate New York and their associated heating and cooling energy demands (NYSERDA, 2019). We then calculated the total commercial area for each building type in each county within the Genesee-Finger Lakes region to 2050, using the same commercial area growth rate as the NY Climate Action Council's Draft Climate Scoping Plan (2022). Finally, we calculated the total heating and cooling demands based on the total commercial area, adjusted the heating and cooling energy intensity for climate change impacts (using a similar method as residential buildings), and adjusted it again for the share of buildings undertaking building shell efficiency measures. The amount of commercial area with building shell improvements was changed under different scenarios, as described in Table 6-1.

Building electrification (quantified): This measure evaluates the potential emissions reduction from electrifying equipment in a commercial building. This equipment includes fossil fuel-based space heating, water heating and cooking technologies. We used the square footage of commercial area calculated in the commercial building shell efficiency scenario and the commercial fuel consumption data calculated for the Phase 1 Baseline Emissions Inventory and estimated the energy intensity of fossil fuel consumption per square foot. Then, we adjusted the energy intensity based on the amount of commercial area affected by building electrification, which varied depending on the scenario analyzed, per Table 6-1.

LED street lighting (not quantified): We were unable to find publicly available data on street lighting in each county, so we did not include street lighting in the emissions inventory. As such, we could not measure the potential emissions reduction from switching street lighting to LEDs. However, many municipalities noted that they were undertaking this action, so it would be useful to investigate this measure in the future.

Schools as community hubs (not quantified): Many households do not have adequate heating and cooling systems to handle extreme weather events like heat waves and cold snaps. These events are becoming more common as a result of climate change. Many focus group

participants noted how schools could be used as community hubs (heating/cooling centers) during these events. This study did not measure the emissions reduction from this type of action.

5.1.5 Industrial

General efficiency measures (quantified): This measure assumes an improvement in efficiency across all industrial sub-sectors compared to the baseline energy use obtained from the National Renewable Energy Laboratory's (NREL's) Industrial Energy Data Book (IEDB). We modified the energy intensity of each fuel across all industrial sub-sectors based on the efficiency improvement proposed in each scenario described in Table 6-1.

Electrification of non-fossil equipment (quantified): This measure assumes a shift from fossil fuel to electricity across all industrial sub-sectors. To implement this mitigation measure, we reduced the share of fossil fuels used by a particular industrial sub-sector, depending on the scenario (per Table 6-1) and made an equivalent increase in the share of electricity use.

Process emissions (not quantified): The NY Climate Action Council's Climate Scoping Plan includes emissions reductions from carbon capture and storage (CCS) from cement, iron and steel production. Since CCS is not commercially available, it was not quantified in this analysis.

5.1.6 Agricultural

Manure management (quantified): Livestock manure accounts for 8% of the region's emissions per the Phase 1 Baseline Emissions Inventory report. This mitigation measure aims to reduce manure-related emissions, such as by collecting and storing manure and installing methane capture systems. We assume the captured methane is flared, though it methane could also be used to generate electricity or further processed to create RNG. We implemented this mitigation measure by reducing baseline manure emissions following the methane capture rates given for each scenario in Table 6-1. The calculation of baseline manure emissions is detailed in Section 1.3.2.2 of the Phase 1 Baseline Emissions Inventory report.

Alley cropping (quantified): Alley cropping involves planting rows of trees or shrubs to create alleys within agricultural or horticultural crops. Alley cropping is rare in the region but could have benefits like improving water quality, reducing runoff, increasing land productivity, decreasing the carbon footprint of cropping systems, and sequestering carbon in the soil. Determining the mitigation potential from alley cropping for the Genesee-Finger Lakes region involved multiplying the statewide mitigation potential by the ratio of each county's crop area to the total crop area of New York State. We obtained the statewide mitigation potential under different scenarios from McDonnell and Sullivan (2020) and crop area from the United States Department of Agriculture (2022c).

Fertilizer Management (quantified): Fertilizer runoff contributes to algae blooms which are becoming more common in the Finger Lakes and Great Lakes. In addition, nitrogen from

fertilizer can enter soil and water, where microbes can break it down to produce nitrous oxide, a powerful greenhouse gas. Fertilizer management can reduce the amount of nitrogen entering the soil and water. Similar to the alley cropping scenario, determining the mitigation potential from fertilizer management for the region involved multiplying the statewide mitigation potential from McDonnell and Sullivan (2020) by the ratio of each county's crop area to the total crop area of New York State.

Alternative fertilizer (quantified): This measure assumes that synthetic fertilizer is replaced with an organic fertilizer, such as dried manure and activated sewage, which have lower nitrous oxide emissions and less water pollution. The share of synthetic and organic fertilizer use under different scenarios is provided in Table 6-1.

Cover Crops (quantified): Cover crops are planted in the off-season to secure the soil instead of it being harvested, increase organic matter, and suppress weed growth. Cover crops can be very useful in the Genesee-Finger Lakes region, particularly in vineyards. Similar to the alley cropping scenario, determining the mitigation potential from cover crops for the counties in the Genesee-Finger Lakes involved multiplying the statewide mitigation potential under different scenarios by the ratio of each county's crop area to the crop area of New York State.

Alternative livestock feed (not quantified): Enteric fermentation accounts for 12% of regional emissions. Changing livestock diets through alternative feed has the potential to reduce enteric fermentation. While there is ongoing research about alternative diets for dairy cows, such as seaweed, this practice has yet to be scaled up.

Reduced tillage practices (not quantified): Reducing tillage decreases soil disturbance and soil erosion. The type of fertilizer used and how it is applied can affect whether reduced tillage can decrease regional greenhouse gas emissions. Due to limited data on existing tillage practices, it is difficult to quantify the impacts of reduced tillage.

Community gardens/year-round greenhouses (not quantified): Access to healthy, affordable, locally grown produce can help reduce food transport emissions and promote carbon removal through expanding green space. However, there is limited data on developed areas that could be converted into community gardens. Future research should explore this.

Plant based diets (not quantified): Action to change consumer behavior is a very sensitive issue. After facing backlash, the UK government retracted a research paper recommending people shift to plant-based diets (Islam, 2021). As plant-based milk and meat sales continue to increase, it is unclear to what extent this will decrease the consumption of dairy and meat products. Currently, 98 percent of people purchasing plant-based products also buy dairy and meat (Good Food Institute, 2021). Although sales of dairy as milk have gone down as a result of the entry of plant-based milk (Stewart & Kuchler, 2022) dairy consumption (cheese, ice cream, etc.) has increased overall (Dairy Foods, 2022). Therefore, plant-based diets affecting dairy production in the region seems unlikely in the near term.

Reduction in food waste at the production side (not quantified): The USDA and EPA aim to reduce food loss and waste by 50% by 2030 (USDA, 2022b). Currently, 31% of all agricultural products are wasted (USDA, 2022a). By 2030, existing policy aims to reduce that to 15.5%. However, the current rate of food waste in the region is not known.

5.1.7 Waste

Landfill gas capture (quantified): All of the large landfills in the region have landfill gas capture systems. The reduction in emissions from landfill gas are already incorporated in the baseline scenario.

Reducing consumption (not quantified): Most of the goods that we purchase are produced outside of the region, including appliances, vehicles, clothes, etc. An analysis of the potential emissions reduction from reducing consumption would require data on the type and amount of goods being brought into the region and the baseline emissions from manufacturing those goods. This data is generally difficult to find at a sub-national scale.

Waste diversion (not quantified): The amount of recycling of waste, reusing or fixing of goods is not readily available at a county level, and was not quantified at this time. This includes the diversion of food waste to community composting. There is also potential to generate electricity or produce fuel from compost.

5.1.8 Land

Afforestation of Former Agricultural Land (quantified): This mitigation measure evaluates the potential for emissions removal from the afforestation of former agricultural land. Similar to the agricultural alley cropping scenario, the mitigation potential for the Genesee-Finger Lakes region was determined by multiplying the statewide mitigation potential under different scenarios by the ratio of each county's crop area to the total crop area of New York State.

Parks and green space / urban trees (not quantified): The extent of developed land or vacant lands that are available for parks and green spaces was not investigated. This should be explored further in the future.

5.2 Non-technical measures

A summary of the non-technical measures to facilitate emission reductions are as follows:

Land use planning: Land use planning is a cross-cutting need brought up in many focus groups and workshop discussions. One comment from the scenario workshop summarizes this well: "Land use planning is important in terms of building out of housing, transportation and renewable energy resources, while also preserving agricultural land." There is a need to consider where to locate new businesses and building developments in the region through community input and to align with strategies from a land use perspective. This way, new

businesses can be accessible to the workforce via public transport systems.

Reducing inequality: The Phase 1 Baseline Emissions Inventory report shows a clear connection between income and emissions. Moderate- to high-income households consume twice as much energy as lower-income households. Addressing this inequity is important for reducing emissions as higher-income households consume more than they need, while lower-income households consume less and have higher energy cost burdens. All households require capital investment in energy efficiency, from an emissions reduction perspective and to reduce energy costs. However, due to the lower energy cost burdens experienced by higher-income households, they are less incentivized to take action to electrify. Higher-income households need greater awareness of climate mitigation measures, alongside other mechanisms (i.e., regulations) to adopt climate solutions. For lower-income households, there is concern over living wages, poor housing affordability, limited access to healthy food, technological divide, poor transportation options, and greater health and livelihood burdens from climate change. Better managed and more widespread subsidies and incentives are needed to support poorer households. As lower income households gain wealth, they might increase their energy consumption, but if they use clean energy to meet energy needs, this transition will have minimal impact on emissions.

Education and awareness on climate change: Many survey respondents noted that they had some knowledge of climate issues but needed clarification on how this affected the region and the breadth of available climate solutions. Institutional leadership and policymakers often view climate issues as a separate issue when in reality, it affects every aspect of one's life – where we live, how we live, and how we move. Media, social media, workplaces, as well as improvements to educational curriculum across all levels should be used to increase awareness of climate change issues. Hands-on learning and peer-to-peer learning are encouraged to understand the importance of nature to our lives and livelihoods, as many of us are disconnected from nature. Municipalities can share their experiences in enacting climate policies, businesses can share sustainable business practices, farmers can share regenerative agriculture measures, and neighbors can share lifestyle changes.

Supporting clean energy businesses and training programs: A sufficient workforce is needed to meet energy efficiency and renewable energy goals. There needs to be substantial investment in supporting entrepreneurs in this area and building the workforce through affordable training programs, including feeder programs from high schools. The region is strongly interested in becoming a clean manufacturing hub for heat pumps, energy storage, solar panels, and more. Plans for the full renewable energy supply chain are needed to make this a reality.

Funding: To make these mitigation measures happen, they need to be funded. Financial instruments are necessary, including typical instruments such as subsidies, loans, grants, and taxes or climate-specific instruments such as a cost on carbon, payment for ecosystem services for farmers to invest in soil health, support for businesses, a cap on grid interconnection costs for renewables, financing of energy efficiency projects, workforce development, to name a few. Funding measures also need to be easily accessible by lower-income individuals without

needing significant, time-consuming paperwork.

Codes and standards: Many examples of potential codes and standards emerged from the stakeholder discussions, including updated green building codes, water-taking permits, requiring landlords of existing buildings and developers of new buildings to meet energy efficiency standards, restricting building permits for new buildings in sensitive ecosystems, ensuring all solar farms/wind turbines/new factories undergo extensive siting assessments and more.

6 Scenario description

We combined the technical measures outlined above to create combined mitigation scenarios. We adopted an integrated framework that avoids double counting of emission reductions from each measure. For example, if analyzed separately, more efficient cars, lower carbon fuels, and increased non-motorized travel may all avoid the same baseline transportation emissions, thus overstating emission reductions. We analyzed three scenarios building from the baseline scenario developed in Phase 1. The scenario descriptions are as follows and detailed descriptions of the measures and level of ambition is provided in Table 6-1.

Scenario 1 – Existing policy scenario: Based on our analysis of the various mitigation measures, we assembled a suite of measures that each county could undertake, with active participation from businesses, residents, and partner institutions and jurisdictions. This first scenario assumes emission reductions over the baseline scenario if current federal, state and regional targets and plans are met in full.

Scenario 2 – Existing policies plus low ambition scenario: Our second scenario (low ambition) postulates further actions by each county beyond the first scenario that seem politically and socially feasible in the short term. We have based our understanding of the feasibility of these measures from the focus group outputs – specifically the values and visions of the local communities and specific challenges identified, as well as what is outlined as feasible in the NY Draft Climate Scoping Plan document (NY Climate Action Council, 2022). The target goal for this scenario is to meet the 85% reduction in emissions by 2050 outlined in the CLCPA.

Scenario 3 – Existing policy plus high ambition scenario: Our third scenario (high ambition) consists of more ambitious measures with an aim to exceed an 85% reduction in emissions by 2050. This scenario helps to elucidate the maximum emission reductions that the region could achieve.

The level of ambition for each mitigation measure from the residential, transport, commercial, industrial, agriculture and waste sectors were mainly drawn from the NY Climate Action Council's Draft Scoping Plan. For the land and forestry sector, levels of ambition were taken from the New York State Energy Research and Development Authority's (NYSERDA's) 2020 report on the *Sources and Sinks of Major Greenhouse Gases Associated with Ne' York State's*

Natural and Working Lands: Forests, Farms, and Wetlands authored by McDonnell and Sullivan (2020). Assumptions were made in some cases, as documented in Table 6-1 below.

While the scenario analyses provides useful guidance for evaluating pathways to "close the gap" between the region's projected emissions and the potential climate goals, it will be important to recognize that, given large uncertainties looking out 30 years, these scenarios will not necessarily provide a specific recommended way forward: moving from the visioning of the scenario analysis to the practical elements of strategy development is the role of Phase 3.

Table 6-1*: Scenario details*

Sector	Sub-sector	Scenario 1: existing policy scenario	Scenario 2: low ambition policy scenario (goal: meeting 85% emission reduction by 2050)	Scenario 3: high ambition policy scenario (goal: exceeding 85% emission reduction by 2050)
Electricity Generation	**Generation Capacity**	**GRID1: Carbon Fre– Grid 2040** - In line with the CLCPA, this measure seeks to have a carbon free grid by 2040. Emissions produced from electricity generation are slowly reduced to 0 tCO_2 per unit of energy by 2040.	**GRID2: Carbon Fre– Grid 2035 -** Going beyond the CLCPA, this measure seeks to have a carbon free grid by 2035. Emissions produced from electricity generation are slowly reduced to 0 tCO_2 per unit of energy by 2035.	**GRID3: Carbon Fre– Grid 2030 -** Going beyond the CLCPA, this measure seeks to have a carbon free grid by 2030. Emissions produced from electricity generation are slowly reduced to 0 tCO_2 per unit of energy by 2030.
Transport	**Fcaféeconomy**	**CAFE: Fuel Standards –** All vehicles wil' meet the NHTSA's Corporate Averagcaféel Economy (CAFE) Standards	Since it is highly unlikely that the region can influence car manufacturers, a higher ambition scenario is not evaluated. Therefore, we use the same assumptions as the existing policy scenario.	Since it is highly unlikely that the region can influence car manufacturers, a higher ambition scenario is not evaluated. Therefore, we use the same assumptions as the existing policy scenario.
Transport	**Light duty vehicles**	**EVLDV1: EV LDV–Scenario Reference -** In accordance with state legislation A.4302/S.2758, this scenario assumes that 100% of all new sales of passenger cars and trucks from 2035 onwards will only be battery electric vehicles (BEVs).	**EVLDV2: –V LDV Scenario Low -** This scenario assumes that through subsidies and other incentives provided by the region, it might be possible for 100% of passenger and truck sales from 2035 onwards to be BEVs, and 10% of LDVs will undergo early retirement before 2030.	**EVLDV3: E– LDV Scenario High -** This scenario assumes that through subsidies and other incentives provided by the region, it might be possible for 100% of passenger and truck sales from 2035 onwards to be BEVs, and 25% of LDVs will undergo early retirement before 2030.
Transport	**Heavy duty vehicles**	**EVMHV1: EV–MHDV Scenario 2045 -** In accordance with legislation A.4302/S.2758, this scenario assumes that 100% of new sales of medium-	**EVMHV2: EV–MHDV Scenario 2040 -** This scenario assumes that through subsidies and other incentives 100% of new sales of medium- and heavy-duty	**EVMHV3: EV–MHDV Scenario 2035 -** This scenario assumes that through subsidies and other incentives 100% of new sales of medium- and heavy-duty

Sector	Sub-sector	Scenario 1: existing policy scenario	Scenario 2: low ambition policy scenario (goal: meeting 85% emission reduction by 2050)	Scenario 3: high ambition policy scenario (goal: exceeding 85% emission reduction by 2050)
		and heavy-duty trucks from 2045 onwards will only be EVs.	trucks from 2040 onwards will only be EVs.	trucks from 2035 onwards will only be EVs.
Transport	**Electrification of Public buses**	**EVB–S1: Electric Buses -** According to the Regional Transit Service (RTS), 25% of the RTS bus fleet will be EVs by 2025 and 100% by 2035. ’ccording to the RTS' 2021-2014 Comprehensive Strategic Plan, it has 395 buses in its fleet.	Since the RTS covers all public buses in the region, the same assumptions as the existing policy scenario are used.	Since the RTS covers all public buses in the region, the same assumptions as the existing policy scenario are used.
Transport	**Bus transit improvements**	Same as baseline scenario.	**PBUS1: More Public Transit 5:** This scenario assumes that by 2030, VMT by LDVs will decrease by 2.5% because of an expansion of bus transit service and technology enhancements that improve the efficiency of buses. This will increase to 5% by 2050.	**PBUS2: More Public Transit 10:** This scenario assumes that by 2030, VMT by LDVs will decrease by 5% because of an expansion of bus transit service and technology enhancements that improve the efficiency of buses. This will increase to 10% by 2050.
Transport	**Biking/walking /working from home**	Same as baseline scenario.	**BIKE1: Mor– Biking and WFH 10 -** This scenario assumes that by 2030, VMT by LDVs will decrease by 10% due to an increase in biking, walking and working from home. This will increase to 20% by 2050.	**BIKE2: Mor– Biking and WFH 25 -** This scenario assumes that by 2030, VMT by LDVs will decline by 25% due to an increase in biking, walking and working from home. This will increase to 35% by 2050.
Residential	**Building shell efficiency**	**RESSHEL1: Residential Build–ng Shell Reference -** This scenario uses the assumptions from the NY Draft	**RESSHEL2: Residential–Building Shell Low -** This scenario uses the assumptions from the NY Draft	**RESSHEL3: Residential –uilding Shell High -** This scenario uses the assumptions from the NY Draft

Sector	Sub-sector	Scenario 1: existing policy scenario	Scenario 2: low ambition policy scenario (goal: meeting 85% emission reduction by 2050)	Scenario 3: high ambition policy scenario (goal: exceeding 85% emission reduction by 2050)
		Climate Scoping Plan reference scenario which says that by 2030, 4% of homes will undergo basic shell upgrades and another 3% will undergo deep shell upgrades. By 2050, 10% of homes will undergo basic shell upgrades and 5% will undergo deep shell upgrades. A more efficient building shell reduces space heating and air conditioning needs.	Climate Scoping Plan scenario 1 which says that by 2030, 10% of homes will undergo basic shell upgrades and another 3% will undergo deep shell upgrades. By 2050, 56% of homes will undergo basic shell upgrades and 12% will undergo deep shell upgrades. A more efficient building shell reduces space heating and air conditioning needs.	Climate Scoping Plan scenario 4 which says that by 2030, 18% of homes will undergo basic shell upgrades and another 7% will undergo deep shell upgrades. By 2050, 66% of homes will undergo basic shell upgrades and 26% will undergo deep shell upgrades. A more efficient building shell reduces space heating and air conditioning needs.
Residential	**Space heating electrification**	**RESSPAC1: Residential Space Heating Electr–fication Reference** - This scenario is b'sed off Gov. Hochul's plan to have 2 million (or 31%) of NY households electrified by 2030. It is assumed that households will electrify at the same pace to 2050. Only air-sourced heat pumps (ASHPs) are assumed per the NY Draft Climate Scoping Plan.	**RESSPAC2: Residential Space Heating –lectrification Low** - This scenario assumes that 50% of households will be electrified by 2030. It is assumed that households will electrify at the same pace to 2050. The heating equipment share will be 70% ASHPs, 10% ASHPs + fuel backup, 20% ground-sourced heat pumps (GSHPs) per the NY Draft Climate Scoping Plan.	**RESSPAC3: Residential Space Heating E–ectrification High** - This scenario assumes that 70% of households will be electrified by 2030. It is assumed that households will electrify at the same pace to 2050. The heating equipment share will be 77% ASHPs and 23% GSHPs per the NY Draft Climate Scoping Plan.
Residential	**Thermal Heating Network**	**RESDIST1: Residential Thermal Heatin– Network Reference** - This scenario is based off the utility mandate for a thermal heating network pilot programs in each utility territory and assumes 5% of	**RESDIST2: Residential Thermal – eating Network Low** - This scenario assumes the households with GSHP's per RESSPAC2 are connected to thermal heating networks.	**RESDIST3: Residential Thermal H– ating Network High** - This scenario assumes the households with GSHP's per RESSPAC2 are connected to thermal heating networks.

Sector	Sub-sector	Scenario 1: existing policy scenario	Scenario 2: low ambition policy scenario (goal: meeting 85% emission reduction by 2050)	Scenario 3: high ambition policy scenario (goal: exceeding 85% emission reduction by 2050)
		households are connected to thermal heating networks by 2030.		
Residential	**Water heating electrification**	**RESWATR1: Residential Water Heating Electr–fication Reference** - This scenario is b'sed off Gov. Hochul's plan to have 2 million (or 31%) of NY households electrified by 2030. It is assumed that households will electrify at the same pace to 2050.	**RESWATR2: Residential Water Heating –lectrification Low** - This scenario assumes that 50% of households will be electrified by 2030. It is assumed that households will electrify at the same pace to 2050.	**RESWATR3: Residential Water Heating E–ectrification High** - This scenario assumes that 70% of households will be electrified by 2030. It is assumed that households will electrify at the same pace to 2050.
Residential	**Electrification of other energy services**	**RESOTHR1: Residential Other Electr–fication Reference** - This scenario is b'sed off Gov. Hochul's plan to have 2 million (or 31%) of NY households electrified by 2030. It is assumed that households will electrify at the same pace to 2050	**RESOTHR2: Residential Other –lectrification Low** - This scenario assumes that 50% of households will be electrified by 2030. It is assumed that households will electrify at the same pace to 2050	**RESOTHR3: Residential Other E–ectrification High** - This scenario assumes that 70% of households will be electrified by 2030. It is assumed that households will electrify at the same pace to 2050.
Commercial	**Building shell efficiency**	**COMSHEL1: Commercial Build–ng Shell Reference -** This scenario uses the assumptions from the NY Draft Climate Scoping Plan reference scenario which says that by 2030, 4% of commercial buildings will undergo basic shell upgrades and another3% will undergo deep shell upgrades. By 2050, 10% of commercial buildings will	**COMSHEL2: Commercial–Building Shell Low -** This scenario uses the assumptions from the NY Draft Climate Scoping Plan scenario 1 which says that by 2030, 10% of commercial buildings will undergo basic shell upgrades and 3% will undergo deep shell upgrades. By 2050, 56% of commercial buildings will undergo	**COMSHEL3: Commercial –uilding Shell High -** This scenario uses the assumptions from the NY Draft Climate Scoping Plan scenario 4 which says that by 2030, 18% of commercial buildings will undergo basic shell upgrades and 7% will undergo deep shell upgrades. By 2050, 66% of commercial buildings will undergo

Sector	Sub-sector	Scenario 1: existing policy scenario	Scenario 2: low ambition policy scenario (goal: meeting 85% emission reduction by 2050)	Scenario 3: high ambition policy scenario (goal: exceeding 85% emission reduction by 2050)
		undergo basic shell upgrades and 5% will undergo deep shell upgrades.	basic shell upgrades and 10% will undergo deep shell upgrades.	basic shell upgrades and 26% will undergo deep shell upgrades.
Commercial	**Electrification**	**COMELEC1: Commercial Electrification Reference –** This scenario uses the assumptions from the NY Draft Climate Scoping Plan which aims for 2% of commercial buildings to be electrified by 2030 and 3.5% by 2050.	**COMELEC2: Commercial Electrification Low –** Based off scenario 1 from the NY Draft Climate Scoping Plan, this scenario which aims for 11.5% of commercial buildings to be electrified by 2030 and 94% by 2050.	**COMELEC3: Commercial Electrification High –** Based off scenario 4 from the NY Draft Climate Scoping Plan, this scenario which aims for 27% of commercial buildings to be electrified by 2030 and 99% by 2050.
Industrial	**General efficiency measures**	**INDEFF1: Industrial E–ficiency Reference -** Using the same assumptions as the reference scenario of the NY Draft Climate Scoping Plan, this scenario assumes a 10% increase in industrial efficiency by 2025.	**INDEFF2: Indust–ial Efficiency Low** - Using the same assumptions as scenario 1 of the NY Draft Climate Scoping Plan, this scenario assumes a 10% increase in efficiency by 2025 and 30% by 2050.	**INDEFF2: Industr–al Efficiency High** - Using the same assumptions as scenario 2 of the NY Draft Climate Scoping Plan, this scenario assumes a 20% increase in efficiency by 2030 and 40% by 2050.
Industrial	**Electrification of non-fossil equipment**	Based on the reference scenario from the NY Draft Climate Scoping Plan, no changes are applied. It is the same as the baseline scenario.	**INDELEC1: Industrial –lectrification Low -** This scenario is based on scenario 1 from the NY Draft Climate Scoping Plan whereby 4% of industrial natural gas use will be converted to electricity by 2030 and 33% by 2050.	**INDELEC2: Industrial E–ectrification High** - This scenario is based on scenario 4 from the NY Draft Climate Scoping Plan whereby 4% of industrial natural gas use is converted to electricity by 2030 and 83% by 2050.
Agriculture	**Fertilizer**	Same as baseline scenario.	**SOILFERT1: Alternate Fertilizer Low –** Under this scenario, by 2030, 25% of fertilizer will be derived from organic	**SOILFERT2: Alternate Fertilizer High –** Under this scenario, by 2030, 50% of fertilizer will be derived from organic

Sector	Sub-sector	Scenario 1: existing policy scenario	Scenario 2: low ambition policy scenario (goal: meeting 85% emission reduction by 2050)	Scenario 3: high ambition policy scenario (goal: exceeding 85% emission reduction by 2050)
			sources including dried manure and activated sewage, and 50% by 2050.	sources including dried manure and activated sewage, and 80% by 2050.
Agriculture	**Manure management**	Same as baseline scenario.	**MANURE1:–Biogas capture Low** - Using the same assumptions as the NY Draft Climate Scoping Plan, this scenario assumes that by 2030, 50% of emissions from manure will be captured and 76% by 2050.	Same as low ambition scenario.
Agriculture	**Alley Cropping**	Same as baseline scenario.	**ALLEY1:–Alley cropping low -** This scenario is based on an analysis by McDonnell and Sullivan (2020) which estimates that 80% of the statewide mitigation potential of 0.67 $MMtCO_2e$/year for alley cropping could be achieved at a relatively low cost of < $50 per Mg CO_2e. By considering the proportion of crop area in the Genesee-Finger Lakes region to the entire state, this measure has the potential to remove 0.139 $MMtCO_2e$/yr under this scenario.	**ALLEY2: –lley cropping high -** This scenario is based on an analysis by McDonnell and Sullivan (2020) that estimates that a statewide mitigation potential of 0.67 $MMtCO_2e$/year could be achieved by 2050 through alley cropping. By considering the proportion of crop area in the region to the entire state, this measure has the potential to remove 0.174 $MMtCO_2e$/yr under this scenario.
Agriculture	**Fertilizer management (crop N_2O)**	Same as baseline scenario.	**FERTMNG1: Fertil–zer management low -** This scenario is based on an analysis by McDonnell and Sullivan	**FERTMNG2: Fertili–er management high -** This scenario is based on an analysis by McDonnell and Sullivan

Sector	Sub-sector	Scenario 1: existing policy scenario	Scenario 2: low ambition policy scenario (goal: meeting 85% emission reduction by 2050)	Scenario 3: high ambition policy scenario (goal: exceeding 85% emission reduction by 2050)
			(2020) that estimates 77% of the statewide mitigation potential of 0.20 $MMtCO_2e$/year for crop N_2O management could be achieved at a low cost of < $10 per Mg CO_2e. By considering the proportion of crop area in the Genesee-Finger Lakes region to that of the entire state, this measure has the potential to remove 0.04 $MMtCO_2e$/yr under this scenario.	(2020) that estimates that a statewide mitigation potential of 0.20 $MMtCO_2e$/year could be achieved by 2050 through crop N_2O management. By considering the proportion of crop area in the region to the entire state, this measure has the potential to remove 0.05 $MMtCO_2e$/yr under this scenario.
Agriculture	**Cover Crops**	Same as baseline scenario.	**COVRCR–1: Cover crops low -** This scenario is based on an analysis by McDonnell and Sullivan (2020) that estimates 96% of the statewide mitigation potential of 0.85 $MMtCO_2e$/year from cover cropping could be achieved at a low cost of < $10 per Mg CO_2e. By considering the proportion of crop area in the Genesee-Finger Lakes region to that of the entire state, this measure has the potential to remove 0.212 $MMtCO_2e$/yr under this scenario.	**COVRCRP2: Cover crops high –** This scenario is based on an analysis by McDonnell and Sullivan (2020) that estimates that a statewide mitigation potential of 0.85 $MMtCO_2e$/year could be achieved by 2050 through cover cropping. By considering the proportion of crop area in the Genesee-Finger Lakes region to that of the entire state, this measure has the potential to remove 0.221 $MMtCO_2e$/yr under this scenario.
Land Use	**Reforestation of Former Ag Land**	Same as baseline scenario.	**AFOREST1**: This scenario is based on an analysis by McDonnell and Sullivan (2020) that estimates a statewide	**AFOREST1**: This scenario is based on an analysis by McDonnell and Sullivan (2020) that estimates a statewide

Sector	Sub-sector	Scenario 1: existing policy scenario	Scenario 2: low ambition policy scenario (goal: meeting 85% emission reduction by 2050)	Scenario 3: high ambition policy scenario (goal: exceeding 85% emission reduction by 2050)
			reforestation potential of 3.81 $MMtCO_2e$/year by 2050 on the low end. By considering the proportion of crop area in the Genesee-Finger Lakes region to that of the entire state, this measure has the potential to remove 0.989 $MMtCO_2e$/yr under this scenario.	reforestation potential of 4.90 $MMtCO_2e$/year by 2050 on the high end. By considering the proportion of crop area in the Genesee-Finger Lakes region to that of the entire state, this measure has the potential to remove 1.272 $MMtCO_2e$/yr under this scenario.
Waste	**Landfill gas / biogas management**	Same as baseline scenario.	**LANDFLL1: Landfill leakage Low** – Under the same assumptions used in scenario 1 of the NY Draft Climate Scoping Plan, this scenario assumes that there will be a 5% reduction per year in methane leakage from landfills.	**LANDFLL2: La–dfill leakage High** - Under the same assumptions used in scenario 1 of the NY Draft Climate Scoping Plan, this scenario assumes that there will be a 10% reduction per year in methane leakage from landfills.

7 Scenario analysis results

The results of the scenario analysis are presented in this section. The possible emissions reduction in each scenario is measured against the targets set forth in the CLCPA of a 40% reduction of gross emissions by 2030 compared to 1990 emissions, 85% reduction of gross emissions by 2050 and net zero emissions by 2050. The Genesee-Finger Lakes region is estimated to have emitted 30 million metric tons of carbon dioxide equivalent ($MMtCO_2e$) in 1990. To stay in line with CLCPA targets, by 2030, gross annual emissions need to be around 18 $MMtCO_2e$ and by 2050, 4.5 $MMtCO_2e$. Since emissions data for the region is not available prior to 2010, the 1990 value was estimated by downscaling the 1990 state-level emissions reported in the 2021 New York State Statewide Greenhouse Gas Emissions Report ("NY GHG inventory") (NYSDEC, 202') using the region's percentage of the state total in 2010.

In accordance with the CLCPA, results are reported using 20-year global warming potential (GWP20), which emphasizes methane-related warming in the upcoming 10 to 30 years. The calculation of gross emissions includes upstream fossil fuel production emissions and biogenic carbon dioxide (CO_2) released during the combustion of biofuels or biomass.

7.1 Scenario 1: Existing policy scenario

As shown in Table 7-1 and Figure 7-1, existing plans and policies can potentially eliminate 212 $MMtCO_2e$ of emissions by 2050 compared to the baseline scenario, equivalent to an average annual reduction of 6.6 $MMtCO_2e$ per year. Despite a 34% reduction of emissions in 2050 compared to the baseline, existing policies are insufficient to meet the 2030 and 2050 CLCPA targets.

Because no agricultural policies currently exist, the share of agricultural emissions is likely to rise from 22% in 2018 to 40% by 2050. Most of the emissions reductions occur in the transport and residential sectors. Figure 7-2 shows the emissions reduction potential from individual mitigation measures in 2030 and Figure 7-3 shows the same information for 2050. The transportation sector accounts for about 20% of emissions reductions, including the implementation of national fuel efficiency standards and the state requirement that all car sales be electric vehicles from 2035. This is followed by an 8% emissions reduction from decarbonizing the grid and 4% from the electrification of residential space heating equipment.

Table 7-1: *Sectoral emissions under the existing policy scenario (scenario 1)*

Sector	-Historical-				-Scenario Projection-			
	2010		2018		2030		2050	
	$mMtCO_2e$	% of total	$mMtCO_2e$	% of total	$mMtCO_2e$	% of total	$MMtCO_2e$	% of total
Residential	4.67	16	4.66	16	3.40	15	1.76	9
Commercial	2.37	8	2.60	9	2.29	10	2.21	11
Industrial	3.62	12	2.00	7	1.75	8	1.85	9
Transportation	9.39	32	9.57	33	5.21	23	2.65	13

Sector	-Historical-				-Scenario Projection-			
	2010		2018		2030		2050	
	$mMtCO_2e$	% of total	$mMtCO_2e$	% of total	$mMtCO_2e$	% of total	$MMtCO_2e$	% of total
Agriculture	5.49	19	6.34	22	6.85	30	8.08	40
Waste	3.75	13	3.22	11	3.40	15	3.42	17
Losses	0.21	1	0.17	1	0.08	0	0.01	0
Gross emissions total (Scenario 1)	**29.50**	**100**	**28.57**	**100**	**22.97**	**100**	**19.98**	**100**
Net emission removal	-1.69		-1.64		-1.57		-1.48	
Biogenic CO_2	0.92		0.98		0.69		0.53	
Net emissions total (Scenario 1)	**26.89**		**25.95**		**20.71**		**17.98**	
Gross emissions total (Baseline)	29.50		28.57		28.77		30.42	
Avoided emissions compared to Baseline	0.00		0.00		-5.80		-10.43	

Note: Fuel-related emissions include upstream emissions outside of New York State using 2020 emissions factors. Gross emissions include biogenic CO_2.

Figure 7-1: *Sectoral Emissions under the Existing Policy Scenario (Scenario 1)*

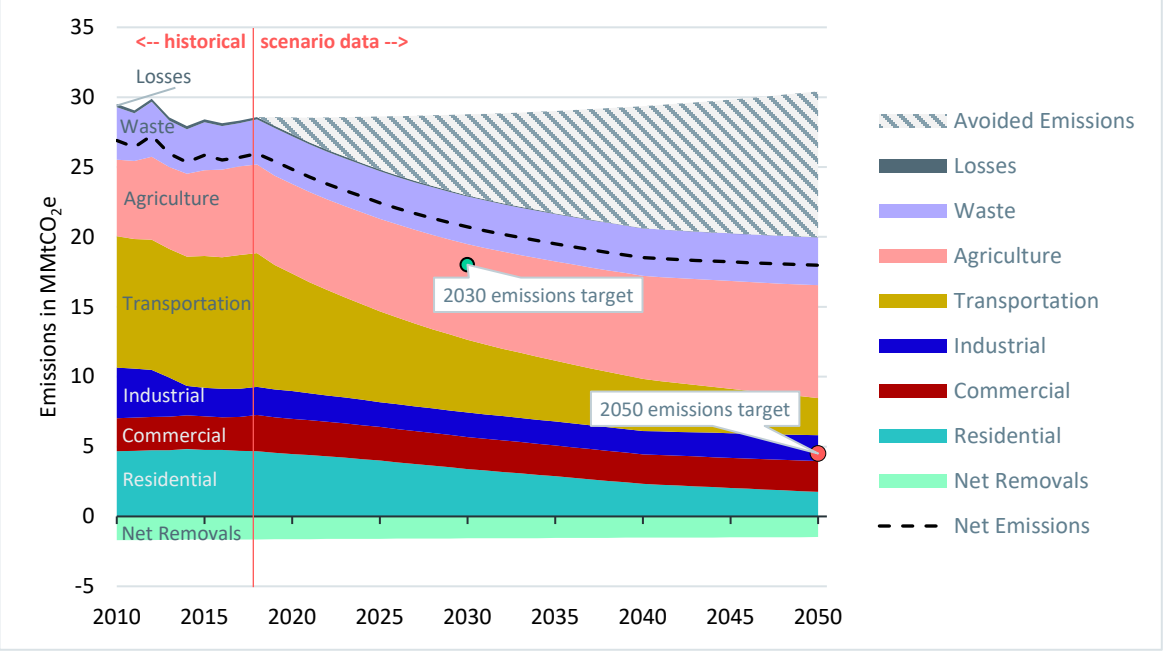


Figure 7-2: *Top Mitigation Measures in 2030 Under the Existing Policy Scenario (Scenario 1)*

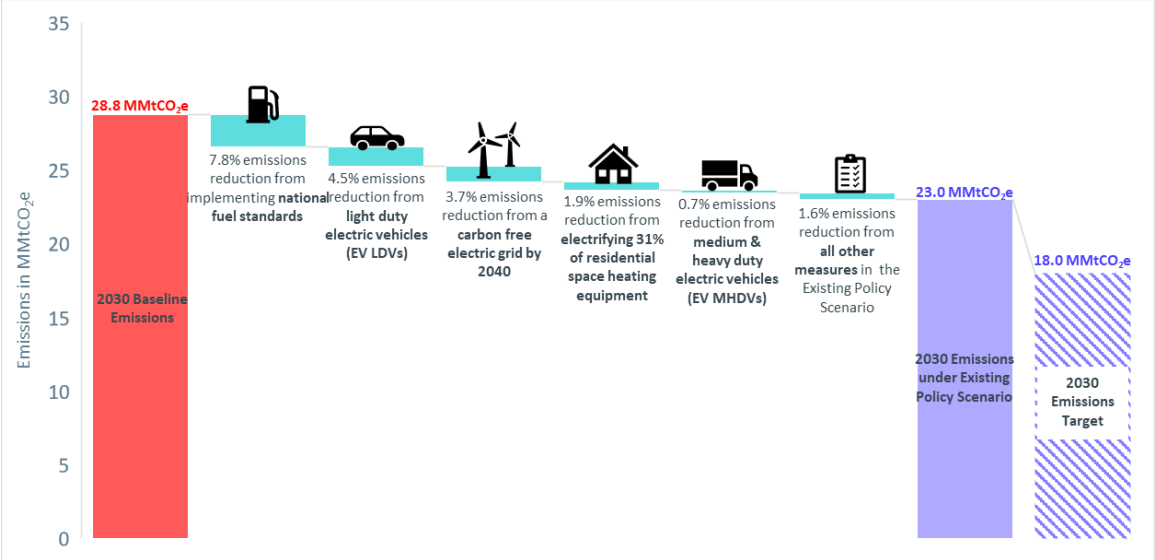
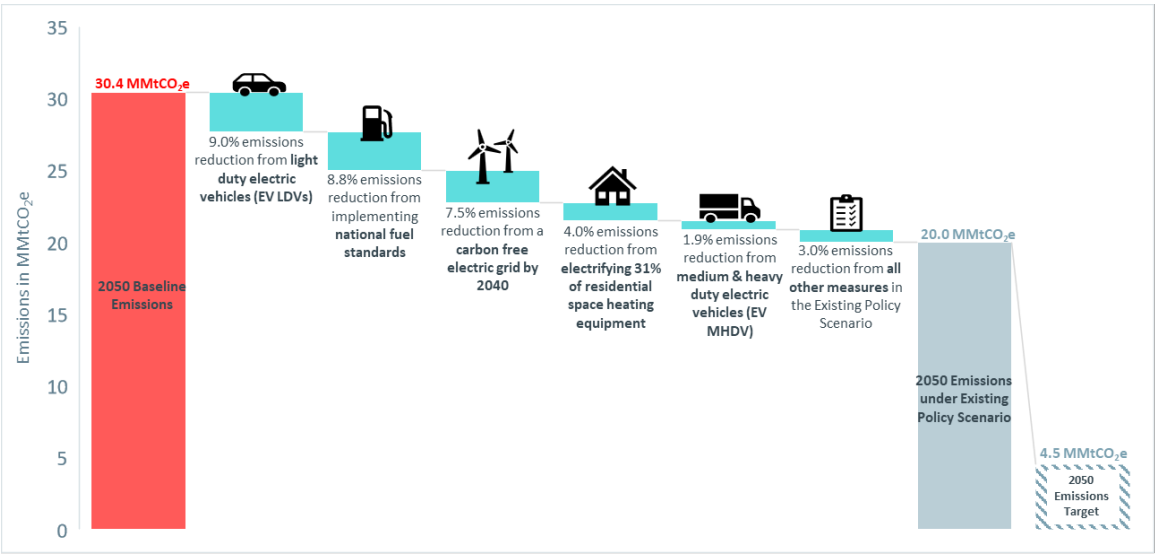


Figure 7-3: *Top Mitigation Measures in 2050 Under the Existing Policy Scenario (Scenario 1)*



7.2 Scenario 2: Existing policy + low ambition scenario

Under the existing policy plus low ambition scenario, the total annual emissions reductions could be 19.1 $MMtCO_2e$ by 2050 (see Table 7-2 and Figure 7-4 for details). This is equivalent to a 63% reduction in emissions compared to 1990 emissions, meaning that the CLCPA's goal of an 85% reduction 2050 is still not achievable for the Genesee-Finger Lakes region with slightly more ambitious policies.

On a sectoral level, a decarbonized grid by 2035, combined with electrification, results in near-zero emissions from residential and commercial buildings by 2050. Compared to Scenario 1, in which agricultural emissions reductions were limited, the agricultural sector contributes about 14% of the emissions reductions in this scenario, largely due to manure management (see Figures 7-5 and 7-6). In most state-level policies, the transport and residential sectors receive most of the attention, since agriculture only makes up 6% of statewide emissions. Since agriculture has a much larger role in this region, agricultural mitigation measures merit additional emphasis.

Table 7-2: *Sectoral emissions under the existing policy plus low ambition scenario (scenario 2)*

Sector	-Historical-				-Scenario Projection-			
	2010		2018		2030		2050	
	$mMtCO_2e$	% of total	$mMtCO_2e$	% of total	$mMtCO_2e$	% of total	$MMtCO_2e$	% of total
Residential	4.67	16	4.66	16	2.51	13	0.15	1
Commercial	2.37	8	2.60	9	1.97	10	0.01	0
Industrial	3.62	12	2.00	7	1.59	8	1.17	10
Transportation	9.39	32	9.57	33	4.65	24	2.34	21
Agriculture	5.49	19	6.34	22	5.50	29	5.49	48
Waste	3.75	13	3.22	11	2.91	15	2.21	19
Losses	0.21	1	0.17	1	0.06	0	0.00	0
Gross emissions total (Scenario 2)	**29.50**	**100**	**28.57**	**100**	**19.19**	**100**	**11.37**	**100**
Net emission removal	-1.69		-1.64		-1.57		-1.48	
Biogenic CO_2	0.92		0.98		0.58		0.39	
Net emissions total (Scenario 2)	**26.89**		**25.95**		**17.36**		**10.49**	
Gross emissions total (Baseline)	29.50		28.57		28.77		30.42	
Avoided emissions compared to Baseline	0.00		0.00		-9.58		-19.04	

Note: Fuel-related emissions include upstream emissions outside of New York State using 2020 emissions factors. Gross emissions include biogenic CO_2.

Figure 7-4: *Sectoral Emissions Under the Existing Policy plus Low Ambition Scenario (Scenario 2)*

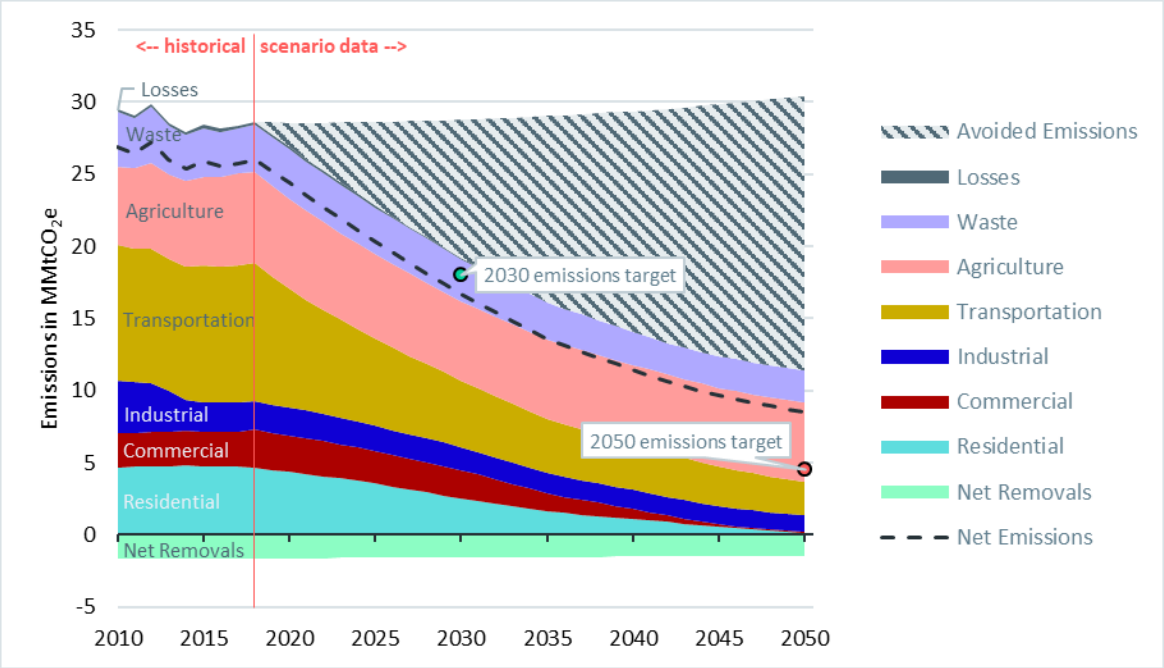


Figure 7-5: *Top mitigation measures in 2030 Under the Existing Policy plus Low Ambition Scenario (Scenario 2)*

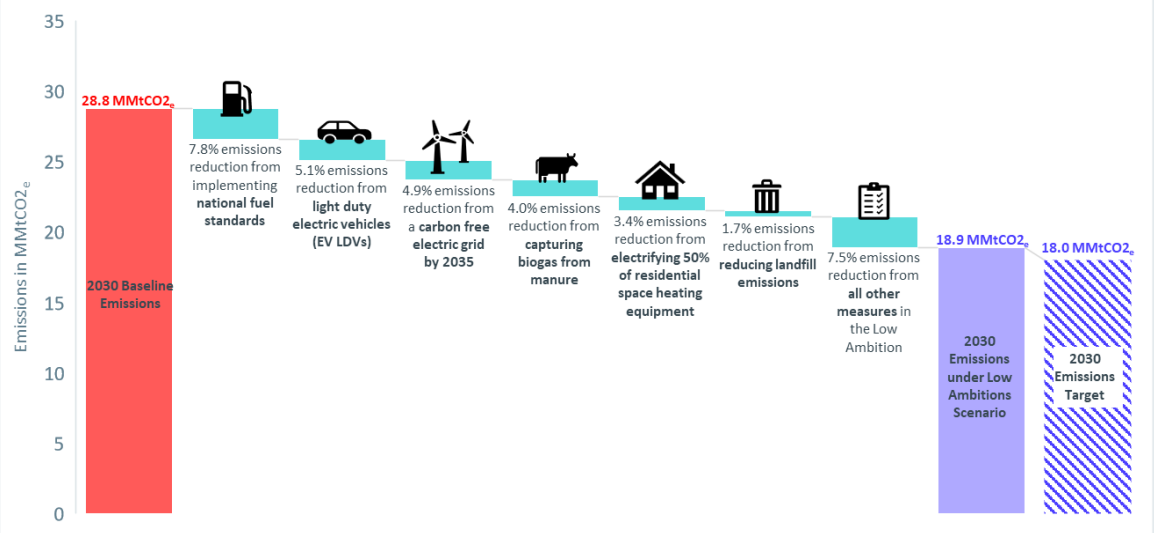
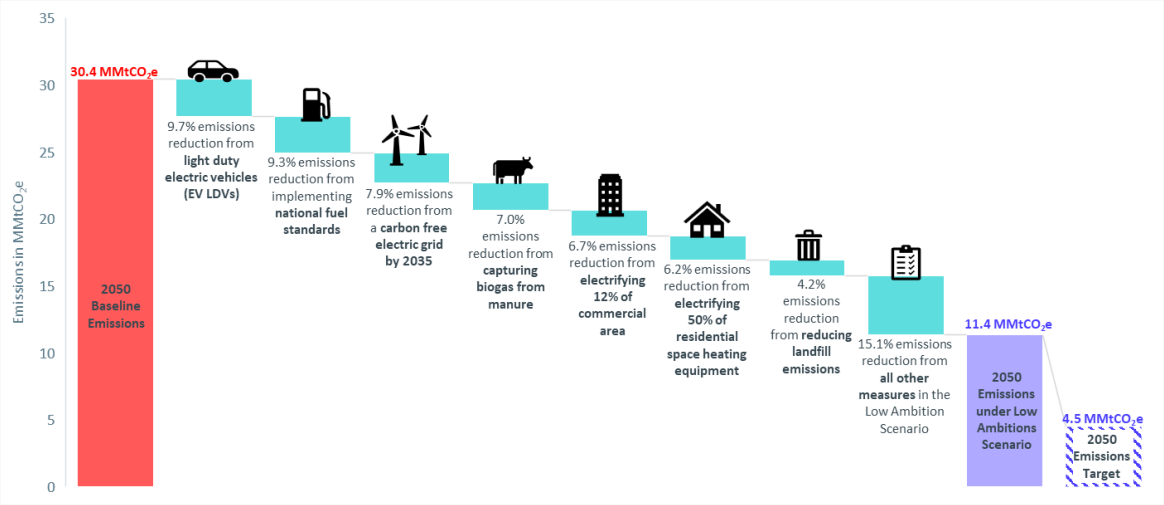


Figure 7-6: *Top mitigation measures in 2050 Under the Existing Policy plus Low Ambition Scenario (Scenario 2)*



7.3 Scenario 3: Existing policy + high ambition scenario

As shown in Table 7-4 and Figure 7-7, under the existing policy plus high ambition scenario, the total possible annual emissions reductions is 20.2 $MMtCO_2e$ by 2050. This is equivalent to a 67% reduction in emissions compared to 1990 levels. As such, even with more ambitious policies, the CLCPA target for 2050 will be difficult to attain, requiring an additional 18% of emissions reduction. Around 75% of the remaining emissions in 2050 are from solid waste (landfill) and agricultural emissions. The region hosts the largest landfills in the state with waste coming in from all over New England, Canada and New York. Despite significant landfill gas capture, there methane leakage still occurs that might be difficult to contain simply due to the landfill size. For the agricultural sector, the emissions that remain are primarily from enteric fermentation processes of dairy cows. While research continues into alternative feed and diets to reduce enteric fermentation emissions, they are not yet available on a commercial scale, and it is unclear whether they will be widely adopted.

Transport emissions will also continue to represent a large portion of emissions in 2050, because a lot of trucks, private buses and rail trains will still run on fossil fuels. The emissions reduction potential of alternative fuels had not yet been assessed because hydrogen-powered vehicles are not yet available at a commercial scale in the US, and the characteristics of vehicles that run on renewable natural gas and renewable distillate vary. In years to come, these fuels may provide an additional method of reducing remaining on-road emissions.

Table 7-3: *Sectoral emissions under the existing policy plus high ambition scenario (scenario 3)*

Sector	-Historical-				-Scenario Projection-			
	2010		2018		2030		2050	
	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total	$MMtCO_2e$	% of total
Residential	4.67	16	4.66	16	1.38	9	0.11	1
Commercial	2.37	8	2.60	9	1.37	9	0.00	0

Sector	-Historical-				-Scenario Projection-			
	2010		2018		2030		2050	
	MMtCO₂e	% of total	MMtCO₂e	% of total	MMtCO₂e	% of total	MMtCO₂e	% of total
Industrial	3.62	12	2.00	7	1.37	9	0.51	5
Transportation	9.39	32	9.57	33	4.07	25	2.09	20
Agriculture	5.49	19	6.34	22	5.41	34	5.33	52
Waste	3.75	13	3.22	11	2.42	15	2.21	22
Losses	0.21	1	0.17	1	0.01	0	0.00	0
Gross emissions total (Scenario 3)	**29.50**	**100**	**28.57**	**100**	**16.01**	**100**	**10.26**	**100**
Net emission removal	-1.69		-1.64		-1.57		-1.48	
Biogenic CO_2	0.92		0.98		0.49		0.38	
Net emissions total (Scenario 3)	**26.89**		**25.95**		**13.53**		**7.13**	
Gross emissions total (Baseline)	29.50		28.57		28.77		30.42	
Avoided emissions compared to Baseline	0.00		0.00		-12.76		-20.15	

Note: Fuel-related emissions include upstream emissions outside of New York State using 2020 emissions factors. Gross emissions include biogenic CO_2.

Figure 7-7: *Sectoral Emissions under the Existing Policy plus High Ambition Scenario (Scenario 3)*

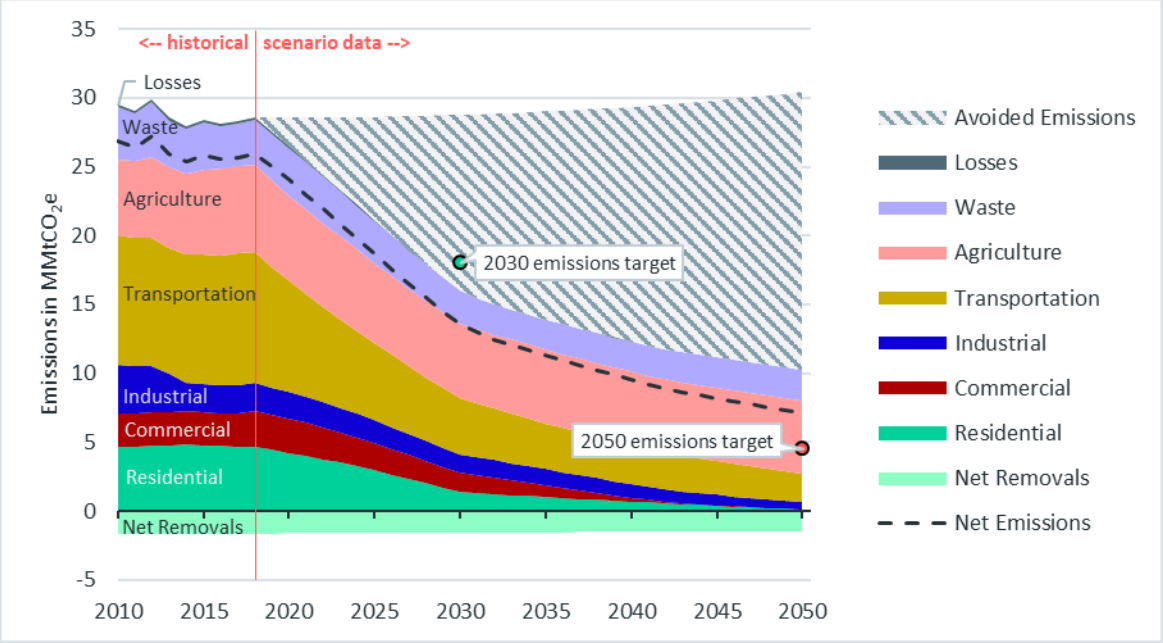


Figure 7-8: *Top mitigation measures in 2030 Under the Existing Policy plus High Ambition Scenario (Scenario 3)*

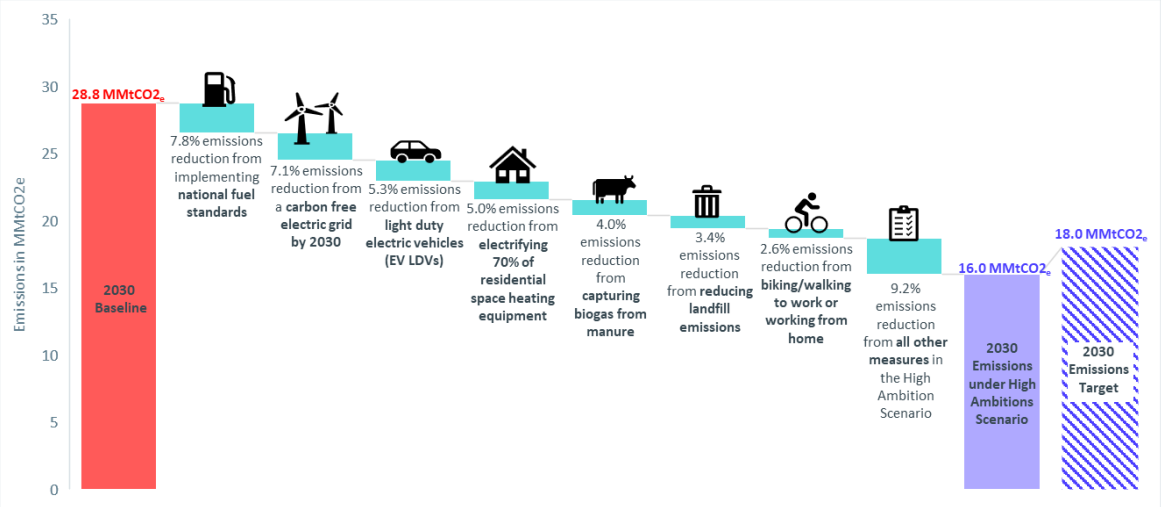
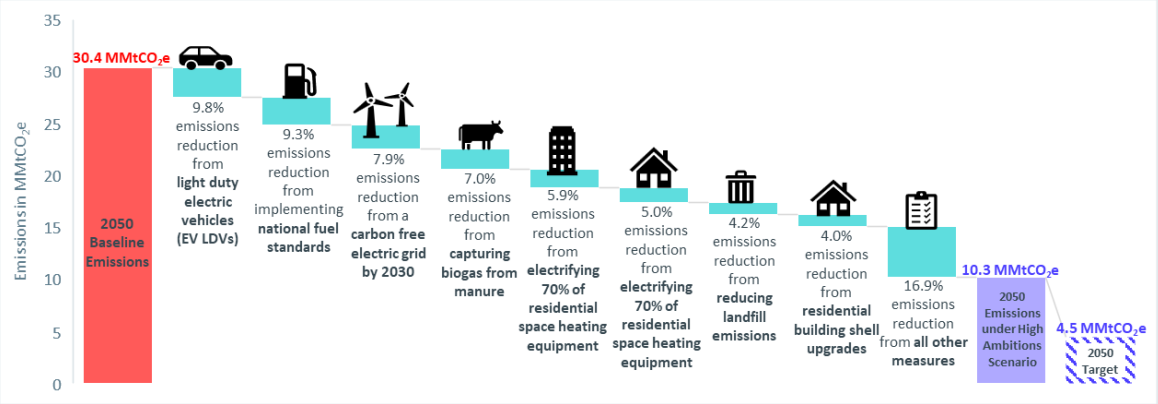


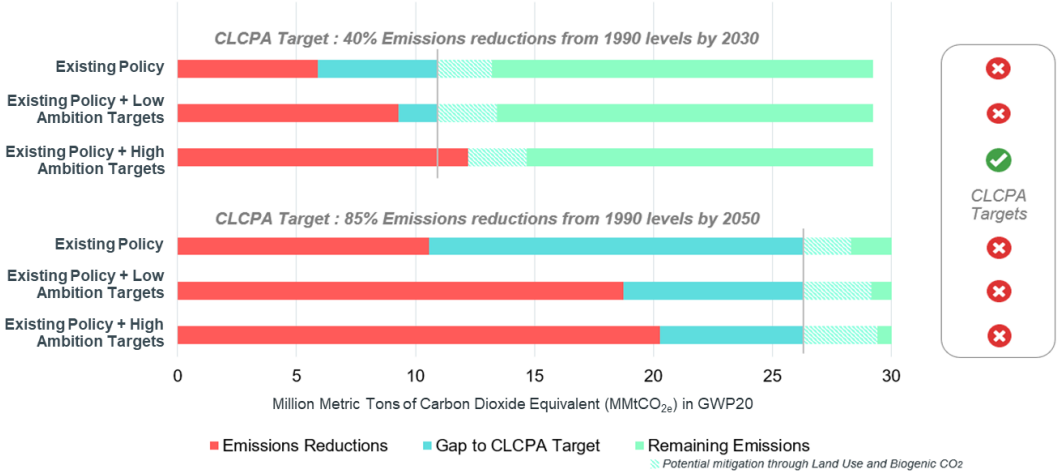
Figure 7-9: *Top mitigation measures in 2050 under the Existing Policy plus High Ambition Scenario (Scenario 3)*



7.4 Comparison of scenarios to CLCPA targets

A summary of the findings from the scenarios is presented in Figure 7-10 below. The existing policy plus high ambition scenario achieves the intermediate 2030 target from the proposed set of emission reduction measures in Table 6-1. As mentioned above, there are several scenarios that we were unable to quantify at this time. It is possible that the CLCPA goals could be achieved if additional data is made available to enable the quantification of all proposed measures.

Figure 7-10: *Comparison Between Regional Greenhouse Gas Emissions Mitigation Scenarios*



8 Conclusion and next steps

This analysis looked at three different packages of mitigation measures grouped into an existing policy scenario, existing policy and low ambition scenario and existing policy and high ambition scenario. Despite driving significant emissions reductions, none of the scenarios are sufficient in their current form to meet the 2050 emissions reductions goals set forth by the New York Climate Leadership and Community Protection Act. However, this does not mean it is not possible. As mentioned in Section 5, there are several measures that we were unable to quantify at this time. It is possible that the CLCPA goals could be achieved if additional data is made available to quantify all proposed measures. Additionally, with continued political action and enactment of policies such as the Inflation Reduction Act, it is possible that we will see increased rates of adoption beyond what is assumed in this analysis. Furthermore, with ongoing research and development into clean fuels and alternative livestock diets, there is potential for transport and agricultural emissions to be further reduced once these technologies and processes are commercially viable.

Despite long-term goals being out of reach, the analysis shows that short-term 2030 goals are achievable under the existing policy and high ambition scenario. The top climate measures to meet this goal include an immediate transition to a clean electricity grid, the replacement of gasoline and diesel vehicles with electric vehicles, an increase in manure storage and biogas capture, the electrification of building space heating systems, and more connected (walkable and bikeable) neighborhoods. Some of these measures match up with the vision that survey, focus group and workshop participants identified, including close-knit walkable and bikeable communities, more renewable energy and affordable, energy-efficient housing for all. Other measures that are important to the vitality of the community and should also be prioritized in the near-term include more green space and year-round, locally grown, affordable foods.

For any of these measures to be successful, there are a number of non-technical measures that are necessary, including collaborative land use planning, addressing inequality and affordability of measures, greater education and awareness on climate change, workforce development and small business support, funding and the implementation of energy codes and standards**.** In this way, not only can climate goals be met, but the values identified as important to the region can be upheld, such as greater connectedness, community, collaboration, equity, justice, affordability, inclusion and accountability.

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APPENDIX A

April 2021 Survey Questions

Appendix A: April 2021 Survey Questions

Question Number	Question Text
Q1	Many climate solutions can be used to address other areas of community need. To better understand what community needs, please select your top three priorities for our Region. • Access to clean water • Affordable housing • Air quality • COVID relief • Criminal justice/police reform • Drug abuse prevention or rehabilitation • Economic development • Education improvements • Employment opportunities • Energy costs • Eviction prevention • Extreme weather events • Food access/quality • Health care access/quality • Local government reform • Open space improvements • Racial justice • Recreational opportunities • Renewable energy development • Transportation improvements • Violence prevention/reduction • Other_____
Q2	Climate solutions can provide additional benefits to local communities. Select your top three priorities for solutions that both reduce greenhouse gas emissions and provide community benefits. • Active transit opportunities (e.g. bike lanes and sidewalks) that improve air quality by reducing the need for fossil fuel vehicles and improve the walkability of our communities • Agricultural practices that can increase agricultural yield and the availability of nutritious food while improving water quality of nearby waterways • Brownfield remediation projects that address environmental hazards and increase property values

Question Number	Question Text
	• Clean energy job opportunities that improve our infrastructure and provide above average wages and benefits • Composting programs that reduce harmful emissions by keeping food scraps out of landfills and generating sustainable sources of fertilizer • Efficient clean heating and cooling technologies that improve home comfort and indoor air quality by providing heat and air conditioning without burning fossil fuels • Electrical grid improvements that accommodate more renewable energy sources and reduce the likelihood of power outages • Energy efficiency and weatherization improvements that reduce household utility costs indoor air pollutants mold and pests while making the home more comfortable for residents • Land use planning decisions that locate amenities e.g. grocery stores urban farms/farmers markets and parks in local neighborhoods creating more walkable prosperous communities • Open space and green space development that provides recreational opportunities and reduces temperatures • Public transportation improvements that reduce commute times and improve access to jobs and services • Renewable energy projects that reduce our dependence on imported fossil fuels • Sustainability related research and development to position our Region as a leader in next generation energy technologies • Sustainability-themed businesses that provide local economic development opportunities • Other:_____
Q3	What is your level of knowledge or understanding about how climate change will impact our Region? • I don't care about how climate change will impact our Region. • Not at all knowledgeable • Not very knowledgeable • Somewhat knowledgeable • Very knowledgeable
Q4	What is your level of knowledge or understanding about what climate solutions are appropriate for our Region? • I don't care about which climate solutions are appropriate for our Region. • Not at all knowledgeable • Not very knowledgeable • Somewhat knowledgeable

Question Number	Question Text
	• Very knowledgeable
Q5	What is your level of knowledge or understanding about climate or environmental justice? • I don't care about climate or environmental justice. • Not at all knowledgeable • Not very knowledgeable • Somewhat knowledgeable • Very knowledgeable
Q6	What is your level of knowledge or understanding about how to access energy efficiency programming or incentives? • I don't care about accessing energy efficiency programming or incentives. • Not at all knowledgeable • Not very knowledgeable • Somewhat knowledgeable • Very knowledgeable
Q7	What is your level of knowledge or understanding about how to access renewable energy programs and incentives? • I don't care about accessing renewable energy programs or incentives. • Not at all knowledgeable • Not very knowledgeable • Somewhat knowledgeable • Very knowledgeable
Q8	In your opinion, which of the following would be most helpful for increasing the adoption of energy efficiency and clean heating and cooling technologies in residential properties? • Ban all gas hookups in new building construction. • Educate property owners about the importance of reducing energy use and the availability of programs that can help them reduce energy usage. • Increase financial incentives for weatherization measures (e.g. insulation and air sealing) and clean heating and cooling technologies (i.e., heat pumps). • Reduce paperwork and other requirements to simplify and streamline the process of enrolling in residential energy programs. • Require landlords to meet energy efficiency standards to receive a certificate of occupancy for a property.

Question Number	Question Text
	• Other:_____
Q9	In your opinion, which of the following transit options should be prioritized? • Expanding access to electric vehicle charging stations • Expanding bike lanes and bike paths • Expanding sidewalks and pedestrian plazas to create safer, more walkable communities • Expanding the geographic reach and efficiency of public transit • Other:_____
Q10	In your opinion, which of the following land use and development options should be prioritized? • Consolidate/merge local governments to better coordinate development and reduce inefficiency • High-density development that makes alternative transit (e.g., walking, biking, and public transit) more feasible, and preserves open space and agricultural lands • Inter-municipal and regional community planning that designates priority development and conservation areas, curbs inefficient development and over-development, revitalizes cities and villages, and preserves open space and agriculture • Overhaul current zoning codes and rules to increase flexibility, innovation, and access • Other:_____
Q11	In your opinion, which of the following agricultural practices should be prioritized? • Co-developing agricultural land for renewable energy projects (e.g., solar and wind projects) and agricultural production (e.g., sheep farming, beekeeping, fruit and vegetable production) • Convert waste to energy by using animal and crop waste to create biogas for electricity • Develop a soil health label similar to the organic label that indicates sustainable agricultural practices • Educate farmers about climate-friendly agricultural practices • Modify crop insurance programs to provide protections for farmers practicing climate-friendly agricultural production • Provide payment to farmers for ecosystem services (e.g., carbon sequestration, soil health, pollinator services, improving water quality) • Other:_____

Question Number	Question Text
Q12	In your opinion, which of the following technologies are appropriate for our Region? • Expanding hydrogen fuel cell production • Expanding nuclear production capabilities • Expanding renewable natural gas (or biogas) • Expanding solar farms • Expanding utility-scale energy storage facilities • Expanding wind farms
Q13	In your opinion, which of the following best captures why climate solutions have not been widely implemented in our community? • Many perceive that the necessary technology to address climate change has not yet been developed. • Public perceptions that the costs associated with addressing climate change exceed the benefits of taking action. • There is a lack of knowledge about local climate change impacts and potential solutions. • There is a lack of political will and community leadership in prioritizing climate change in our community. • Other:_____
Q14	In your opinion, how should we fund climate solutions? • Corporations should pay a carbon fee or taxes for greenhouse gas emissions. • Individuals should be willing to pay more for climate-friendly products and services. • The government should prioritize funding for climate solutions without raising taxes. • The government should raise taxes to fund climate solutions. • Other:_____
Q15	In your opinion, what is most needed to address climate change in our Region? • Education. People do not understand what needs to be done to address climate change. • Laws. People will not take action to address climate change unless required. • Leadership. People are hesitant to take action because they do not want to be the first in their communities to do so. • Money. The Region does not have the resources necessary to take action. • Other:_____

Question Number	Question Text
Q16	How willing are you to adopt sustainability measures in your own life/household? • Not at all willing • Not very willing • Somewhat willing • Very willing
Q17	What barriers prevent you from adopting sustainability measures in your own life/household? • I already take advantage/implement the full range of sustainability measures. • I do not have the necessary financial resources to implement sustainability measures. • I do not have the necessary knowledge to implement sustainability measures. • I do not have the necessary time to implement sustainability measures. • I do not own my own house and that largely prevents me from implementing sustainability measures. • Implementing sustainability measures is not something I am interested in. • Other:_____
Q18	If you could implement one solution to address a community or neighborhood need, what would it be?
Q19	What is your zip code?
Q20	Which of the following best describes you? Please select one answer. • White or Caucasian • Hispanic or Latino • Multiracial/Biracial • Black/African American • Asian or Pacific Islander • Native American or Alaskan Native • Other: _____
Q21	What is your household size? • 1 • 2 • 3 • 4 • 5

Question Number	Question Text
	• 6 • 7 • 8+
Q22	Which of the following best captures your annual household income? • <$25K • $25-$50K • $50-$75K • $75-$100K • $100-$125K • >$125K
Q23	What is your highest level of education completed? • Grade school • High School • Associates or trade degree • Bachelor's degree • Advanced degree
Q24	Which of the following best describes you? - Selected Choice • Woman • Man • Non-Binary • Prefer not to answer • Prefer to self-identify:_____

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