

Agriculture and Forestry Advisory Panel

Emissions Reduction and Carbon Sequestration Recommendations

April 5, 2021



**Climate Action
Council**

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Acronyms

AEM: Agricultural Environmental Management

AgNPS: Agricultural Non-point Source Pollution

BIPOC: Black Indigenous People of Color

CALS: Cornell College of Agriculture and Life Sciences

CCA: Certified Crop Advisors

CCE: Cornell Cooperative Extension

CNCPS: Cornell Net Carbohydrate and Protein System

CRF: Climate Resilient Farming

EJ: Environmental Justice

ENGO: Environmental Non-Governmental Organization

ESFPA: Empire State Forest Products Association

NASS: National Agricultural Statistics Service (USDA)

NRCS: National Resources Conservation Service (USDA)

NYGB: New York Green Bank

NYSSWCC: New York Soil and Water Conservation Committee

PES: Payment for Ecosystem Services

REDCs: Regional Economic Development Councils

SAF: Society of American Foresters

SUNYESF: State University of New York College of Environmental Science and Forestry

SWCD: Soil and Water Conservation District

TNC: The Nature Conservancy

USDA: United States Department of Agriculture

WI-DNR: Wisconsin Department of Natural Resources

WPDC: Wood Products Development Council

NYS Agencies and Authorities

AGM: Department of Agriculture and Markets

DEC: Department of Environmental Conservation

DASNY: Dormitory Authority of the State of New York

DOH: Department of Health

DOS: Department of State

DOT: Department of Transportation

DOTF: Department of Taxation and Finance

DPS: Department of Public Service

ESD: Empire State Development

HCR: Homes and Community Renewal

NYPA: New York Power Authority

NYSERDA: New York State Energy Research and Development Authority

OGS: Office of General Services

PANYNJ: Port Authority of New York and New Jersey

PSC: Public Service Commission

SWCC: NYS Soil and Water Conservation Committee

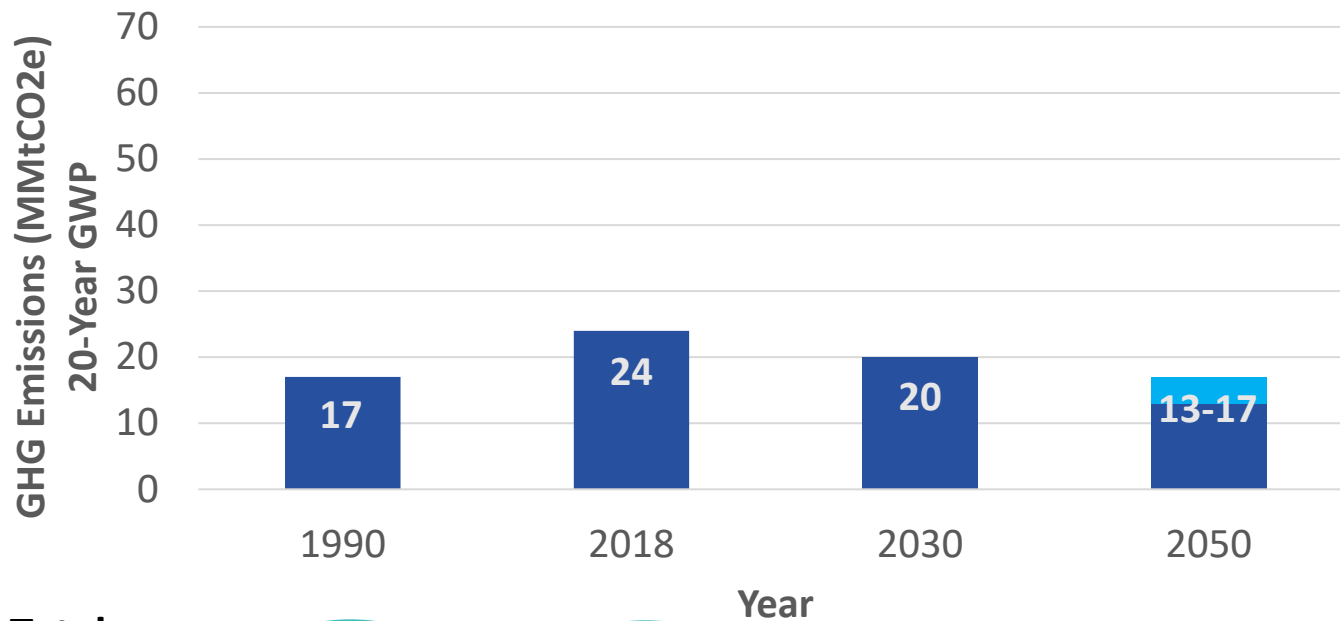
Description of Recommendation Types

From the Recommendations Guidance document

- > **Mitigation strategies:** actions that directly reduce emissions and contribute to the achievement of the greenhouse gas emission limits or carbon sequestration needed to achieve net zero, where applicable. Consider how the collective estimated emissions impact of these strategies amount to the Pathways reduction target for the panel (if applicable) and support attaining the greenhouse gas limits.
- > **Enabling initiatives:** actions without direct emissions benefit that enable or magnify the mitigation strategies, enhance climate justice, or just transition
 - Examples of such initiatives include outreach, education, and increasing awareness; capacity building; workforce development; and research and development.
 - While enabling initiatives do not need to be tied to specific mitigation strategies, an enabling initiative should be tied to specific mitigation strategies wherever possible.
- > **Adaptation and resilience strategies:** actions to help adapt to the effects of climate change and increase resilience to climate hazards
- > Not all panels will have all of these types of recommendations
- > While advisory panels should try to answer each question in the companion guidance document when filling in the recommendations template, there may be cases where not all questions are relevant or answerable. In such cases, it is fine to leave questions unanswered.

Aggregate GHG Emissions impact of Agriculture and Forestry panel recommendations

Estimated GHG Emissions
Agriculture



% of Total NY Emissions*



Scope (2018 Subtotal DRAFT):

- Agricultural Emissions: Livestock and Fertilizer (24 MMt)

Emission Reduction Goals

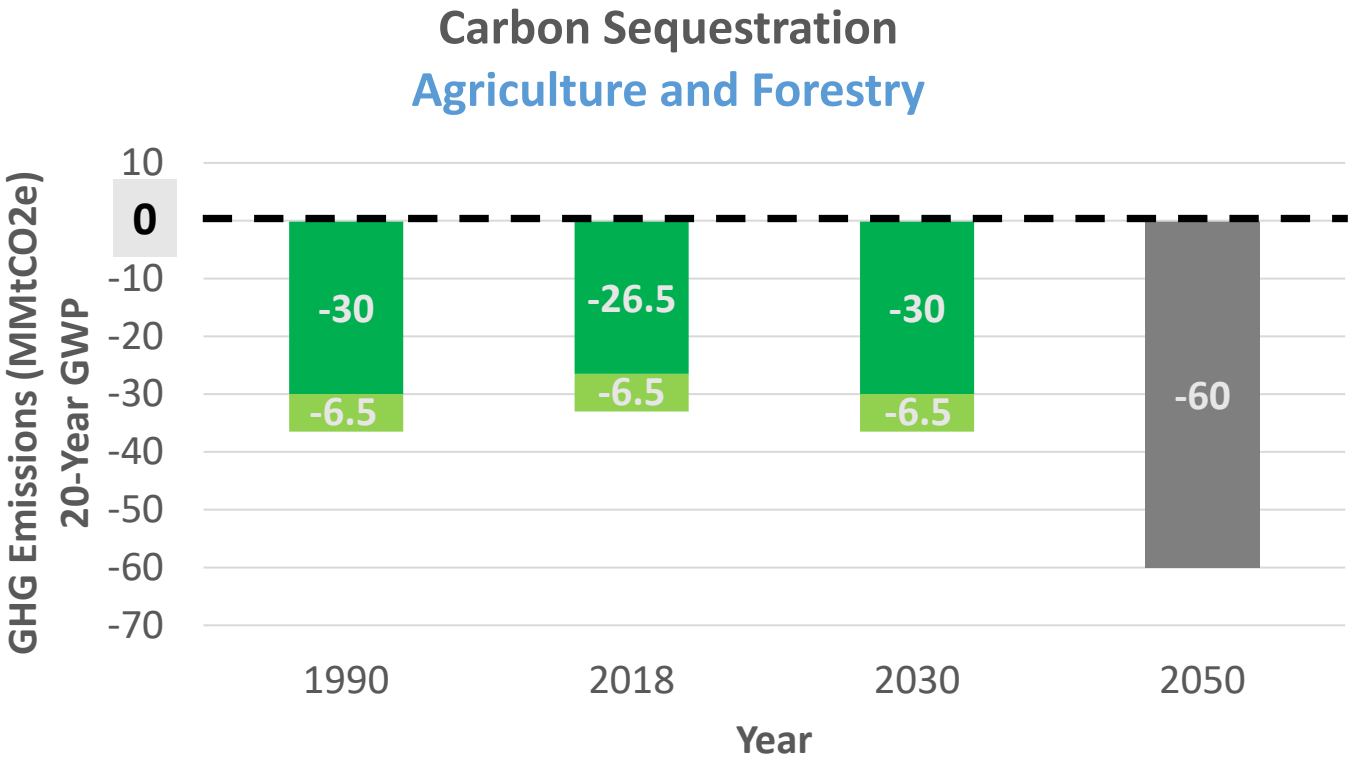
- 2030: Reduce 15% from current levels
- 2050:
 - Reduce 30% (return to 1990 levels)
 - Reduce 45% (additional ambition)

Additional Goals

- Avoid leakage by maintaining and enhancing agriculture in NYS
- Increase carbon sequestration on agricultural lands (next slide)

*Not including carbon sequestration.
2018 emissions data are preliminary draft

Carbon Sequestration impact of Agriculture and Forestry panel recommendations



Scope (2018 Subtotal DRAFT):

- Forestry and Agroforestry Sequestration (-26.5MMt)
- Cropland, Grassland, Urban Trees, Harvested Wood Products Sequestration (-6.5MMt)

Carbon Sequestration Goals

- 2030: No Net Loss Forests (= 1990 levels)
- 2050: Achieve full Net Zero Goal across all sectors in NYS by enhancing carbon sequestration in Agriculture and Forestry

Mitigation strategy summary – Agriculture

Initiative #	Description	Action type	Emissions impact	Ease of implementation	Cost
1A	Soil Health Management Practices (also referred to as Regenerative Agricultural Practices)	Executive/ Financial/ Legislative	Low – 2030 Medium - 2050	Easy-Hard	\$\$
2A	Nutrient Management	Executive/ Financial/ Legislative	Low-Medium – 2030 Medium-High- 2050	Easy-Medium	\$
3A	Alternative Manure Management	Executive/ Financial/ Legislative	Medium - 2030 High – 2050	Easy - Medium	\$\$
4A	Precision Feed, Forage and Herd Management	Executive/ Financial/ Legislative	Medium – 2030 Medium – High - 2050	Easy	\$
5A	Agroforestry	Executive/ Financial/ Legislative	Low-2030 Medium - 2050	Easy-Medium	\$\$

Mitigation strategy – Initiative 1A Soil Health: Overview

Description:	Reduce net GHG emissions and increase carbon sequestration/storage and other environmental benefits through <u>adoption</u> of soil health management practices (e.g., cover/double crops, reduced tillage, perennial crop systems. Also referred to as Regenerative Agricultural Practices).		
Action type:	Agricultural Emission Reduction/Sequestration (Executive, Legislative, Financial)		
GHG reduction by 2030:	Low	GHG reduction by 2050:	Medium
Cost and funding considerations:	\$\$, funding from Environmental Protection Fund (EPF) through Climate Resilient Farming (CRF) , Agricultural Environmental Management (AEM) Base Program, Agricultural Non Point Source Abatement and Control (AgNPS) Program (water quality), and other state and federal programs, seek new and enhanced funding sources, including private investments as many soil health practices have the potential to generate cost savings, improve yields and quality, and diversify farm products.		
Ease of implementation:	Easy, infrastructure and cost-share funding programs exist to support soil health including the implementation of regenerative farming practice systems; Medium, develop soil health standard to help further adoption of BMPs, develop an annual acre goal for the most common practices (cover and double crops/reduced tillage); Hard, quantification and verification tools.		
Example case studies:	Carbon Farm Study , Healthy Soils NY , Soil Health Characterization Report , Whole Farm Nutrient Mass Balance (Cornell Spear Program) , US Climate Alliance Toolkit, Carbon Reduction Potential Evaluation (CaRPE) Report		

Risks / Barriers to success	Possible mitigants
<ul style="list-style-type: none"> • Upfront costs to adoption • Uncertainty in potential mitigation and impermanence of increasing soil carbon – Difficult to verify • Proving additionality • Equipment affordability and access • Planting windows – highly dependent on weather conditions throughout growing season • Need for continued research, field trials, and pilot projects for data collection and monitoring • (Im)Balance of imports/exports of carbon (soil health) and nutrients at the farm, landscape, and regional scales • Practice adoption on rented/leased land 	<ul style="list-style-type: none"> • Increase CRF and AgNPS funding, increase payment rates and access to cost-share programs, increase technical assistance, • Increase adoption of soil health practices; Support cover & double-crop practices, encourage coupling of practices (e.g., no-till & cover cropping together) • Make efforts under Healthy Soils NY visible to farmers and public • Advance quantification and measurement and reporting tools • Advance research in perennial grain production • Convert annual cropland to perennial hayland/pasture where appropriate (e.g., steep slopes, highly erodible lands, etc.) • Expand on-farm planning to include site specific, explicit carbon sequestration goals • Establishing a Payment for Ecosystem Services (PES) mechanism to assist in incentivizing long-term adoption • Outreach to landowners to incentivize adoption of practices on rented lands

Mitigation strategy – Initiative 1A Soil Health: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Increase financial support for currently available and implemented practices - Expand funding for NYS CRF, AEM Base, AgNPS; increase payment rates, increase access, build equity into programs, increase technical assistance, encourage adoption of a system of practices, develop soil health standard, establish annual goal for common practices. Increase awareness and support for urban soils and agriculture.	NYSAGM, NYSSWCC, SWCDs	6-12 months	USDA, Cornell, CCE Farmers
Quantification and measurement - Develop tools for verification of benefits, invest in remote sensing to quantify adoption of practices.	NYSAGM, NYSSWCC, Cornell	1-2 years	SWCDs, USDA, NYSERDA, Farmers, ESF, TNC
Establish and maintain a comprehensive research, development, and demonstration strategy for monitoring and verification of soil health that address additionality and permanence to support State climate goals and enable Federal and private funding of GHG mitigation practices.	NYSAGM, NYSSWCC, Cornell	2-4 years	SWCDs, USDA, NYSERDA, Farmers, ESF, TNC
Support perennials - Convert annual cropland to perennial hayland/pasture and where appropriate (e.g., steep slopes, highly erodible lands, etc.).	NYSAGM, NYSSWCC, SWCDs	6-12 months	CCE, Farmers, USDA
Establish and maintain a comprehensive research strategy in soil health to bring new practices and approaches (e.g., enhanced rock weathering, biochar) that increase sequestration rates, productivity, other environmental benefits, and scale for adoption.	NYSAGM, Cornell, SUNYs, USDA	2-4 years	NYSSWCC, SWCDs, Farmers, Other Colleges and Universities
Support continued development and implementation of precision/digital agricultural tools and sustainable intensification, which is the sustainable increase in yields on current cropland to reduce stress on marginal cropland to support this mitigation strategy.	NYSAGM, NYSSWCC, Cornell, CCE, SWCDs	3-5 years	Farmers, NYSERDA, USDA

Mitigation strategy – Initiative 1A Soil Health:

Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
AEM Planning – Conduct comprehensive on-farm planning to include carbon sequestration goals, GHG emission, nutrient management, and soil health.	NYSAGM, NYSSWCC, SWCDs	continuous	Farmers, CCE, Cornell, USDA
Make efforts visible to farmers and public through outreach campaign making information more available, expand regenerative agricultural practices in marketing programs (e.g., NY Grown & Certified), improve information provided to public to help customers understand practices involved in products they purchase.	NYSAGM, CCE	1-2 years	NYSSWCC, SWCDs, Farmers
Expand education and outreach to include all farmers and to support practice adoption and encourage coupling of practices into systems for maximum benefit. Emphasize agricultural and soil health instruction in schools to connect students with farms and farmers and knowledge of ecological benefit of healthy soils.	NYSAGM, NYSSWCC, Cornell, SWCDs, CCE	continuous	USDA, NYSERDA, Farmers, ESF
Expand capacity of SWCDs and partners to aid on farm implementation of GHG reduction and sequestration management practices.	NYSAGM, NYSSWCC, SWCDs	continuous	Farmers, CCE, Cornell, USDA, Land Trusts, Non-Profits

Mitigation strategy – Initiative 1A Soil Health:

Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Identify practice systems that can generate revenue and/or added value to the farm, identify variety of public and private funding sources.	NYSAGM, NYSSWCC, Cornell, CCE, SWCDs	6-12 months	Farmers, NYSERDA, USDA
Peer to peer networking to elevate long-term adoption of SH practices (local farmer SH discussion groups). Seek feedback from groups/communities not currently engaged in practices and programs (e.g., holding focus groups or surveys, addressing urban soils and urban agricultural operations). Improving access reflects the need to ensure that all farmers can take part in these practices and programs.	NYSAGM, NYSSWCC, SWCDs, Cornell, CCE	6-12 months	Farmers, USDA, NYS Farm Bureau, NYFVI, Other farm organizations
Increase adoption on rented and leased land. Seek feedback regarding support needed for farmers not currently engaged in practices and programs. Engage, educate, and incentivize landowners to increase adoption of practices on land they rent to farmers.	NYSAGM, NYSSWCC, SWCDs, Cornell, CCE	6-12 months	Farmers, USDA, NYS Farm Bureau, NYFVI, American Farmland Trust, Other farm organizations
Establish a Payment for Ecosystem Services (PES) mechanism to provide a new structure for establishing and maintaining practice systems, to incentivize carbon sequestration, carbon storage, GHG reduction, and other environmental benefits.	NYSAGM, NYSSWCC, SWCDs	1-2 years	Farmers, USDA, Cornell, CCE

Mitigation strategy – Initiative 1A Soil Health: Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities

Increasing research, planning, technical services and financial assistance improves access to programs and effective practices for all farmers. The strategy will also prioritize disadvantaged communities by placing emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Components of the strategies include: considering a higher percentage of cost share funding for state programs designed to assist historically underserved farmers and/or creating program targets for funding for such farmers, in implementing GHG reductions strategies; collecting data on the number of farms in disadvantaged communities, the demographics of farmers in the state, and the experiences of minority farmers to allow greater access to programs and technical assistance.

Improvements in food production capacity, resiliency and diversity have a positive effect on disadvantaged communities. Additional focus will be on connecting availability of fresh, local food to disadvantaged communities through programs like NY Fresh Connect, farm to school programs, and others. Emphasize agricultural and soil health instruction in schools to connect students with farms and farmers and knowledge of ecological benefit of healthy soils.

Health and co-benefits

Increased soil health; increased farm viability; adaptation and resilience to extreme weather (increased water retention during drought and erosion prevention during extreme precipitation), potential profitability of harvesting a double-crop, and improved water quality due to nutrient and sediment retention.

Just transition: businesses and industries, workers

Inter-generational family transfer provides opportunities to encourage and incentivize soil health management practices. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers. This strategy will include youth engagement, internships, educational opportunities, public and private sector job creation through increased technical assistance and implementation (e.g., climate conservation corps, tree corps), and potentially on-farm job creation.

Other

Mitigation strategy – Initiative 2A Nutrient Management: Overview

Description:	Nutrient Management - Reduce nitrous oxide (N ₂ O) emissions while achieving desired crop yield and quality through continued and expanded nutrient management planning and implementation on crop fields, hay fields, pastures, orchards, vineyards, and other agricultural lands receiving nutrients.		
Action type:	Agricultural Emission Reduction (N ₂ O) (Executive, Financial, Legislative)		
GHG reduction by 2030:	Low-medium (based on fertilizer N and manure use efficiency)	GHG reduction by 2050:	Medium-high (based on fertilizer N and manure use efficiency)
Cost and funding considerations:	\$, funding from EPF through Climate Resilient Farming, AEM Base Program, AgNPS Program (water quality), other state and federal programs, and private sector investment where practices provide a reasonable return.		
Ease of implementation:	Easy for implementation of nutrient management. Medium for more advanced as well as future approaches.		
Example case studies:	Carbon Farming Report; N Fertilizer Mgt (Info Sheet #5);. Whole Farm Nutrient Mass Balance (Cornell Spear Program), US Climate Alliance Toolkit, CaRPE Report		
Risks / Barriers to success	Possible mitigants		
<ul style="list-style-type: none"> • New processes, technologies, costs, and returns to evaluate • Demands sustained, adaptive management by farmers and crop advisors for most benefit • Learning curve by farmers, crop advisors, and fertilizer industry • Gaps in applied research as well as field monitoring technology • Weather variability changes N efficiency performance • Lack of necessary equipment 	<ul style="list-style-type: none"> • On-farm research partnerships to continue to identify efficient, site specific management strategies (N eff. with crop yield and quality) • More public and private sector investment • More public and private sector planning capacity • Fertilizer industry-led priorities focused on 4Rs of nutrient mgt • Improved methods of monitoring performance via crop yield measurement and N use efficiency • Peer-to-peer crop yield and N efficiency contests • Crop insurance options 		

Mitigation strategy – Initiative 2A Nutrient Management:

Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Technical Assistance - Increase cost-share support for technical assistance (planning) and soil health/nutrient management practice implementation through AEM Programs, such as the Climate Resilient Farming Program. Seek feedback from groups not currently engaged in practices and programs to remove obstacles (e.g., holding focus groups or surveys).	NYSAGM, NYSSWCC, SWCDs	6-12 months	CCE, CCAs, Cornell, USDA, Fertilizer Industry, Farmers
Increase Financial Support - Expand cost-share eligibility in AEM Programs, such as the Climate Resilient Farming Program, for equipment needed by farms to implement more advanced soil health and nutrient management practices. Build equity into programs	NYSAGM, NYSSWCC, SWCDs	6-12 months	CCE, CCAs, Cornell, USDA, Fertilizer Industry, Farmers
Evaluation – Further use of improved methods of monitoring performance via crop yield measurement, N use efficiency, and Whole Farm Nutrient Mass Balances (NMB for farm-wide N management). Document benefits of NM to farmers, policymakers, and public.	Cornell, CCE, CCAs, Fertilizer Industry, Farmers	Continuous	NYSAGM, NYSSWCC, SWCDs
Collaboration with industry led Nutrient Management Initiatives/services. N efficiency x yield crop contests for peer-to-peer competition and informational opportunities.	Fertilizer Industry, CCA, Farmers, Cornell	Continuous	CCE, Cornell, USDA, NYSAGM, NYSSWCC, SWCDs

Mitigation strategy – Initiative 2A Nutrient Management: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Expand capacity of custom farming service providers to aid on farm implementation of nutrient management practices.	NYSAGM, NYSSWCC, SWCDs	6-12 months	CCE, CCAs, Cornell, USDA, NYSDEC, Fertilizer Industry, Farmers
Expand capacity of SWCDs and partners to aid on farm implementation of GHG reduction and sequestration management practices.	NYSAGM, NYSSWCC, SWCDs	Continuous	Farmers, CCE, Cornell, USDA, Land Trusts, Non-profits
Implement long-term funding support for nutrient management applied research and outreach (management approaches, technology, new inputs with lower GHG inputs, etc.).	Cornell, CCE, CCAs, Fertilizer Industry, Farmers	Continuous	NYSAGM, NYSSWCC, SWCDs
Increase outreach to all farmers, that's consistent with the research and technical standards used in NY, and make steps taken by farmers more visible to consumers.	Fertilizer Industry, CCAs, Farmers, CCE, Cornell, USDA, NYSAGM, NYSSWCC, SWCDs	6-12 months	
Continue and enhance training for planners and farmers.	NYSAGM, NYSSWCC, SWCDs, Cornell, CCE	Continuous	USDA, Farmers, CCAs

Mitigation strategy – Initiative 2A Nutrient Management: Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities

Increasing planning, technical services and financial assistance improves access to programs and effective practices for all farmers. The strategy will also prioritize disadvantaged communities by placing emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Components of the strategies include: considering a higher percentage of cost share funding for state programs designed to assist historically underserved farmers and/or creating program targets for funding for such farmers, in implementing GHG reductions strategies; collecting data on the number of farms in disadvantaged communities, the demographics of farmers in the state, and the experiences of minority farmers to allow greater access to programs and technical assistance.

Improvements in food production capacity, resiliency and diversity have a positive effect on disadvantaged communities. Nutrient management improves downstream community water resources, including disadvantaged communities.

Health and co-benefits

Nutrient management improvements have the potential to elevate local food production and resiliency, improve water quality, air quality, economic development and jobs.

Just transition: businesses and industries, workers

Inter-generational family transfer provides opportunities to incentivize changes in farm management for GHG emission reduction. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers. This strategy will include youth engagement, internships, educational opportunities, public and private sector job creation through increased technical assistance and implementation (e.g., climate conservation corps, tree corps), and potentially on-farm job creation.

Other

Mitigation strategy – Initiative 3A Alternative Manure Management: Overview

Description:	Alternative Manure Management - Reduce methane emissions by implementing practice systems specifically planned and designed for each farm, such as cover and flare systems, anaerobic digester systems, and other/innovative systems that collect, capture and combust methane from manure storages or prevent methane production from manure storage.		
Action type:	Agricultural Emission Reduction / (Executive, Financial, Legislative)		
GHG reduction by 2030:	Medium – High	GHG reduction by 2050:	High
Cost and funding considerations:	\$\$, funding from EPF through AEM Base, CRF, and AgNPS Program (water quality), Federal funds, private investment where practices provide a sufficient return, NYSERDA (related to energy generation)		
Ease of implementation:	Easy for systems with a track record of use in NYS and medium for more advance manure management systems.		
Example case studies:	Climate Resilient Farming Program; Carbon Farming Report; Manure Storage GHG Mitigation (Info Sheets #2 and #3); Cornell PRO-DAIRY Environmental Systems (research and on-farm case studies); NYSERDA Programs/projects.		

Risks / Barriers to success	Possible mitigants
<ul style="list-style-type: none"> • New processes, technologies, costs, and returns to evaluate • Storage retrofit and bedding challenges • Operation and maintenance necessary for optimal methane capture and combustion • Methane loss risk relative to ambient manure storage baseline • Gaps in applied research as well as in-field leak monitoring processes • Potential nutrient imbalances with increase in imported organic waste processing • Quantifying and verifying outcomes 	<ul style="list-style-type: none"> • AEM Planning – develop specific mitigation strategies for each farm • Performance based funding; building performance measures into access to public funds; include GHG monitoring into implementation of new GHG mitigation practices • Increase adoption of cover and flare systems for existing manure storages. Track performance of GHG reductions of completed projects • More public and private sector investment • More private sector engineering, technology, operation, and verification support. • Mitigation services for other sectors (e.g., food waste, energy) • Dairy farmer-led industry priorities toward net zero GHG • University and on-farm research partnerships to continue to identify effective, value-generating manure management systems for a range farm management scenarios

Mitigation strategy – Initiative 3A Alternative Manure Management: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Expand funding for NYS Climate Resilient Farming Program & AgNPS. Increase payment rates, access, technical assistance, and eligible manure management practice systems, build equity into programs.	NYSAGM, NYSSWCC, SWCDs	Ongoing	CCE, PEs, Cornell, NYSERDA, USDA, Farmers, Lenders
Expand funding for advancement of energy production, methane mitigation, including measurement and abatement of methane leakage, and future innovations based upon the recommendations from the biomass action plan.	NYSERDA	5 Years	NYSAGM, Farmers, PEs, Cornell, NYS DEC
Expand Public/Private Partnerships - Align manure management systems designed for energy production, organic waste management, and methane mitigation with markets (existing or future; LCFS; industry net zero initiatives; etc.) and private sector investment.	Industry, NYSAGM, PEs, Cornell, CCE, NYSERDA, USDA, Farmers, Lenders	5 Years	NYSSWCC, SWCDs
Increase technical assistance and engineering capacity for feasibility assessment, planning, design, operation, maintenance, and monitoring of systems.	Industry, PEs, Cornell, CCE, NYSERDA, USDA, NYSAGM, NYSSWCC, SWCDs	5 Years	Farmers, NYSDEC, Lenders
Refine policies to encourage new manure storages funded through the state programs to incorporate methane mitigation strategies including retrofit capacity.	NYSAGM, NYSSWCC, SWCDs	6-12 months	CCE, PEs, Cornell, NYSERDA, USDA, Farmers
Expand capacity of SWCDs and partners to aid on farm implementation of GHG reduction and sequestration management practices.	NYSAGM, NYSSWCC, SWCDs	Continuous	Farmers, CCE, Cornell, USDA

Mitigation strategy – Initiative 3A Alternative Manure Management: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Pursue further methane leakage research and monitoring to guide systems and management to minimize losses and optimize GHG reduction benefit.	NYSAGM, NYSERDA	Ongoing	CCE, PEs, Cornell, USDA, Farmers
Through training, expand capacity of technical service providers and farm staff to design, build, operate, and maintain alternative manure management systems.	NYSAGM, Cornell, PEs, SWCDs	1-2 years	CCE, NYSERDA, USDA, Farmers, NYS Farm Bureau, Other farm organizations
Implement long-term funding support for alternative manure management applied research and outreach, including processes for realizing additional value from manure and analyses for strategic development/siting of methane mitigating manure and organic waste management systems.	NYSAGM, NYSERDA, Cornell, NYSDEC	6-12 months	SWCDs, CCE Farmers, Pes
Develop a NYS-funded loan guarantee program to stimulate investment in alternative manure management systems.	NYSAGM, NYSERDA, Cornell, Lenders	1-2 years	NYSSWCC, SWCDs
Develop NYS-bulk buying programs to reduce core material and equipment costs (covers, flares, separators, standardized controls, other components, etc.). Similar to solar industry and energy efficient heating programs.	NYSAGM, NYSERDA, Industry	2-4 years	Farmers, NYSDEC, Lenders
Improve connections/markets between farms with alternative manure management systems and other businesses able to supply organic co-products or use products generated by such on-farm systems (e.g., electricity, heat, gas, organic soil amendments).	NYSAGM, NYSERDA, NYSDEC	1-2 years	CCE, PEs, Cornell, USDA, Farmers

Mitigation strategy – Initiative 3A Alternative Manure Management: Benefits

Anticipated Benefits and Impacts

Disadvantaged communities	<p>Increasing planning, technical services and financial assistance improves access to programs and effective practices for all farmers. The strategy will also prioritize disadvantaged communities by placing emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Components of the strategies include: considering a higher percentage of cost share funding for state programs designed to assist historically underserved farmers and/or creating program targets for funding for such farmers, in implementing GHG reductions strategies; collecting data on the number of farms in disadvantaged communities, the demographics of farmers in the state, and the experiences of minority farmers to allow greater access to programs and technical assistance.</p> <p>Improvements in food production capacity, resiliency and diversity have a positive effect on disadvantaged communities.</p>
Health and co-benefits	<p>Manure management improvements for methane mitigation have the potential to elevate local food production and resiliency, water quality, and air quality, economic development, energy, higher use of organic waste, and jobs by reducing the negative impacts of climate change from short-lived climate pollutants. NYSDEC regulates emissions from engines and flares associated with alternative manure management systems. Flares associated with ambient temperature covered manure storages are exempt from registration and permitting, because emissions, such as hydrogen sulfide, sulfur dioxide, nitrogen oxides, carbon monoxide, particulate matter, and volatile organic compounds, are below regulatory thresholds. Engines and flares associated with anaerobic digester systems process gases in higher concentrations, so such emissions are regulated via registration or permit for monitoring and compliance with State and federal air quality standards.</p>
Just transition: businesses and industries, workers	<p>Inter-generational family transfer provides opportunities to incentivize changes in farm management for GHG emission reduction. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers. This strategy will include public and private sector job creation through increased technical assistance and implementation (e.g., climate conservation corps, tree corps), and potentially on-farm job creation.</p>
Other	

Mitigation strategy – Initiative 4A Precision Feed, Forage and Herd Management: Overview

Description:	Precision Feed, Forage and Herd Management – Reduce methane and nitrous oxide emissions while achieving desired ruminant growth and lactation goals. Strategy acknowledges that additional methane emission reduction may be realized from feed additives developed in the future.		
Action type:	Agricultural Emission Reduction (methane and nitrous oxide) / (Executive, Financial, Legislative)		
GHG reduction by 2030:	Medium (based on feed and forage mgt. only; higher potential with future feed additives)	GHG reduction by 2050:	Medium (based on feed and forage mgt. only; higher potential with future feed additives)
Cost and funding considerations:	\$, funding from EPF through AEM Base, CRF, and AgNPS Program (water quality), Federal Programs, private investment where practices provide a sufficient return.		
Ease of implementation:	Easy for implementation of precision feed and forage management with continued and enhanced training delivered to farms/industry.		
Example case studies:	Carbon Farming Report; Dairy Manure Mgt and GHG Opportunities (Info Sheet #2); Cornell Net Carbohydrate and Protein System (CNCPS) research and extension; Precision Feed Management projects in NYC Watershed.		

Risks / Barriers to success	Possible mitigants
<ul style="list-style-type: none"> • New processes, technologies, costs, and returns to evaluate • Demands sustained, adaptive management by farmers and advisors for most benefit • Learning curve by farmers, advisors, and feed industry • Gaps in applied research • Weather and market disruptions can influence performance (low quality forage) 	<ul style="list-style-type: none"> • University and on-farm research partnerships to continue to identify efficient, site specific management and herd strategies • More public and private sector investment • More public and private sector planning capacity • Dairy farmer-led industry priorities toward net zero GHG. • Improved methods of monitoring performance throughout forage and feeding systems on farms

Mitigation strategy – Initiative 4A Precision Feed, Forage and Herd Management: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Expand outreach and education of precision feed and forage management to more ruminant livestock farmers, nutritionists, and feed industry professionals.	Cornell, CCE, Farmers, Independent Nutritionists, Feed Industry Nutritionists, CCAs, SWCDs, NRCS	Ongoing	Milk Cooperatives and Processors
Expand access to precision feed and forage management monitoring (e.g., for feeding, production, intake) and decision tools (e.g., CNCPS) applicable to a range of farm conditions and management. Increase on-farm use of methane module within CNCPS and develop statewide benchmarks to gauge improvement overtime.	Cornell, CCE, Farmers, Independent Nutritionists, Feed Industry Nutritionists, CCAs, SWCDs, NRCS	Ongoing	Milk Cooperatives and Processors
Expand capacity of SWCDs and partners to aid on farm implementation of precision feed and forage management practices.	NYSAGM, NYSSWCC, SWCDs	continuous	Farmers, CCE, Cornell, USDA

Mitigation strategy – Initiative 4A Precision Feed, Forage and Herd Management: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Implement long-term funding support for precision feed and forage management applied research and outreach (including basic and applied research for methane mitigating feed additives).	NYSAGM, NYSSWCC, Cornell, SWCDs	2 Years and Continuous	Milk Cooperatives and Processors
Explore establishment of a co-product market (e.g., food “wastes” supplied from food processors, retailers, or institutions) for best uses (including as livestock feed).	Food Processors, Food Retailers, Food Institutions, NYSDEC	2 Years	Cornell, CCE, Farmers, Independent Nutritionists, Feed Industry Nutritionists, NYSAGM
Develop a science-based strategy focused on improving herd management decision making which positively impacts cow efficiency to reduce GHG emissions while optimizing milk yield and return on investment. Provide technical assistance for implementation.	NYSAGM, Cornell CALS, PRO DAIRY	1-2 Years	Dairy farmers, NYSDEC, CCE, SWCDs, Farm organizations

Mitigation strategy – Initiative 4A Precision Feed, Forage and Herd Management: Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities	<p>Increasing planning, technical services and financial assistance improves access to programs and effective practices for all farmers. The strategy will also prioritize disadvantaged communities by placing emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Components of the strategies include: considering a higher percentage of cost share funding for state programs designed to assist historically underserved farmers and/or creating program targets for funding for such farmers, in implementing GHG reductions strategies; collecting data on the number of farms in disadvantaged communities, the demographics of farmers in the state, and the experiences of minority farmers to allow greater access to programs and technical assistance.</p> <p>Improvements in food production capacity, resiliency and diversity have a positive effect on communities.</p>
Health and co-benefits	<p>Precision feed and forage management improvements have the potential to elevate local food production. Feed and forage management can result in higher production, quality, and returns on investment, enhancing profitability and farm resiliency. Additional co-benefits include water quality improvements, air quality, economic development and jobs by reducing the negative impacts of climate change from short-lived climate pollutants.</p>
Just transition: businesses and industries, workers	<p>Inter-generational family transfer provides opportunities to incentivize changes in farm management for GHG emission reduction. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers. This strategy will include youth engagement, internships, educational opportunities, public and private sector job creation through increased technical assistance and implementation (e.g., climate conservation corps, tree corps), and potentially on-farm job creation.</p>
Other	

Mitigation strategy – Initiative 5A Agroforestry: Overview

Description:	Agroforestry - Adding trees into areas of agricultural production to reliably increase carbon sequestration and other environmental benefits.		
Action type:	Agricultural Emission Reduction/Sequestration (Legislative, Executive, Financial)		
GHG reduction by 2030:	Low	GHG reduction by 2050:	Low - Medium
Cost and funding considerations:	\$, funding from EPF through Climate Resilient Farming and AgNPS Program (water quality); Watershed-wide funding opportunities; Federal Funding, USDA Programs, (CSP, CRP, EQIP), private investment where practices provide a sufficient return.		
Ease of implementation:	Easy for implementation of buffers; Medium for silvopasturing and alleycropping; Medium for ensuring survivability of tree plantings		
Example case studies:	Buffers: AgNPS, USC Buffer Pilot, Watershed Groups; Silvopasture: CRF Program, CCE field research, Cornell Forest Connect; Plantation Silvopasture, Woodland Silvopasture) Angus Glen Farms, Schuyler County.		

Risks / Barriers to success	Possible mitigants
<ul style="list-style-type: none"> • Upfront costs to adoption • Land access and transfer • Workforce gaps • Gaps in research, field trials, pilot projects, and market analyses in agroforestry systems • Long-term management and maintenance • Tree species selection and survivability 	<ul style="list-style-type: none"> • Increase adoption of agroforestry practices; support (research (applied R&D & case studies of economics of practices), education, & technical asst) for farms diversifying operations (e.g., nut/orchard/maple/Christmas tree). that have revenue potential for farms • Set goals for acres of practices implemented (based on ~3M acres available land) # acres technically available & # acres feasible for implementation • Buffers: increasing incentives for implementation through existing programs; developing new incentive structures for buffers (PES), elevating workforce to plan, design, implement and <u>establish</u> buffers • Silvopasture: expand the Climate Resilient Farming Program to include a track for agroforestry/silvopasture; expand education and technical assistance; expand programs that plan, design and implement intensively managed rotational grazing systems • Alleycropping: conduct field trials and pilot projects, expand education and technical assistance

Mitigation strategy – Initiative 5A Agroforestry: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Expand NYS Climate Resilient Farming Program to include agroforestry track. Set acreage targets for priority practices.	NYSAGM, NYSSWCC, SWCDs	6-12 months	Cornell, CCE, USDA, Farmers
Continue emphasis on forested buffers through AgNPS and Source Water Buffer Program, USDA CRP/CREP.	NYSAGM, NYSSWCC, SWCDs, Land Trusts	6-12 months	USDA, Farmers, Watershed Coalitions, municipalities
Expand Trees for Tributaries Program, Non-Ag NPS, DEC Division of Fish and Wildlife Programs.	NYSDEC, NYSAGM, NYSSWCC	1-2 years	SWCDs, CCE, Farmers, Watershed Coalitions
Expand education and technical assistance for beginning farmers and generational transfer. Assist farmers with business planning and modeling. Expand supply chain development for new products.	NYSAGM, CCE, Cornell	continuous	American Farmland Trust, Land Trusts, CCE, SWCDs, Farmers, Landowners, Farm Bureau, Financial lenders, Watershed Coalitions
Alleycropping: conduct field trials and pilot projects, expand education and technical assistance.	NYSAGM, NYSSWCC, Cornell, CCE, SWCDs	2-4 years	Farmers, Farm Bureau, Other farm orgs.
Silvopasture: expand programs that plan, design, and implement intensively managed rotational grazing systems with a focus on proper site and species selection for adding trees.	NYSAGM, NYSSWCC, SWCDs, CCE	2-4 years	Farmers, NYSDEC, TNC, USDA

Mitigation strategy – Initiative 5A Agroforestry: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Establish a Payment for Ecosystem Services (PES) mechanism to provide a new structure for establishing and maintaining practice systems, to incentivize carbon sequestration, carbon storage, GHG reduction, and other environmental benefits.	NYSAGM, NYSSWCC, SWCDs	1-2 years	Farmers, USDA, Cornell, CCE
Farmland access: Assist farmers in securing long term leasing and farm transfer to beginning farmers – long term leases required for long term perennial systems.	NYSAGM, NYSSWCC, American Farmland Trust, Land Trusts	continuous	Cornell, CCE, Financial Lenders
Conduct outreach to financial lenders/insurance providers	NYSAGM, CCE, Cornell	continuous	Financial Lenders, American Farmland Trust, Land Trusts, SWCDs, Farmers, Landowners, NYFB
Collaboration with federal partners to better align federal and state policy priorities	NYSAGM, NYSSWCC, Cornell, CCE, SWCDs	2-4 years	Farmers, Farm Bureau
Expand capacity of SWCDs and partners to aid on farm implementation of GHG reduction and sequestration management practices.	NYSAGM, NYSSWCC, SWCDs	continuous	Farmers, CCE, Cornell, USDA

Mitigation strategy – Initiative 5A Agroforestry: Benefits and Impacts

Anticipated Benefits and Impacts

Disadvantaged communities

Increasing planning, technical services and financial assistance improves access to programs and effective practices for all farmers. The strategy will also prioritize disadvantaged communities by placing emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Components of the strategies include: considering a higher percentage of cost share funding for state programs designed to assist historically underserved farmers and/or creating program targets for funding for such farmers, in implementing GHG reductions strategies; collecting data on the number of farms in disadvantaged communities, the demographics of farmers in the state, and the experiences of minority farmers to allow greater access to programs and technical assistance.

Improvements in food production capacity, resiliency and diversity have a positive effect on disadvantaged communities.

Health and co-benefits

Agroforestry practice systems have the potential to elevate local food production, diversify farm incomes and increase farm profitability. Systems also provide resiliency, water quality, air quality, storm/flood mitigation, public infrastructure protection, drought resiliency, habitat, scenic vistas/tourism, market diversification, economic development and jobs.

Just transition: businesses and industries, workers

Inter-generational family transfer provides opportunities to incentivize changes in farm management for GHG emission reduction, improved access for historically underserved including, BIPOC and beginning farmers. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers. This strategy will include youth engagement, internships, educational opportunities, public and private sector job creation through increased technical assistance and implementation (e.g., climate conservation corps, tree corps), and on-farm job creation.

Other

Woody perennial buffers are small reliable practices that have a high value of carbon sequestration per acre. Silvopasture and alleycropping have the potential to increase income streams for farms, providing an economic return on investment.

Enabling (or Support) Strategy Summary – Agriculture

Initiative #	Description	Action type	Ease of implementation	Cost
1A	AEM Planning for Climate Mitigation/Adaptation, aka “Carbon Farm Planning”	Planning (Exec/Financial)	Medium	\$
2A	Establish a program for long-term, annual monitoring and benchmarking of GHG mitigation, carbon sequestration, and adaptation performance across applicable areas of management on farms in NYS. Information products provide useful, farm-level data for confidential benchmarking by farmers as well as publicly available data through farm case studies (with farmer agreement) and aggregated datasets to support future policy, research, and implementation.	Monitoring (Executive/Financial/Legislative)	Medium	\$\$

Enabling initiative – Initiative 1A: AEM Planning for Climate Mitigation/Adaptation, aka “Carbon Farm Planning”: Overview

Description:	AEM Planning for Climate Change Mitigation/Adaptation
Action type:	Planning/Evaluation/Estimating Impact (Executive/financial)
Cost and funding considerations:	\$; funding that supports AEM planning; expansion of models, planning framework, education and training of SWCDs and AEM planning workforce, pilot plans on various sizes and types of farms, potential for farmers to develop their own plans (also with training, minimum required standards, and at certain scales)
Ease of implementation:	Easy for overview planning; moderate for comprehensive planning, including forest management, energy consumption, feed management, etc.
Example case studies:	COMET Planner, COMET Farm, Forestry Management, NYSERDA Ensave Agricultural Energy Audits, CNCPS and Precision Feed and Forage Management Guidelines, CNMP Guidelines, USDA-NRCS Carbon Planning Guidance, other existing tools/guidelines

Risks / Barriers to success	Possible mitigants
<ul style="list-style-type: none"> • Funding for planning template • Maintaining strong emphasis on water quality and soil health planning, while planning for GHG and adaption • Workforce demands and gaps • Challenges with farmer interest or incentives for these planning efforts • Coarse models and quantification methodology • Challenges with matching scales and levels of planning rigor with various levels of yet defined goals/outcomes 	<ul style="list-style-type: none"> • Increase state and federal funding • Assemble technical advisory committee to develop planning protocols appropriate to scale(s) and accuracy(s) of existing models and methods, farmer interests/goals, and mitigation/adaptation goals • Develop protocols proportional to scale and accuracy of existing tools • Add GHG mitigation and climate adaptation to existing plans for water quality/soil health • Train additional SWCDs and AEM Planners for intentional climate mitigation/adaptation planning and implementation • Depending on applicability and scale, develop tools and train farmers to develop their own plans • Inform and educate farmers on climate impact and mitigation opportunity, match incentives to plans • Invest in model evaluation and development and quantification methods

Enabling initiative – Initiative 1A: AEM Planning for Climate Mitigation/Adaptation, aka “Carbon Farm Planning”: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Form technical advisory panel.	NYSAGM, NYSSWCC	6-12 months	Cornell, SWCDs, Farmers, USDA, CCE, NYSDEC
Technical advisory panel to define different levels of planning goals and outcomes (e.g., overview, whole farm scale; detailed management area scale; to inform directionally correct change; to inform change leading to quantifiable or even marketable outcomes; what information are farmers most interested in).	NYSAGM, NYSSWCC, Cornell, SWCDs, Farmers, NRCS, CCE, NYSDEC, NGOs	1-2 years	Other entities with mitigation/adaptation tools and methods
Technical advisory panel to develop planning protocols (including methods, preferred models, and recommended planner skills) for the levels defined, above. Iterative process, as some planning levels may not be supported by existing methods and models. Process will identify gaps for future development. Strive for compatibility among State and federal programs. Design methods for collection and aggregation of outcomes from planned and implemented practice systems (e.g., estimates for GHGs, sequestration, metrics for adaptation).	NYSAGM, NYSSWCC, Cornell, SWCDs, Farmers, NRCS, CCE, NYSDEC, NGOs	1-2 years	Other entities with mitigation/adaptation tools and methods

Enabling initiative – Initiative 1A: AEM Planning for Climate Mitigation/Adaptation: aka “Carbon Farm Planning”: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
On-farm piloting of those planning protocols deemed currently feasible by the panel (supported through AEM Base Program among Districts and farmers).	NYSAGM, NYSSWCC, SWCDs, Farmers	1-2 years	Cornell, NRCS, CCE, NYSDEC
Technical advisory panel reviews pilots and refines planning protocols.	NYSAGM, NYSSWCC, Cornell, SWCDs, Farmers, NRCS, CCE, NYSDEC, NGOs	2-3 years	Other entities with mitigation/adaptation tools and methods
Training of feasible planning protocols to public- and private-sector Ag service providers.	NYSAGM, NYSSWCC, Cornell, SWCDs, NRCS	2-3 years	
Communication of AEM Planning for Climate Mitigation/Adaptation with farmers (case studies, learning from pilot farmers, training on farmer developed planning protocols/tools, etc.).	NYSAGM, NYSSWCC, Cornell, SWCDs, Farmers, NRCS, CCE, NGOs	2-3 years	
Inclusion of planning protocols in AEM Base Program and perhaps federal programs for full use with farmers. Priority practice systems from plans lead to implementation via direct investment by farmers, other private investors, and/or lenders, as well as State and federal cost-share programs and incentives.	NYSAGM, NYSSWCC, SWCDs, NRCS, Farmers, NYS DEC	Continuous	Cornell, CCE, NGOs
Technical advisory panel uses new science and feedback from on-farm use to adapt, advance, train, and implement new planning protocols over time.	NYSAGM, NYSSWCC, Cornell, SWCDs, Farmers, NRCS, CCE, NYSDEC, NGOs	Continuous	Other entities with mitigation/adaptation tools and methods

Enabling initiative – Initiative 1A: AEM Planning for Climate Mitigation/Adaptation, aka “Carbon Farm Planning: Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities

Increasing planning, technical services and financial assistance improves access to programs and effective practices for all farmers. Emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Improvements in food production capacity, resiliency and diversity have a positive effect on disadvantaged communities.

Health and other co-benefits

AEM Planning for Climate Mitigation/Adaptation has the potential to elevate local food production and resiliency, water quality, air quality, storm/flood mitigation, public infrastructure protection, drought resiliency, habitat, scenic vistas/tourism, economic development and jobs.

Just transition: businesses and industries, workers

Inter-generational family transfer provides opportunities to incentivize changes in farm management for GHG emission reduction. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers. This strategy will include youth engagement, internships, educational opportunities, public and private sector job creation through increased technical assistance and implementation (e.g., climate conservation corps, tree corps), and potentially on-farm job creation.

Other

Enabling initiative – Initiative 2A: Benchmarking and Monitoring: Overview

Description:	A new program for long-term, annual monitoring and benchmarking of GHG mitigation, carbon sequestration, and adaptation performance across applicable areas of management on farms in NYS. Information products provide useful, farm-level data for confidential benchmarking by farmers as well as publicly available data through farm case studies (with farmer agreement) and aggregated datasets to support future policy, research, and implementation.	
Action type:	Program establishment and development (Executive/Financial/Legislative)	
Cost and funding considerations:	\$\$; Necessary annual costs likely to include staff and program overhead; incentives for farmer participation; costs of data products (e.g., remotely sensed data); cost for contractors where specialty services in information management, on-farm analyses, or applied research are necessary; and web service and IT expenses.	
Ease of implementation:	Medium; requires development of methods for efficient and meaningful monitoring, benchmarking (including establishing feasible performance goals), aggregated summarization, and delivery (communication at various scales). Expectation that methods will adapt with future knowledge and technology.	
Example case studies:	Whole Farm Nutrient Balance (Cornell Spear Program); Dairy Farm Business Summary (Cornell PRO-DAIRY and Farm Credit East); Precision Feed Management Benchmarking (Cornell and CCE); Ag Census and Annual Surveys (NASS); Soil Health Case Studies (American Farmland Trust); NYS and EPA GHG inventories.	
Risks / Barriers to success	Possible mitigants	
<ul style="list-style-type: none"> • New program development (ramp-up expenses: time, funding, defining best initial direction/methods, sample sizes, and scales for various areas of farm management) • Trust and participation among Ag-sector participants • Potential sampling bias stemming from subpopulation of participating farms 	<ul style="list-style-type: none"> • Experienced advisory committee to shape the program based on comprehensive knowledge of existing approaches, NYS agriculture, and CLCPA • Incentives for farm participation (useful for farm performance; pathway to other markets or programs; funding for participation; marketing benefit for farm; others) • Private sector partnership (e.g., dairy processors or co-ops) where goals align among programs 	

Enabling initiative – Initiative 2A: Benchmarking and Monitoring: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Establish funding line for a CLCPA agricultural benchmarking and monitoring program.	NYSAGM, NYSDEC	1 year	Cornell, NYSSWCC, Farmers, CCE, Farm Credit East, SWCDs, CCAs, NASS, food processors and co-ops
Co-develop methods for program (program staff and advisory committee).	NYSAGM, NYSSWCC Cornell, NYSDEC	1-2 years	ESF, Farmers, SWCDs, CCE, Farm Credit East, CCAs, NASS, TNC, American Farmland Trust, food processors and co-ops
Introduce program with farmers and farm advisors (field).	NYSAGM, NYSSWCC, Cornell	2-3 years	ESF, Farmers, SWCDs, CCE, Farm Credit East, CCAs, NASS, TNC, American Farmland Trust, food processors and co-ops
Initiate program with farmers.	NYSAGM, NYSSWCC, Cornell	2-3 years	ESF, Farmers, SWCDs, CCE, Farm Credit East, CCAs, NASS, TNC, American Farmland Trust, food processors and co-ops
Deliver data summaries for confidential farm-scale use and aggregated summaries for public use.	NYSAGM, NYSSWCC, Cornell	2-3 years	ESF, Farmers, SWCDs, CCE, Farm Credit East, CCAs, NASS, TNC, American Farmland Trust, food processors and co-ops
Repeat method annually.	NYSAGM, NYSSWCC, Cornell	Continuous	ESF, Farmers, SWCDs, CCE, Farm Credit East, CCAs, NASS, TNC, American Farmland Trust, food processors and co-ops

Enabling initiative – Initiative 2A: Benchmarking and Monitoring: Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities

This enabling initiative will increase access to methods/programs that help farmers generate their own farm-scale information for decision making, with an emphasis on assisting historically disadvantaged farmers, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Improvements in food production capacity, resiliency and diversity have a positive effect on disadvantaged communities.

Health and other co-benefits

Improved farm-level data and broader-scaled, aggregated information about farm management have the potential to elevate local food production and resiliency, water quality, air quality, storm/flood mitigation, public infrastructure protection, drought resiliency, habitat, scenic vistas/tourism, economic development and jobs.

Just transition: businesses and industries, workers

Inter-generational family transfer provides opportunities to incentivize changes in farm management for GHG emission reduction. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers. This strategy could include youth engagement, internships, educational opportunities, public and private sector job creation through increased technical assistance and implementation (e.g., climate conservation corps, tree corps), and potentially on-farm job creation.

Other

Mitigation Strategy Summary – Avoided Conversions

Initiative #	Description	Action type	Emissions impact	Ease of implementation	Cost
1	Keep Forests as Forests: Maintain and enhance the state's carbon sequestration potential through avoided forest conversion	Legislative (Budget, Programmatic); Regulatory	High	Easy for land acquisition. Difficult for new tax incentives and regulatory changes	\$\$\$

Mitigation strategy – Initiative # 1: Avoided Forest Conversion: Overview

Description:	Keep Forests as Forests: Maintain and enhance the state’s carbon sequestration potential through avoided forest conversion	
Action type:	Legislative (Budget, Programmatic); Regulatory	
GHG reduction by 2030:	High	GHG reduction by 2050: High
Cost and funding considerations:	\$\$\$: Land acquisition funding, tax incentives, staffing needed to implement land acquisition goals, administer tax incentive, implement regulations and provide technical assistance	
Ease of implementation:	Easy for land acquisition. Difficult for new tax incentive and regulatory changes	
Example case studies:		
Risks / Barriers to success	Possible mitigants	
<ul style="list-style-type: none"> • Dependent on passage of Legislation • Cost to taxpayers for acquisition and tax incentives • Landowner interest to participate varies • Nearly 700,000 forest landowners • Large number of municipalities/home rule • Potential tax base impact to municipalities • Sprawl needs to be managed effectively 	<ul style="list-style-type: none"> • State reimbursement of municipalities must be sufficient to address tax shift caused by Forest Tax Law • Prioritize conservation easements as appropriate, and provide resources for adequate long-term stewardship • Invest in partner capacity • Bolster local forest economies • Restore state open space conservation funding to historic levels (2008 Environmental Protection Fund included \$60 million), environmental bond act • Reinvigorate NYS Open Space planning process with emphasis on conservation as a climate strategy • Increasing focus of state economic development incentives to reduce sprawl and spur climate smart investments in community development 	

Mitigation strategy – Initiative #1: Avoided Forest Conversion

Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Land Acquisition (fee and conservation easement) by state, municipalities, land trusts	DEC	10 years	Municipalities, land trusts, communities, OPRHP, SUNY ESF
Statutory change to Real Property Tax Law amending current 480a and creating tracks including forest carbon management. Address deficiencies in current 480a to make program more attractive to private forest landowners, easier to administer, lower acre threshold, and further sustainability goals. (see Forest Management recommendations for further details)	DEC	3 years	DTF, DEC, Municipalities, Legislature, NYFOA, ESFPA, SAF, land trusts and NGOs, SUNY ESF
Keep Forests as Forests Law – Require mitigation of forest carbon loss due to conversion for development.	DEC	3 years	Municipalities, NYFOA, ESFPA, SAF, land trusts and NGOs, SUNY ESF
Forest Carbon Markets	TBD	5 years	Municipalities, NYFOA, ESFPA, SAF, land trusts and NGOs, SUNY ESF
<i>Note: LULG is leading on local land use recommendations.</i>			

Mitigation strategy – Initiative #1: Avoided Forest Conversion Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Continued sustainable management of NYS forests which maintains or increases forest carbon stocks, while producing an annual sustained yield of bio-based feedstocks from the forest.	DEC, AGM	Ongoing	CAFRI, SAF, NYFOA, ESFPA, SUNY ESF
Enhance local capacity for land conservation – Statewide authorization of Community Preservation Act (incl working lands), Conservation Partnership Program, etc.	DEC, AGM, municipalities	Ongoing	Land trusts, NGOs, SWCDs
Strengthen Right to Practice Forestry Law	DEC	1 year	Municipalities, DOS, ESFPA, NYFOA
Outreach and technical assistance to landowners on forest management, estate planning/intergenerational transfer, outreach to public on importance and contribution of working forestlands	DEC	Ongoing	SUNY ESF, Cornell, CCE, AGM, land trusts and NGOs, SWCDs
Research agenda to support avoided conversion – quantification for No Net Loss, prioritize conservation activities, monitoring to quantify policy impacts	DEC	1 year, ongoing	SUNY ESF, Cornell, AGM, land trusts and NGOs
State legislation to secure local government ability to maintain roads as minimum maintenance roads to reduce development pressure	Municipalities, DOT	1 year	Municipalities, landowners, DOS

Mitigation strategy – Initiative #1: Avoided Forest Conversion Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities

Include measures to increase access to land, resources, education, training, and incentives for BIPOC.
Include indigenous consultation and deeper community engagement
Payment of taxes on state-owned lands varies

Health and co-benefits

Air and water quality. Numerous [studies](#) in the U.S. and around the world are exploring the health benefits of spending time outside in nature, green spaces, and, specifically, forests. Reduce emissions from vehicle use from prevented sprawl development. Wildlife habitat, outdoor recreation, flood mitigation

Just transition: businesses and industries, workers

Include provision for alternative locations of housing and business development

Other

Allows lower and middle income landowners to keep their lands and manage them more sustainability. Harvested wood product markets support this strategy and are discussed in the Advance Markets for Sustainably Harvested Long-Lived Wood Products and Sustainable biomass feedstock action plan for 2050 hard-to-decarbonize products strategies. This strategy will be supported by the LULG Advisory Panel's recommendation on facilitating and supporting collaborative county-wide and regional smart growth comprehensive planning.

Inter-agency collaboration is occurring to advance renewable energy development in a way that avoids, minimizes and mitigates impact to prime agricultural soils, and forest carbon stocks and ecosystems.

Enabling strategy summary – Avoided Conversions

Initiative #	Description	Action type	Ease of implementation	Cost
1	Avoided agricultural land conversion - Maintain and protect the states' potential for carbon sequestration on agricultural lands through avoided farmland conversion	Legislative (Budget, Technical/ Programmatic)	Easy	\$\$
2	Bolstering Local Agricultural Economies	Legislative (Budget, Technical/ Programmatic)	Easy	\$-\$\$
3	Enhance local government planning for land conservation	Legislative, Technical Assistance	Easy	\$

Enabling strategy – Initiative #1: Avoided Agricultural Land Conversion: Overview

Description:	Maintain and protect the states’ potential for carbon sequestration on agricultural lands through avoided farmland conversion; enhance farm viability, increase food security, and implement smart growth to reduce future GHG emissions from Vehicle Miles Traveled.
Action type:	Legislative (Budget, Technical/ Programmatic)
Cost and funding considerations:	\$\$: Environmental Protection Fund, staffing needed to implement farmland protection goals and provide technical assistance
Ease of implementation:	Easy for land acquisition.
Example case studies:	US Climate Alliance Toolkit, Carbon Farm Study
Risks / Barriers to success	Possible mitigants
<ul style="list-style-type: none"> • Cost to taxpayers for acquisition of conservation easements and tax incentives • Landowner interest in selling their land or CE • Number of municipalities/home rule • Data for land conversion and quantification of GHG reduction • Land access and intergenerational transfer 	<ul style="list-style-type: none"> • Incentives for intergenerational transfer and farmland access • Incentives for intergenerational family transfer and support for farm succession. • Support for farmland protection and improved access for historically underserved including, BIPOC and beginning farmers • Youth engagement, internships and educational opportunities • Leasing state land to new farmers, prioritizing beginning, socially disadvantaged, limited resources and women farmers • Providing tax incentives for farmers to lease or sell land to qualified farmers, with a higher tax incentive for lease or sale to beginning, socially disadvantaged, limited resource and women farmers

Enabling strategy – Initiative #1: Avoided Agricultural Land Conversion: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Increase funding for Farmland Protection programs to plan for agriculture and purchase Development Rights (through conservation easements) by state, municipalities, and land trusts.	AGM	10 years	Farmers, Municipalities, land trusts, SWCDs
Farmland access: Assist farmers in securing long-term leasing and farm transfer to historically underserved including, BIPOC, beginning farmers, socially disadvantaged, limited resources, and women farmers. Support youth engagement, internships and educational opportunities.	AGM	Ongoing	Farmers, Municipalities, land trusts, SWCDs
Continue and strengthen agricultural assessment and agricultural districts programs	AGM	1 year	Farmers, Municipalities, land trusts, SWCDs
Enhance local capacity for land conservation – Statewide authorization of Community Preservation Act (incl working lands), Conservation Partnership Program, transfer of development rights, etc.	DEC, AGM, municipalities	Ongoing	Farmers, land trusts, SWCDs
Support and enhance farmland access and succession programs	AGM	Ongoing	Farmers, Municipalities, land trusts, SWCDs

Enabling strategy – Initiative #1: Avoided Agricultural Land Conversion: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Make connections between existing programs (e.g., AEM, CRF, AgNPS) to increase co-benefits. Target protected farmland for agricultural BMPs that reduce GHG emissions and sequester carbon like soil health management practice systems.	AGM, DEC, NRCS, FSA	Ongoing	Farmers, Municipalities, land trusts, SWCDs
Develop new data sets to support avoided conversion. Develop monitoring and quantification methodology to measure impacts of avoided conversion.	AGM, Cornell	1 year, ongoing	Cornell, SWCDs, Municipalities, farm owners, NRCS
Expand education and technical assistance for beginning farmers and generational transfer. Assist farmers with business planning and modeling. Expand supply chain development for new products.	AGM, CCE, Cornell, SWCDs	Ongoing	American Farmland Trust, Land Trusts, Farmers, NRCS, Landowners, Farm Bureau, Financial Institutions
State legislation to secure local government ability to maintain roads as minimum maintenance roads to reduce development pressure	Municipalities, DOT	1 year	Municipalities, DOS, landowners

Enabling strategy – Initiative #1: Avoided Agricultural Land Conversion: Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities

Increasing planning, technical services, and financial assistance improves access to programs and effective practices for all farmers. Emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Include indigenous consultation and deeper community engagement. Utilize existing programs that provide economic support to farms, like farmers markets or the Fresh Connect Checks Program, to connect vulnerable populations to healthy local food.

Health and co-benefits

Agricultural land protection captures carbon in the land base and prevents future emissions from vehicle use from prevented sprawl development. Protecting farmland has the potential to maintain or improve local food production, community resiliency, water quality, air quality, storm/flood mitigation, public infrastructure protection, drought resiliency, wildlife habitat, economic development and employment. All of these may have associated health benefits.

Just transition: businesses and industries, workers

Include provision for alternative locations of housing and business development (infill)
Improve the resiliency of communities by improving food security
Inter-generational family transfer, improved access for BIPOC and beginning farmers, youth engagement, internships and educational opportunities, public and private sector job creation, on-farm job creation.

Other

Reducing emissions from prevented sprawl development will only be achieved through strategic farmland protection, coupled with planning and smart growth.
This strategy will be supported by the LULG Advisory Panel's recommendation on facilitating and supporting collaborative county-wide and regional smart growth comprehensive planning.
Inter-agency collaboration is occurring to advance renewable energy development in a way that avoids, minimizes and mitigates impact to prime agricultural soils.

Enabling initiative – Initiative #2: Bolstering Local Agricultural Economies: Overview

Description:	Support emission reductions by enhancing existing programs, and promoting the expansion of those programs, that encourage farm viability and resilient communities through the production and consumption of local food
Action type:	Legislative (Budget, Technical/Programmatic)
Cost and funding considerations:	\$-\$\$: Funding needed to support programmatic needs and staffing
Ease of implementation:	Easy; supporting existing initiatives
Example case studies:	There is a lot of research on impacts of food miles, institutional purchasing of local products, community agriculture, etc.
Risks / Barriers to success	Possible mitigants
<ul style="list-style-type: none"> - Cost of expanding programs - Interest in participation from farms and communities 	<ul style="list-style-type: none"> - Promote expansion of farmers markets and incentive programs for disadvantaged communities such as seniors, veterans and SNAP recipients within these markets through programs like the Fresh Connect Checks Program and Farmers Market Nutrition Program - Improve implementation of the 2013 Food Metrics Law to enhance state procurement of local foods - Enhance urban food production and greening efforts through programs such as the Community Gardens Program - Connect institutions, like schools, universities, food banks, hospitals and prisons, who procure large volumes of food from out of state to local buying opportunities through initiatives like Farm-to-School and Nourish NY

Enabling initiative – Initiative 2: Bolstering Local Agricultural Economies: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Expand existing programs in the state that support local procurement of NYS agricultural products (e.g., Fresh Connect Checks Program, Farmers Market Nutrition Program, Farm-to-School, Nourish NY).	AGM; OGS; ESD	0-3 years depending on resources	Institutions, NGOs, SWCDs
Engage with communities and producers to advertise these opportunities	AGM- Council on Hunger and Food Policy; ESD	0-3 years depending on resources	Municipalities, NGOs, Agricultural Associations , SWCDs
Expand education and technical assistance for beginning farmers and generational transfer. Assist farmers with business planning and modeling. Expand supply chain development for new products.	NYSAGM, CCE, Cornell	Continual	American Farmland Trust, SWCDs, Farmers, Landowners, Farm Bureau, Financial lenders

Enabling initiative – Initiative #2: Bolstering Local Agricultural Economies: Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities	Provide additional resources to existing programs that connect vulnerable populations, such as SNAP recipients and underserved communities of color, to healthy local food. Emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Improvements in food production capacity, resiliency and diversity have a positive effect on disadvantaged communities.
Health and other co-benefits	Increase the availability of local nutritious food to mitigate and prevent chronic disease. Potential to elevate local food production, diversify farm incomes and increase farm profitability. Systems also provide community resiliency, water quality, air quality, storm/flood mitigation, public infrastructure protection, drought resiliency, wildlife habitat, scenic vistas/tourism, market diversification, economic development and employment. All of these may have associated health benefits.
Just transition: businesses and industries, workers	Improve the resiliency of communities by improving food security Support economic viability of farms to maintain agricultural careers
Other	

Enabling initiative – Initiative #3: Enhance local government planning for land conservation: Overview

Description:	Encourage and provide guidance for the inclusion of farmland and forestland protection in municipal comprehensive plans. Require inclusion of farmland and forestland protection in state funded municipal comprehensive plans. Encourage and fund development of Natural Resource Inventories.
Action type:	Legislative, Technical Assistance
Cost and funding considerations:	\$ - Technical assistance staff, grants, support for Environmental Management Committees and Conservation Advisory Councils.
Ease of implementation:	Easy – enhance existing programs
Example case studies:	Smart Growth program, Hudson River Estuary Program (HREP)

Risks / Barriers to success	Possible mitigants
Home rule Resources needed for planning	Replication of HREP style support across state Support planning through Smart Growth and other programs

Enabling initiative – Initiative #3: Enhance local government planning for land conservation: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Develop guidance for the inclusion of farmland and forestland protection in municipal comprehensive plans. Require inclusion of farmland and forestland protection in state funded municipal comprehensive plans. Fund development of Natural Resource Inventories.	DOS, DEC, AGM	3 years	Municipalities, municipal associations, NGOs, SWCDs, SUNY ESF
Technical Assistance to implement guidance effectively, including strategies and best practices for land conservation, and identifying priority areas for conservation. Encourage development of Natural Resource Inventories.	DOS, DEC, AGM	Ongoing	municipalities, municipal associations, NGOs, SWCDs, ESFPA, NYFOA, SUNY ESF

Enabling initiative – Initiative #3: Enhance local government planning for land conservation: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Create resources to support local and regional smart growth planning and decision-making (e.g., maps to identify suitable reforestation locations, highest value cropland, idle lands for farming, etc.)	DOS, DEC, AGM	Ongoing	municipalities, municipal associations, NGOs, SWCDs, SUNY ESF
Conduct quantitative survey of land resources across the state and identification of critical barriers including options of using idle and underutilized lands.	DOS, DEC, AGM	Ongoing	municipalities, municipal associations, NGOs, SWCDs, SUNY ESF

Enabling initiative – Initiative #3: Enhance local government planning for land conservation: Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities	<p>Include recreational access as a component of forest planning. Include farm and forest land access for disadvantaged communities including BIPOC. Include indigenous consultation and deeper community engagement. Food security enhanced by keeping land in farming in communities.</p>
Health and other co-benefits	<p>Air and water quality. Maintain food and crop production in NYS communities, maintain carbon sequestration of farm and forest land in NYS. Numerous studies in the U.S. and around the world are exploring the health benefits of spending time outside in nature, green spaces, and, specifically, forests. Wildlife habitat, outdoor recreation, flood mitigation. Avoided vehicle emissions from avoided development. Increase the availability of local nutritious food to mitigate and prevent chronic disease.</p>
Just transition: businesses and industries, workers	<p>Include provision for alternative locations of housing and business development (infill) Improve the resiliency of communities by improving food security</p>
Other	<p>This strategy will be supported by the LULG Advisory Panel’s recommendation on facilitating and supporting collaborative county-wide and regional smart growth comprehensive planning.</p>

Mitigation strategy summary – Forest Management

Initiative #	Description	Action type	Emissions impact	Ease of implementation	Cost
1	Maintain and increase carbon sequestration in NYS forests by securing forest regeneration, improving forest health and productivity, and restoring degraded forests through the widespread adoption of improved, sustainable forest management practices	Statutory, Incentives	High. 3.3-11.0 million metric tons of CO ₂ e per year	Medium	\$\$-\$\$\$
2	Increase forested acres through afforestation and reforestation efforts to establish climate adapted and resilient forests. There are potentially 1.7 million acres of marginal lands available for establishing forests.	Statutory, Incentives	High 5-12 million metric tons CO ₂ e per year	Medium	\$\$\$
3	Increase and maintain tree cover in urban and developed areas to reduce energy use and corresponding GHG emissions through the shading and cooling effect of trees. Increase carbon sequestration through tree establishment and extending the average life of urban trees through improved maintenance.	Statutory, Incentives	Medium	Medium	\$\$

Mitigation strategy – Initiative #1:

Improved, Sustainable Forest Management: Overview

Description:	Maintain and increase carbon sequestration in NYS forests by securing forest regeneration, improving forest health and productivity, and restoring degraded forests through the widespread adoption of improved, sustainable forest management.		
Action type:	Legislative (RPTL 480a), Regulation, Incentive		
GHG reduction by 2030:	Carbon sequestration-High.	GHG reduction by 2050:	Carbon sequestration-High
Cost and funding considerations:	\$\$-\$\$\$\$. Substantial investment in NYS forests and forest sector over current levels. Overall cost will depend on state reimbursement levels to local municipalities under current and new tax abatement programs. Increase in funding to cost share and grant programs for private landowners, current and future forest health mitigation efforts and increases in funding to improve forest management on state and municipal lands. Increase agencies staffing levels to deliver and manage programs. Goal of 5 million acres under professional management by 2030 through these proposals		
Ease of implementation:	Medium. Mechanisms, practices and programs for improved forest management exist. Mitigation costs per acre can be high due to invasive species and regeneration issues. Strategy needs to be delivered on a such a scale to improve millions of acres of existing forest to have a significant carbon impact		
Example case studies:	Vermont Current Use Program, Family Forest Carbon Program, FLEP and EQIP, Working Woodlands		
Risks / Barriers to success		Possible mitigants	
<ul style="list-style-type: none"> • High cost to private landowners in time and money • High cost to local municipalities and state budget • Immense, scale of effort to reach 13.6 million acres of privately owned forest • Low landowner interest or skepticism in government programs • Workforce gaps in private and public sectors • The unpredictability of current and future forest health threats • Lack of landowner knowledge of public and private forestry programs 		<ul style="list-style-type: none"> • Diverse, private wood markets • Simplifying programs and removing administrative barriers for landowners • Private industry/public partnership for funding grants/cost sharing projects • State reimbursement to local governments must be sufficient for tax incentives to work • Building forest resiliency measures into all efforts and programs • Creative Financing through NY Green Bank or creation of Forest Carbon Bank • Widespread landowner outreach 	

Mitigation strategy – Initiative #1: Improved, Sustainable Forest Management: Components

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
<p><u>Create a new RPTL 480b real property tax incentive</u> to allow private forest landowners to manage for multiple benefits (e.g., wildlife habitat) and, if desired, conserve their forests in natural conditions to participate in tax programs. Tax benefit to landowners increases as the years of commitment increase, recognizing the accumulated sequestration benefits over time. 25-acre eligibility. A carbon forest management plan written by a carbon certified forester is required if harvesting. Initial benefit starts at a lower level than 480a and 480c. Up to 100% reimbursement to local municipalities.</p>	DEC	3 years	Legislature, NYFOA, ESFPA, SAF, NGO's, Landowners, NYS Tax and Finance, Local municipalities, SUNY ESF
<p><u>Create a real property tax incentive, RPTL 480c</u> to provide forest landowners a tax incentive to undertake practices that increase carbon stocks while addressing need for additionality. A carbon forest management plan written by a carbon certified forester is required if harvesting. 25-acre eligibility. Practice and/or forest carbon inventory based. Tax benefit to landowners increases as the years of commitment increase, recognizing the accumulated sequestration benefits over time. Up to 100% reimbursement to local municipalities</p>	DEC	3 years	Legislature, NYFOA, ESFPA, SAF, NGO's, Landowners, NYS Tax and Finance, Local municipalities, SUNY ESF
<p><u>Amend 480a statute and regulations</u> to induce greater landowner participation and integrate stronger sustainability provisions (e.g., forest regeneration). The primary goal remains to encourage sustainable timber management. Tax abatement benefit for landowners remains unchanged. Up to 100% reimbursement to local municipalities.</p>	DEC	3 years	Legislature, NYFOA, ESFPA, SAF, NGO's, Landowners, NYS Tax and Finance, Local municipalities, SUNY ESF

Mitigation strategy – Initiative #1: Improved, Sustainable Forest Management: Components

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Enhance agency and partner capacity to deliver free forest carbon and forestry technical assistance and education programs (e.g., Forest Stewardship Program, AEM, PRISM, Master Forest Owners, etc.) to forest landowners. Improve agency and partner coordination in delivery and reporting of forestry services to maximize efficiency	DEC/CCE/SWCD/NGO's/ SUNY ESF	1 Year	SWCD NYFOA, ESFPA, SAF, NGO's, CCE, Landowners, USDA
Expand funding for cost share programs, such as Regenerate NY and AEM to assist forest landowners in widespread implementation of project-based practices to protect and increase carbon stocks on private forestland. Projects would focus on forest regeneration, restoring degraded forests and installation of best management practices for forest carbon.	DEC/CCE/SWCD/AGM/ NGO	1 year	Legislature, SWCD NYFOA, ESFPA, SAF, NGO's, Landowners, USDA
Establish caches across the state to allow operators to borrow forestry and logging equipment and devices on a short-term basis needed for implementing best management practices during logging operations.	DEC, SWCD, NGO, Wood Products Development Council	1-2 Years	SWCD, Industry, NGO's
Provide funding for low interest loans or grants for upgrading to new logging or manufacturing equipment to facilitate, increased utilization, improved forest management or best management practices (e.g. lower site impacts). Example: Machine tracks for wheeled harvesters to lower soil impacts.	Wood Products Development Council, NGO's	1 year	Legislature, SWCD NYFOA, ESFPA, SAF, NGO's

Mitigation strategy – Initiative #1: Improved, Sustainable Forestry: Components

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
<p>Increase prevention of invasive forest pests and diseases entering New York and the U.S (e.g. SMART trade). Work with federal and state partners to strengthen regulations, inspection and enforcement of wood packaging material and live plant imports. Improve surveillance for forest health and disease</p>	<p>DEC</p>	<p>1-2 years</p>	<p>USDA-APHIS, AGM, ESFPA, SAF,</p>
<p>Reduce the loss of forest carbon due to acute forest health issues on private and public forest. Facilitate an increase in capacity for rapid response teams for forest pest and disease outbreaks (e.g., ALB) or invasive vegetation issues that negatively impact forest carbon (e.g. forest regeneration).. Priority would be on intervening where rapid, extensive loss of forest carbon sequestration capacity could occur.</p>	<p>DEC</p>	<p>1 year</p>	<p>Legislature, SWCD NYFOA, ESFPA, SAF, NGO's</p>
<p>Create a NY Forest Carbon Bank. A carbon bank would allow New York State to finance Greenhouse Gas (GHG) reduction and carbon sequestration activities by NYS farm forests and forest landowners by allowing entities to buy tons of carbon from forest landowners generated through improved land management practices that increase carbon sequestration.</p>	<p>DEC, NYSERDA</p>	<p>1-2 years</p>	<p>Legislature, SWCD NYFOA, ESFPA, SAF, NGO's/SUNY ESF</p>

Mitigation strategy – Initiative #1: Improved, Sustainable Forestry: Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities	Strategy will benefit rural economically disadvantaged communities, including those in EJ areas, by improving the forest-based economy and increasing job opportunities. Allows lower to middle income landowners to hold on to their lands, maintain open space, keep forest as forest, and sustainably manage their lands.
Health and co-benefits	Numerous studies in the U.S. and around the world are exploring the health benefits of spending time outside in nature, green spaces, and, specifically, forests. Co-benefits to this strategy include avoided forest conversion, supporting forest and forestry sector jobs in rural communities, improved forest ecosystem resiliency and soil health, improved forest productivity, enhancing wildlife habitat, protecting water quality, maintaining rural character and providing public recreational opportunities.
Just transition: businesses and industries, workers	Mitigation strategy would expand the opportunities available to forestry-based businesses in rural areas of New York; by increasing the demand for forestry services including natural resources professionals, certified herbicide applicators, forestry equipment operators, and mill operators. Ancillary benefits of forest recreation and forest-based recreation businesses.
Other	Sustainability measures already in place or being developed through this strategy are integral to many of the proposed Bioeconomy recommendations.

Mitigation strategy – Initiative #2: Afforestation/Reforestation: Overview

Description:	Increase forested acres through afforestation and reforestation efforts to establish climate adapted and resilient forests. There are potentially 1.7 million acres of marginal lands available for establishing forests.		
Action type:	Regulation (DEC, AGM), Incentive (DEC, AGM)		
GHG reduction by 2030:	Carbon Sequestration-High	GHG reduction by 2050:	Carbon Sequestration-High
Cost and funding considerations:	\$\$\$\$. Upgrading state tree nursery capacity. Costs of labor, trees, tree protection and long-term maintenance. Specialized tree planting equipment will be needed. Increased staffing and volunteers.		
Ease of implementation:	Hard. Need to identify priority acres where afforestation and reforestation are likely to succeed. Seek out opportunities for enhancing natural afforestation success. Long term maintenance on private lands is needed for long term survivorship of established forests		
Example case studies:	CCC efforts in the 1930's and 40's planted around 300,000 acres in NYS		
Risks / Barriers to success		Possible mitigants	
<ul style="list-style-type: none"> • High Cost • Challenge of establishing resilient forests • Many competing land uses for marginal lands (agriculture, development) • Very labor intensive to establish forests either by planting or natural means • Workforce gaps in private and public sectors • Current nursery capacity needs to increased • Deer herbivory is costly to control and increases tree mortality • Seed and seedling availability (lag time for nursery stock) • Term of enrollment must be sufficient to deliver benefit 		<ul style="list-style-type: none"> • Private industry/public partnership for funding projects • State of the Art Marketing Campaign • Reforestation resources and services covered for landowners; landowners provide land • Corp or internships, technology to reduce labor costs • Federal Assistance • Investments in nursery capacity and seeding technology • Statewide deer management and local controls (e.g., hunting, culling, fencing) • Increased investment in PRISMs, tree-smart trade, and other related strategies 	

Mitigation strategy – Initiative #2:

Afforestation/Reforestation: Components

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Establish NY Tree Corp (or Climate Corp) to provide direct tree establishment and maintenance services to public and private landowners. Regionally based Tree Corp would be provided with staff and equipment to establish and maintain seedlings at no or low cost.	SWCD/DEC/AGM	3 years	Legislature, NYFOA,SWCD, ESFPA, SAF, NGO's, landowners, USDA
Expand cost share funding for existing tree establishment and maintenance programs such as Regenerate NY and AEM programs. These existing programs can help move reforestation/afforestation efforts forward while larger efforts, such as the NY Tree Corp become established.	DEC/SWCD/AGM	1-2 years	Legislature, SWCD, USDA NYFOA, ESFPA, SAF, NGO's
Increase state tree nursery capacity to support large scale afforestation and reforestation efforts. Upgrade to expand tree species offerings to meet adaptation and resiliency challenges. Enhance seed collection and storage efforts, seedling production, workforce development, pre- and post-planting practices.	DEC	3 Years	Legislature, NYFOA,SWCD, ESFPA, SAF, NGO's, landowners
Develop an opportunity assessment to identify areas where afforestation and reforestation are likely to succeed. Seek out opportunities for enhancing natural afforestation success, which could be more economical	DEC/SWCD/AGM/SUNY ESF/	3 years	Legislature, NYFOA,SWCD, ESFPA, SAF, TNC, NGO's
Expand or create new, free tree seedling programs such as Buffer in a Bag programs to assist landowner with smaller project areas. Explore partnerships with local governments and regional organizations to scale up programs.	DEC/SWCD	2 years	Legislature, NYFOA, ESFPA, SAF, NGO's

Mitigation strategy – Initiative #2: Afforestation/Reforestation: Components

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
<p>Work with public and private partners on reforestation efforts in ROW areas of the state. Focus on tree and shrub species compatible with power transmission and distribution right of way's, roadside areas, pipelines, railroads, etc. Public outreach for right tree, right place is needed.</p>	<p>DEC, NYPA</p>	<p>1-2 years</p>	<p>NYPA, DOT, Municipalities, ISA (UAA), Industry</p>
<p>Tree Planting Equipment Loan Program to allow landowners and operators access to specialized equipment for small- and large-scale tree planting projects.</p>	<p>SWCD/DEC</p>	<p>1-2 years</p>	<p>Legislature, SWCD, NYFOA, ESFPA, SAF, NGO's</p>
<p>Enhance agency and partner capacity to deliver technical assistance and education programs to landowners. Assist with planting plans, site and species selection. Promote tree planting programs. Increase partner cooperation to meet requests, ensure minimal overlap of services, capture accomplishments and coordinate efforts.</p>	<p>DEC/CCE/SWCD/AGM/NGO</p>	<p>1 year</p>	<p>Legislature, NYFOA, ESFPA, SAF, NGO's</p>
<p>Investment in seeding and seeding technology to fill in smaller forest gaps where needed. Drone, robotic technology to distribute seeds in areas regeneration needs to be supplemented after a treatment.</p>	<p>DEC</p>	<p>1-2 years</p>	<p>Legislature, NYFOA,SWCD, ESFPA, SAF, NGO's</p>

Mitigation strategy – Initiative #2: Afforestation/Reforestation: Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities

Strategy will benefit rural, economically disadvantaged communities, including those in EJ areas, by improving the forest-based economy and increasing job opportunities. Provides valuable job experience and training in tree planting and forestry sector through volunteer opportunities, internship and full and part time jobs in rural areas

Health and co-benefits

Numerous [studies](#) in the U.S. and around the world are exploring the health benefits of spending time outside in nature, green spaces, and, specifically, forests. Co-benefits to this strategy include avoided agricultural conversion, supporting forest and forestry sector jobs in rural communities, improved forest ecosystem resiliency and soil health, improved forest productivity, enhancing wildlife habitat, protecting water quality, and maintaining rural character.

Just transition: businesses and industries, workers

Mitigation strategy would expand the opportunities available to forestry-based businesses in rural areas of New York; by increasing the demand for forestry services including natural resources professionals as well as certified herbicide applicators, tree planters and forestry equipment operators. Increased job opportunities from expanded public and private nursery capacity.

Other

Mitigation strategy – Initiative #3: Urban Forestry: Overview

Description:	Increase and maintain tree cover in urban and developed areas to reduce energy use and corresponding GHG emissions through the shading and cooling effect of trees. Increase carbon sequestration through tree establishment and extending the life of urban trees through improved maintenance.		
Action type:	Emission Reduction and Carbon Sequestration		
GHG reduction by 2030:	Medium	GHG reduction by 2050:	Medium
Cost and funding considerations:	<p>\$\$\$. Increasing grant funding to communities and expanding to individual landowners. Higher cost of establishing urban trees vs. planting trees in fields. Increased staffing resources for program delivery.</p>		
Ease of implementation:	Medium. Sustained tree maintenance after establishment in harsher environments. Most urban and community trees are privately owned		
Example case studies:			

Risks / Barriers to success	Possible mitigants
<ul style="list-style-type: none"> • Requires staff to manage additional workload • Sufficient availability of trained individuals to perform tree work • Sufficient availability of resources/ equipment to perform tree work. • Availability of suitable growing stock to plant • Ensuring survival of trees planted. • Most urban and community trees are privately owned 	<ul style="list-style-type: none"> • Utilizing third party project/ grant managers (not for profits) to handle multiple projects on a regional level • Work with professional organizations (ISA, TCIA, for profit training groups) to develop training programs that can be rolled out statewide • Develop guidance and work with other agencies/ municipalities to establish shared resources such as equipment caches

Mitigation strategy – Initiative #3:

Urban Forestry: Components

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Increase funding levels of Urban and Community Forestry Grants to assist local municipalities in the management of the urban forest which includes planning, planting and maintenance of trees, Provide funding opportunities for private individuals to establish and maintain privately owned trees.	DEC	1-2 years	Local communities, arborists
Develop guidance and provide support to local communities to establish or expand youth and young adult conservation corps that employ and train disadvantaged youth and provide a source of skilled labor for increasing, maintaining and improving the management of the urban forest	DEC, SWCD,	1-2 years	NY Society of Arboriculture, local governments, non-profit organizations
Develop an opportunity assessment to focus tree establishment and maintenance efforts within urban areas and communities where the most climate, societal, and public health benefits are likely to be achieved.	SUNY ESF, SWCD, DEC, CCE	1-2 years	Legislature, NYFOA, SWCD, ESFPA, SAF, NGO's
Develop guidance and provide support and funding to local communities for planning and implementing planting and maintenance projects that help communities adapt to climate change. This may include sharing resources (equipment, staff, bulk ordering, etc.). This will help communities maintain critical ecosystem services like flood mitigation, clean air, clean water, reduced sediment and nutrient runoff, reduced energy use, shade and improved human health	DEC, Cornell CALS/SUNY ESF	1 year	DOS, ESD, nonprofit organizations, local governments, USDA

Mitigation strategy – Initiative #3:

Urban Forestry: Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities	Urban communities in EJ areas will benefit from increased tree canopy and open spaces through increased public health benefits, property values, reduced energy costs, and recreational opportunities. A community engaged in urban forestry activities improves the overall quality of life.
Health and co-benefits	Numerous studies in the U.S. and around the world have shown and continue to explore the mental, physical and societal health benefits of spending time outside in nature, green spaces, and —specifically— forests. Significant co-benefits to this strategy include urban forests more resilient to the negative impacts of climate change; Overall improved public health, mitigation of heat island effects, and providing public recreational opportunities
Just transition: businesses and industries, workers	Provides increased volunteer and job opportunities to local communities. Services for arborists, tree service and utility line workers could increase based on increased tree maintenance activities. This strategy will create more livable communities throughout New York.
Other	

Enabling strategy summary – Forest Management

Initiative #	Description	Action type	Ease of implementation	Cost
1.	Expand funding for peer reviewed climate, forest carbon and applied forest management research	Scientific Research	Medium	\$-\$\$
2.	Develop and support workforce development and training programs for forest sector workers to enable an increase demand in forestry services to be met. Incorporate forest carbon and forest carbon management into training programs and forestry curriculums at the high school (e.g., BOCES) and college level.	Training, Implementation	Medium	\$
3.	Facilitate the development of a forest-based culture and economy through state-of-the-art outreach, education and marketing techniques to inform the public and policy makers about forest and forest carbon issues	Outreach and Education	Hard	\$-SS

Enabling initiative – Initiative #1: Climate and Forest Carbon Research: Overview

Description:	Expand funding for peer reviewed climate, forest carbon, and applied forest management research
Action type:	Research
Cost and funding considerations:	\$-\$\$\$. Provide funding for researchers, facilities, assistants and equipment needed to sustain a robust forest carbon research effort over time.
Ease of implementation:	Medium. Sustaining funding over time and during difficult economic times.
Example case studies:	

Risks / Barriers to success	Possible mitigants
<ol style="list-style-type: none"> 1. Sustaining funding for long term forest research 2. Biased research to further a particular agenda 3. Public and policy-makers education in forestry and climate issues 	<ol style="list-style-type: none"> 1. Identifying long term public and private funding sources, such as forest industry, private foundations, and state budget 2. Published peer reviewed research as a measure of success 3. Creating new ways to disseminate or demonstrate results

Enabling initiative – Initiative #1: Climate and Forest Carbon Research: Components

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Support research needs of improved forestry management mitigation strategies. Focus on peer reviewed forestry and forest carbon research in New York State Forests, such as improving forest resilience and vigor, regeneration and forest soil carbon.	Cornell CALS/SUNY ESF, DEC	1-2 years	AGM, CCE, WPDC NYFOA, ESFPA, SAF, USDA, TNC/ENGOS
Develop a suite of forestry practices designed to improve forest carbon sequestration in New York forests. Practices would be deployed across state funded forestry programs to achieve consistency.	Cornell CALS/SUNY ESF, DEC	1-2 years	CCE, NYFOA, ESFPA, SAF, USDA, WPDC, TNC/ENGOS
Develop efficient, cost effective monitoring and verification systems for accurately measuring forest carbon to evaluate practices and programs over time.	Cornell CALS/SUNY ESF, DEC	1-2 years	CCE, NYFOA, ESFPA, SAF, USDA, WPDC, TNC/ENGOS
Research using science-based decision systems that enables the leveraging of climate change investments to make more efficient and cost-effective decisions on forest-based climate change initiatives.	Cornell CALS/SUNY ESF, DEC	1-2 years	CCE, NYFOA, ESFPA, SAF, USDA, WPDC, TNC/ENGOS

Enabling initiative – Initiative #1: Climate and Forest Carbon Research: Components

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Research on the most cost-effective methods of using trees and short rotation woody crops (e.g., shrub willow, miscanthus) to sequester carbon on marginal lands.	Cornell CALS/SUNY ESF, DEC, AGM	1-2 years	CCE, NYFOA, ESFPA, SAF, USDA, SWCD, TNC/ENGOS
Increase urban forestry and forest carbon research to maximize the carbon and other benefits of establishing and maintaining urban forests. Focus on	Cornell CALS/SUNY ESF, DEC	1-2 years	CCE, NYFOA, ESFPA, SAF, USDA, TNC/ENGOS
Fund research into long term new and emerging Natural and Working Lands solutions to meet our 2050 goals.	Cornell CALS/SUNY ESF, DEC, AGM	1-2 years	CCE, NYFOA, ESFPA, SAF, USDA, TNC/ENGOS
Increase research into emerging forest products and forest product markets as it relates to bioeconomy and harvested wood product initiatives	Cornell CALS/SUNY ESF, DEC, WPDC	1-2 years	CCE, NYFOA, ESFPA, TNC/ENGOS

Enabling initiative – Initiative #1: Climate and Forest Carbon Research: Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities

Provide research employment and volunteer opportunities for students from disadvantaged communities. Demonstration sites or projects could be in EJ areas for urban forestry projects.

Health and other co-benefits

Improving sustainable forestry practices lead to healthier, more productive forests. Research universities and institutions are local economic engines that support the local communities they are located in. They also often include educational programming and events for the general public.

Just transition: businesses and industries, workers

May provide increased job opportunities based on the new products or methods developed through research efforts. Forest sector workers may find new types of positions.

Other

Enabling initiative – Initiative #2: Workforce Development: Overview

Description:	Develop and support workforce development and training programs for forest sector workers meet an increase demand in forestry services. Incorporate forest carbon and forest carbon management into training programs and forestry curriculums at the high school (e.g., BOCES) and college level.
Action type:	Training and Education
Cost and funding considerations:	\$. Private/Public funding partnership opportunity. Increase funding to Wood Products Development Council, forestry colleges, BOCES. Some federal funding may be available.
Ease of implementation:	Medium. Existing programs are in place that could be scaled up and expanded. Some additional areas of need may need to be identified.
Example case studies:	

Risks / Barriers to success	Possible mitigants
<ol style="list-style-type: none"> 1. Liability insurance at facilities 2. Lower paying, more dangerous jobs 3. Cost of training and education to the worker, student or employer 4. Long term success of moving trainees/students into careers 	<ol style="list-style-type: none"> 1. Using state, federal or PPP funding to cover training and education costs to eliminate barriers for employers and individuals 2. Improve on safety training within programs 3. Provide state support to bolster programs 4. Evaluate how many student/trainees go into and remain in forestry careers

Enabling initiative – Initiative #2: Workforce Development: Components

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Improve Cooperating Consulting Forest Policy, CP-36: Require continuing education in forest carbon or forest carbon management. Improve the rigor and accountability of the program	DEC	1 Year	SAF, NYFOA, ACF, SUNY ESF
Provide funding for climate change, forest carbon management, and silvicultural training for forestry and natural resources professionals in the public and private sector.	DEC	Ongoing	SWCD, SAF, ESFPA, CCE, SUNY ESF
Forest Carbon Certification Program: Qualified participants would receive a certification credential that allows them to work under state funding forestry and forest carbon programs.	DEC	1 Year	SAF, ACF, ESFPA, SUNY ESF
Lower the initial fee or provide cost share dollars for forestry workers to obtain their NYS Pesticide Applicator's license	DEC or WPDC	1-2 years	CCE, SAF, ACF, ESFPA
Support and bolster existing state, NGO, or industry urban forestry and utility forestry training programs. Integrate forest carbon and forest carbon management into programs	DEC	1-2 years	ISA, Releaf, SUNY ESF, Public Utilities, Industry
Provide support for existing training apprenticeship programs for careers in forestry and forest product across the entire supply chain from the woods to the mill. Incorporate forest carbon and forest carbon management into training programs and forestry curriculums at the high school (e.g., BOCES) and college level.	Wood Products Development Council	1 Year	Paul Smiths College, SUNY ESF, BOCES, Workforce Development Institute (WDI)
Bolster state support for Trained Logger Certification to develop and implement new training modules around improved forestry practices including forest carbon best management practices (BMP's) designed to increase carbon sequestration(e.g. reduced soil carbon loss through improved harvesting techniques).	DEC	1-2 years	TLC, ESFPA, SUNY ESF

Enabling initiative – Initiative #2: Workforce Development: Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities

Increased job opportunities in rural economically disadvantaged communities. Initiative supports local workers and economy to remain in local communities and NY state by providing the skills necessary to succeed. Keeps local forest industry and manufacturing knowledge intact to position itself to take advantage of new, emerging markets.

Health and other co-benefits

Initiative increases logger safety through training and through increased availability of newer, safer, modern equipment. A better trained forest sector workforce will improve implementation of forestry and climate strategies. Co benefit also include improved water quality, forest productivity and increased public confidence in foresters and loggers.

Just transition: businesses and industries, workers

Maintaining employment in natural resource sectors and related industries. Prevents displacement of workers and industries.

Other

Enabling initiative – Enabling initiative – Initiative #3: Outreach and Education: Overview

Description:	Facilitate the development of a forest-based culture and economy through state-of-the-art outreach, education and marketing techniques to inform the public and policy makers about forest and forest carbon issues	
Action type:	Education and Implementation	
Cost and funding considerations:	\$ - \$\$\$. The cost of sustained state-of-the-art marketing campaigns, social and traditional media, training, and increase in trained outreach staff.	
Ease of implementation:	Medium. Behavior change takes time and requires research-based strategies. Behavior change strategies have been successfully implemented for an array of campaigns	
Example case studies:	Wisconsin DNR, TELE	
Risks / Barriers to success	Possible mitigants	
<ol style="list-style-type: none"> 1. Technical concepts and language 2. Misinformation and opposing public perceptions 3. Potential increased costs to consumers associated with bioeconomy products 4. Proper technical guidance on tree establishment/maintenance for municipalities, tree company's, utilities and general public 	<ol style="list-style-type: none"> 1. Stewardship and Cooperating Forester Outreach Training 2. Happy Little Tree Marketing Campaign 3. Bio-Economy Promotion 4. Increase urban forestry outreach efforts 	

Enabling initiative – Initiative #3: Outreach and Education: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Stewardship and Cooperating Forester Outreach Training: Provide public and private foresters with training, technical assistance, and resources on landowner engagement and climate change.	Cornell CALS/SUNY ESF, DEC	1 year	SWCD, NYFOA, ESFPA, MFO/CCE, TNC/ENGOS
Bio-Economy Promotion: Engage social media influencers and wood product manufactures to promote NYS wood products as trendy, local, and sustainable. This includes supporting and promoting traditional wood products, emerging markets and urban wood utilization	Wood Products Development Council, SUNY ESF	2 years	DEC, AGM, ESFPA
Build public acceptance for forest management and increase the adoption of climate focused private forest management. Communicate clear and simple messages that connect forestry and management to the things people value (clean air, water, recreation, etc.).(e.g Happy Little Trees Marketing Campaign)	Cornell CALS/SUNY ESF, DEC	2 years	MFO/CCE, NYFOA, TNC ENGOS
City and Municipality Engagement: Provide outreach messaging toolkits to urban foresters, city planners, and local officials. Toolkits will focus on the climate and other co-benefits of urban forests, private forest management, and local wood products.	DEC	1 year	Municipalities, SUNY ESF

Enabling initiative – Initiative #3: Outreach and Education: Components of the strategy

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Bolster urban forestry and natural resource education and outreach, especially in underserved communities. Residents in underserved communities are often skeptical of government led improvement projects. Identify and work with local partners.	DEC	1-2 Years	Local government, no nprofit organizations, SUNY ESF
Increase the promotion of urban forestry and tree care through TreeLine USA for utilities, TreeCity USA for communities and Tree Campus for college campuses. Support increased ReLeaf efforts in communities across the state.	DEC	1-2 Years	ReLeaf, Arbor Day Foundation, Municipalities, Private and Public Universities, Public Utilities, Industry, SUNY ESF

Enabling initiative – Initiative #3: Outreach and Education: Benefits and impacts

Anticipated Benefits and Impacts

Disadvantaged communities

Promotion of a bio-based, forest economy is likely to indirectly support the economic wellbeing of rural New Yorkers and may provide opportunities to low-income communities in those areas.

Health and other co-benefits

There is research to suggest that the use of wood products in the built environment has benefits for human health. One such study can be [found here](#).

Just transition: businesses and industries, workers

Training foresters in better communication practices is likely to enhance the skillsets of natural resource professionals. Outreach tools for municipalities and natural resource professionals will serve to enhance landowner engagement and can indirectly expand opportunities for the forest industry.

Other

Planned communication strategies for natural resource professionals is likely to improve outcomes for private landowners. Private landowners will benefit from a better trained workforce and a suite of outreach tools that provide them with a better understanding of the benefits and risks of forest management.

Enabling strategy summary - Bioeconomy

Initiative #	Description	Action type	Ease of implementation	Cost
1	Expand Markets for Sustainably Harvested Durable Wood Products	Market development, Research	Medium	\$\$
2	Sustainable biomass feedstock action plan for 2050 hard-to-decarbonize products	Research and Planning	Medium	\$
3	Increasing market access for NY low-carbon products	Market development; Research	Hard	\$\$
4	Financial and Technical Assistance for Low-Carbon Product Development	Technical support, financial incentives	Easy/Medium	\$\$
5	Bio-based Products Research Development & Demonstration Overview	Research initiative, pilots	Medium	\$
6	Net Negative Carbon Dioxide Removal	Research and policy development	Hard	\$\$

Enabling initiative – Expand Markets for Sustainably Harvested Durable Wood Products

Description:	Advance the use of high value timber for long lasting products while advancing forest health and forest carbon sequestration. Displace GHG-intensive building materials (steel, concrete) with durable wood products (carbon sequestered in cross-laminate timber, hard wood floors) that reduces the net building and infrastructure GHG and provide long duration carbon storage
Action type:	Market development, Research
Cost and funding considerations:	\$\$ (\$25M - \$100M)
Ease of implementation:	Medium;
Example case studies:	other states like Maine and Oregon have embraced mass timber, Canada too

Risks / Barriers to success	Possible mitigants
<ul style="list-style-type: none"> • Current building codes limit the area (square footage), height, and number of floors that be built with mass timber • Cost of construction compared to other methods • No plants currently operate in NYS, meaning construction material would need to arrive ready to use, or a plant would need to be established to process materials • Limited softwood supply for mass timber in NYS means raw material would likely need to be imported • Lifecycle benefits uncertainty for some use cases • Architects and builders do not have as much experience with mass timber and other low carbon bio-based building products 	<ul style="list-style-type: none"> • Accelerate the code revision cycle and adopt the 2021 International Building Code • Incentivize the use of mass timber construction which has long duration carbon sequestration benefits and provides a substitute for high carbon materials (e.g., concrete) • Expand the current efforts of SUNY ESF, to have mass timber dormitories on SUNY campuses • Use mass timber construction in the new DEC Environmental Stewardship building at the Great NYS Fair • Sponsor pilot construction and retrofit efforts to educate builders alongside lifecycle analysis and economic quantification to more clearly demonstrate benefits

Enabling initiative – Expand Markets for Sustainably Harvested Durable Wood Products

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Advance building code changes to adopt the International Code Council 2021 International Building Code	DOS, NYC DOB,	2-3 years	NYSERDA, USGBC, SUNY ESF
Enhance NYS supply chain for harvested wood products; fund innovation to develop mass timber applications using northern hardwoods	SUNY ESF/Cornell CALS, NYSERDA,	5-10 years	ESFPA,WPDC, DEC; ESD, AGM
Revise state procurement specifications that limit the eligibility of wood products that meet the technical performance standards	GreenNY, OGS, DEC, DASNY	2-3 years	SUNY, DOCC, OMH, HCR, NYSERDA, SUNY ESF, WPDC
Remove barriers and create incentives for using wood for infrastructure applications, including bridges, sound barriers, transportation hubs, utility poles, marine and foundation pilings, retaining walls, docks, and piers	DOT, PANYNJ, DEC, EFC	5-10 years	ASCE, AIA, SUNY ESF, RIT P2I

Enabling initiative – Expand Markets for Sustainably Harvested Durable Wood Products

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
<p>Outreach and education to construction industry and public on mass timber construction and harvested wood products (fire safety, high-rise applications)</p> <p>Promoting carbon sequestering materials that are substitutes for energy efficiency materials that are fossil fuel based (e.g., hemp insulation replacing foams; research potential on uses for residues from hemp product creation)</p>	<p>SUNY ESF Cornell CALS</p>	<p>1 year</p>	<p>Industry partners, AIA, USGBC, DEC, USCA, ESFPA, WPDC, AGM, HCR, DASNY, RIT P2I</p>
<p>Set standards and specifications for a minimum portion of harvested wood products, such as mass timber or wood flooring, in new construction in certain state funded/supported buildings and infrastructure projects when NY supply chain can cost effectively meet the demand</p>	<p>GreenNY, OGS, DEC, DASNY,</p>	<p>3-5 years</p>	<p>DEC, HCR, SUNY, DOCCs,</p>
<p>Support R&D, demonstration, and technology transfer of wood utilization and wood innovations to scale the use and climate benefits of wood in the built environment</p>	<p>SUNY ESF/Cornell CALS, NYSERDA, AGM, DEC</p>	<p>1-5 years</p>	<p>ESFPA, WPDC, Industry Partners, USCA</p>

Enabling initiative – Expand Markets for Sustainably Harvested Durable Wood Products

Anticipated Benefits and Impacts

Disadvantaged communities

Promote the value of building with wood in affordable housing to save time and money, provide safe and healthy housing, stimulate jobs, reduce embodied carbon emissions, and enhance carbon storage. The use of clean, low carbon products that have low off-gassing and toxicity will be another benefit to disadvantaged communities

Health and co-benefits

Sustainable harvest practices and improved utilization of high grade wood provides an economic driver for conservation of natural and working lands, particularly when customers want verified low carbon products. Ecosystem conservation will also translate to benefits for human health, water quality and air quality. Improve quality of living for tenants and others which impacts physical and mental health. Bio-based products will also often have a safer profile when installed and from cradle to end of life. Bio-based products also have end-of-life opportunities, in a circular economy landfill wastes are reduced. Modular application of mass timber drives cost efficiencies for construction projects by shortening the urban installation time which also reduces site emissions/nuisances

Just transition: businesses and industries, workers

New York's forests and wood products industries are currently directly responsible for nearly 40,000 well-paying jobs and more than \$13 billion of economic output and are indirectly responsible for another 53,000 jobs and nearly \$10 billion of economic activity. Generates manufacturing and construction jobs. Creates new market for existing secondary wood products industries such as flooring, millwork and molding for interior design. mass timber has the potential to be designed and manufactured in modular capacity in rural locations, creating rural jobs with safer and more efficient conditions

Other

Supports sustainable management of NYS forests which maintains or increases forest carbon stocks, while producing an annual sustained yield of bio-based feedstocks from the forest. COVID-19 pandemic has driven many wood prices high due to increased demand, need to evaluate near term effect on costs/ timeframe of implementing this strategy

Enabling initiative – Sustainable biomass feedstock action plan for 2050 hard-to-decarbonize products

Description:	This plan will identify feedstock volumes and production methods that utilize NYS biomass resources in a sustainable, sequestration maximizing manner to create replacements for hard to decarbonize fuels while considering other uses for these feedstocks (see recommendation on low-carbon product development). Fuel derived from biomass will likely have a limited but strategic role in New York’s 2030 and 2050 needs
Action type:	Research and Plan development
Cost and funding considerations:	\$, <\$2M total cost
Ease of implementation:	Medium. A comprehensive plan is a significant undertaking with many elements that would require coordination and may be challenging.
Example case studies:	

Risks / Barriers to success	Possible mitigants
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<ul style="list-style-type: none"> • Competition for finite land area to grow a variety of products (food, feed, fiber, fuel) • The benefits, environmental and social impacts, and limitations are highly dependent on the specific combination of the source of energy, management, logistics, spatial and temporal scales, conversion technologies, co-products, end-use efficiency, environmental and social externalities, and the baseline to which an energy pathway is compared • Reduced carbon availability for recycling into soils, impacts and nutrient management • Requires comprehensive look at role of other biofuels as well as other uses for the biomass inputs 	<ul style="list-style-type: none"> • Focus on wastes and residues as feedstocks, anticipated 2050 fuels needed should frame 2030 feedstock development and associated infrastructure. • Apply criteria to assess the energy, environmental, and social benefits, impacts, and limitations of all energy pathways (e.g., biomass, solar, wind, fossil etc.) and to select pathways with highest and best use of our limited natural resources with low risks of undesirable environmental and social impacts • Incentivize carbon storage in soil through amendments like biochar • Focus on closed-loop processes where possible and in-state feedstock development to meet in-state demand. • Matching the conversion technology to the fuel source and to the products needed (i.e., jet fuel, chemicals, etc) is essential to achieve the maximum economic returns and long-term performance from a bioenergy system.
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Enabling initiative – Sustainable biomass feedstock action plan for 2050 hard-to-decarbonize products

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Establish rigorous energy, greenhouse gas, and environmental sustainability guidelines and metrics	DEC, NYSERDA, AGM	2-3 years	SUNY, TNC/ENGOS, SUNY ESF/Cornell CALS, USEPA, RIT P2I
Identify bioenergy pathways with high lifecycle energy efficiency and high emissions reductions (from land-harvest, conversion, and delivery to the end user) that replace fossil fuels and complement next generation energy delivery systems	NYSERDA, SUNY ESF/Cornell CALS	2-3 years	SUNY, USDOE, national labs (ARGONNE), toxicology experts/risk assessment
Identify 2050 hard to decarbonize fuel needs (e.g., high quality distillate jet fuels) and incentivize appropriate bioenergy development (feedstock supply chain, conversion systems, and end use markets) to meet these needs.	SUNY ESF/Cornell CALS, NYSERDA/DPS	2-3 years	Utilities, USDOE, Industry, PANYNJ, CAAFI

Enabling initiative – Sustainable biomass feedstock action plan for 2050 hard-to-decarbonize products

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Prioritize use of feedstocks that are residues from existing agricultural, forest, and waste systems. (through preferential pricing in product development proposal)	NYSERDA, DEC, SUNY ESF, Cornell CALS	2-3 years	CCE, SWCD, ESFPA, WPDC, AGM, NYCDEP, RIT P2I, (other waste stakeholders)
Activate former agricultural and underused lands (including former industrial lands) for more productive uses, one of which could be purpose-grown biomass	AGM, DEC	3-5 years	SUNY ESF/Cornell CALS, CCE, SWCD, Forest Connect, TNC/ENGOS, Hunting stakeholders (deer management)
Develop energy systems that can best support a net-zero carbon economy in NY. NYSERDA and the Green Bank to develop programs that leverage private capital to invest in conversion technology for bio-based feedstock into bio-based products	NYSERDA, DPS	Ongoing	Utilities, CAAFI, USDA, USDOE, Industry, SUNY ESF/Cornell CALS

Enabling initiative – Sustainable biomass feedstock action plan for 2050 hard-to-decarbonize products

Anticipated Benefits and Impacts

Disadvantaged communities

Interim fuels and infrastructure systems ensure near-term affordable energy alternatives to traditional fossil fuel systems (e.g., boilers) or promote affordable bio-electricity further encouraging the transition to electrification in both rural and urban areas

Health and co-benefits

Increases forest area under active professional management, increases forest management for maximum sequestration. Keeps our forests as forests, avoids conversion of forests to other land uses, and enables private forest owners to invest in management that not only maintains but scales carbon sequestration, clean water and wildlife habitat. Combustion of biomass could lead to increased air emissions and impacts to public health; any consideration of combustion must address this issue

Just transition: businesses and industries, workers

Develops markets for low grade wood products, increasing value to rural industries. Create new opportunities in rural areas (e.g., agricultural/forestry jobs, biomaterial processing jobs, and infrastructure development and maintenance). New York's forests and wood products industries are currently directly responsible for nearly 40,000 well-paying jobs and more than \$13 billion of economic output and are indirectly responsible for another 53,000 jobs and nearly \$10 billion of economic activity. Strengthen our existing bioeconomy for the future and to ensure a supply chain of feedstock and, workers and innovation to unleash new biobased products.

Other

Supports sustainable management of NYS forests and ag lands which maintains or increases carbon stocks, while producing an annual sustained yield of bio-based feedstocks.

Enabling initiative – Increasing market access for NY low-carbon products

Description:	Enhancing carbon sequestration, greenhouse gas mitigation, and economic development opportunities by reducing barriers and creating competitive advantage for NY produced low carbon products
Action type:	Market development; Research & Development
Cost and funding considerations:	\$\$ (\$25M - \$100M) Low carbon products available in the near-term have comparable cost characteristics to fossil fuel based products after accounting for positive externalities but lack production capacity in Northeast U.S. Public-private partnerships would support initial technology deployment.
Ease of implementation:	Hard for implementation due to policy novelty and lack of NYS-specific carbon intensity calculations for many fossil fuel based products. Moderate for post-implementation under model in which producers of fossil fuel based and bio-based products provide lifecycle data that are reviewed and certified by DEC.
Example case studies:	USDA Biopreferred® program; Dutch Ministry of Infrastructure and the Environment tenders

Risks / Barriers to success	Possible mitigants
<ul style="list-style-type: none"> • Measurement and verification of carbon content is complex and if not done properly can erode market confidence • Lifecycle data availability for covered fossil fuel based products • Deployment of low carbon substitutes to fossil fuel based products • Interim maintenance of existing low carbon supply chains • Permitting timeframes and lack of technology awareness 	<ul style="list-style-type: none"> • Look to leverage existing certification standards • Confidential producer analysis of covered fossil fuel based products • Combine with low carbon preferential procurement policies • Base product coverage on TRL of low carbon substitutes • Leverage in-state academic/industry expertise on low carbon products & conduct needed research to increase certainty in verification, leading to low carbon product standards

Enabling initiative – Increasing market access for NY low-carbon products

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Begin tracking and reporting on this market to spot emerging trends, innovative applications, external market opportunities, growth opportunities to guide the development	ESD, NYSERDA	1 year	Business Council, AGM, REDCs, trade groups
Spur innovation through lead by example in low carbon procurement requirements for state government (e.g. bio-based products, low carbon concrete)	GreenNY, OGS, DEC, DASNY	2-3 years	SUNY, DEC, NYSERDA, PANYNJ
Commence a technology readiness level analysis of low carbon substitutes for fossil fuel based products and fuels; Identify the high value products from bio-based processing of New York grown feedstocks and invest in production facilities	NYSERDA, SUNY ESF	1-3 years	DEC, ESD, Industry, SUNY, OEMs,
Strategic use of incentives to drive scale-up of high-demand products when the low carbon alternative is not yet cost competitive with the fossil fuel based option	NYSERDA, AGM, DEC	3-5 years	Industry, DEC, NYSERDA, ESD

Enabling initiative – Increasing market access for NY low-carbon products

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Develop standards and guidelines for defining a low carbon product, including ensuring sustainable feedstock production (biomass action plan)	GreenNY, DEC, NYSERDA, AGM	2 years	Industry, SUNY,
Expand access to low interest loans or grants for existing NYS businesses to develop new low carbon products lines by educating local banks on emerging bio-technologies and offering NYGB loan guarantees	DFS, NYGB, ESD	2-3 years	NYFB, technology incubators, IDAs, SUNY, Small Business Administration, USDA Rural development, financing partners, Urban Green Council
Create a low-carbon products portal to facilitate connecting NYS producers to corporations and other buyers that have made GHG emission reduction commitments, expand the NY Grown program to cover more products and adding a low-carbon aspect to this program	AGM, RIT P2I	2 years	Industry, Urban Green Council, SUNY ESF/Cornell CALS, NYSERDA, trade groups, producers, SWCD

Enabling initiative – Increasing market access for NY low-carbon products

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Expand production of high-value agroforestry products that contribute to maintaining healthy forests (sap/syrup production, nuts, mushroom cultivation, and ginseng production)	AGM	2 years	SWCD, NYFB, CCE
Enhance the public’s understanding of the bioeconomy and its role in implementing the CLCPA	AGM, SUNY ESF	Ongoing	NYSAF, social scientists, industry, REDCs
Develop low carbon fuel strategies for hard to electrify applications	DEC, NYSERDA	2 years	Industry, Utilities, Aviation stakeholders
Consumer and business-to-business education on bio-based products and low carbon products, build buyer confidence	RIT P2I (?)	1 year	trade groups, OEMs

Enabling initiative – Increasing market access for NY low-carbon products

Anticipated Benefits and Impacts

Disadvantaged communities	Transitioning industrial emitters located primarily in disadvantaged communities to low carbon fuels could decrease co-pollutant emissions (Knothe , Yin et al. , Yang et al.)
Health and other co-benefits	In the transition to electrification and for applications that are difficult to electrify, low carbon fuels can have reduced co-pollutant emissions as compared to fossil fuel emissions at industrial emitters, leading to health benefits. Many low carbon product feedstocks (e.g., willow) provide ecosystems and bioremediation services during growth.
Just transition: businesses and industries, workers	20,000 new jobs are potentially expected in the low carbon products sector in NYS. Low carbon processing is an enabling technology for the broader transition to a decarbonized economy. Significant opportunities exist for worker training, especially within disadvantaged and rural communities, including partnering with local labor unions and community colleges. Investment in market development would provide the market certainty needed to deploy a thriving low carbon processing sector within NYS while minimizing opportunities for carbon leakage.
Other	The amount of material going to landfill will decrease. Building materials that sequester carbon will have additional market value; this may help drive down the costs of sequestration policies. There will be less uncertainty in the long-term market for initial producers of low carbon products.

Enabling initiative – Financial and Technical Assistance for Low-Carbon Product Development

Description:	Provide financial and technical assistance to grow a bioprocessing industry in New York that utilizes low-grade wood and other biomass residuals to create bio-based substitutes for fossil fuel based products
Action type:	Engineering support, supply chain development, financial incentives, legislative action
Cost and funding considerations:	\$\$ (\$25M - \$100M) Costs to support existing supply chains can be through public-private partnerships, agency funding, and/or federal grants and support.
Ease of implementation:	Easy due to current availability of both decarbonization technology and existing supply chains. Work with SUNY campuses and industry to identify qualifying near-term decarbonization investments.
Example case studies:	EPA Green Suppliers Network; Södra pulp mill biomethanol production facility
Risks / Barriers to success	Possible mitigants
<ol style="list-style-type: none"> 1. Owners of existing supply chains lack capital/margins to make near-term decarbonization capacity investments 2. Owners of existing supply chains lack technical expertise to make near-term decarbonization capacity upgrades 3. Rural labor is limited, competitive for workers could hurt existing businesses 4. Incentives to attract new businesses could put existing businesses at a competitive disadvantage 	<ol style="list-style-type: none"> 1. Provision of financial incentives to qualifying near-term decarbonization capacity investments 2. Provision of regulatory and technical support to qualifying near-term decarbonization investments. 3. Policies need to focus on attracting new workers into rural areas to meet labor needs 4. Policies should also encompass new product offerings or diversification of existing businesses

Enabling initiative – Financial and Technical Assistance for Low-Carbon Product Development

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Development of criteria for qualifying near-term bioprocessing capacity investments.	NYSERDA, industry leaders	6-12 months	DEC, ESD, SUNY ESF, SWCD
Financial and technical initiatives to identify and promote the high value outputs from New York bioprocessing inputs	NYSERDA, DTF, ESD	Ongoing	DEC, REDCs, legislature
Define sustainable feedstock production for bio-based processing to determine feedstock volume and practices that maximize sequestration, part of biomass action plan	NYSERDA, DEC, AGM, SUNY ESF, Cornell CALS	2 years	SWCD
Create an economic development initiative focused on attracting bioprocessing/bio-based product businesses to NYS	ESD	2 years	SUNY ESF, REDCs, IDAs, industry leaders, SWCD
Preferential pricing for in-state low grade feedstocks that maximize carbon sequestration (organic waste streams, wood residues, marginal land)	DEC, AGM	2-3 years	Legislature, local governments, SWCD
NYSERDA and the Green Bank to develop programs that leverage private capital to invest in conversion technology for bio-based feedstock into bio-based products	NYSERDA, NYGB	Ongoing	ESD, IDAs

Enabling initiative – Financial and Technical Assistance for Low-Carbon Product Development

Anticipated Benefits and Impacts

Disadvantaged communities

Potential for reinvigoration of idled rural production sites such as sawmills, create projects at existing NYS infrastructure that is able to support future deep decarbonization projects following the deployment of next-generation technology. Bioprocessing facilities should not be sited in disadvantaged communities unless the community is seeking the project

Health and co-benefits

Substantial health benefits are expected from reduced fossil fuel combustion emissions by emitters that interact with existing supply chains. Bio-based products will also often have a safer profile when installed and from cradle to end of life. Bio-based products also have end-of-life opportunities, in a circular economy landfill wastes are reduced

Just transition: businesses and industries, workers

New York's forests and wood products industries are currently directly responsible for nearly 40,000 well-paying jobs and more than \$13 billion of economic output and are indirectly responsible for another 53,000 jobs and nearly \$10 billion of economic activity. Significant opportunities exist for worker training, especially within disadvantaged and rural communities, including partnering with local labor unions and community colleges. Near-term decarbonization of existing supply chains is an enabling technology for the broader transition to a decarbonized economy via the maintenance of those supply chains. Supply chain retention is an important factor in carbon leakage prevention.

Other

Reduced landfilling, increased value proposition for building materials via carbon sequestration potential, reduced uncertainty in long-term market for initial producers of low carbon products, correction of market failure caused by lack of externality internalization. Supports sustainable management of NYS forests which maintains or increases forest carbon stocks, while producing an annual sustained yield of bio-based feedstocks from the forest.

Enabling initiative – Bio-based Products Research Development & Demonstration Overview

Description:	Develop a demonstration and pilot project portfolio to drive investment in the areas of biobased low-carbon fuels, products, and related sequestration that considers intersection of industrial/manufacturing, agriculture, transportation, and power generation sectors. Fund Innovation challenges and select projects that can scale beyond business as usual	
Action type:	Research initiative, Project demonstration/pilot	
Cost and funding considerations:	\$, \$1 million required for initial roadmap analysis with additional funding research and early-stage pilots to be determined pending the outcome of the analysis.	
Ease of implementation:	Medium	
Example case studies:	CA Energy Commission Autothermal Pyrolysis Demonstration; Cornell University's Leland Pyrolysis Kiln Demonstration	
Risks / Barriers to success	Possible mitigants	
<ol style="list-style-type: none"> 1. A poorly defined scope for RD&D could direct limited funds towards low performing technologies creating a lost opportunity for innovation. 2. Decarbonization efficiency will need to be quantified via a metric such as carbon abatement cost to enable comparison of low carbon pathways with net sequestration pathways. 	<ol style="list-style-type: none"> 1. Utilize expert elicitation to determine appropriate research scope. 2. Utilize in-state expertise on lifecycle assessment and techno-economic analysis to establish best practices on decarbonization efficiency quantification. 	

Enabling initiative – Bio-based Products Research Development & Demonstration Overview

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Development of research agenda scope	NYSERDA, SUNY ESF/Cornell CALS	<1 year	DEC, SUNY
Develop solicitation to perform research and identify promising pilot/demonstration projects	NYSERDA	1-2 years	NYCDOB, DEC, AGM, SWCD, ESD, National labs,
Fund research and pilot/demonstration projects	NYSERDA	Ongoing	ESD, NYPA, DEC, USDA, USDOE, private investors, philanthropy

Enabling initiative – Bio-based Products Research Development & Demonstration Overview

Anticipated Benefits and Impacts

Disadvantaged communities

Research must take account of potential impacts to economic development, ecosystem services, and human health in disadvantaged communities in which pilot projects would be located.

Health and other co-benefits

Research must quantify criteria pollutant emissions, ecosystem services, and bioremediation potential of deep decarbonization and net sequestration pathways analyzed under roadmap. This will enable pathways that contribute to improvements in these areas to be considered for pilot funding.

Just transition: businesses and industries, workers

The roadmap will identify the economic growth potential of the pathways considered in the form of market size, jobs growth across the supply chain, and workforce development requirements/opportunities.

Other

Enabling initiative – Net Negative Carbon Dioxide Removal (CDR)

Description:	Advance deployment of natural CDR pathways that serve to create a negative emissions profile for bioeconomy products and other economic sectors. (long duration carbon storage beyond net zero)	
Action type:	Research and policy development	
Cost and funding considerations:	\$\$ (\$25M - \$100M), Currently available CDR technologies require financial incentive in range of DEC's value of carbon to be economically feasible. Many CDR strategies provide co-benefits (e.g., ecosystem remediation) that offset costs elsewhere.	
Ease of implementation:	Medium, many applications are in the RD&D stage, near-commercial applications seek market value for the negative emissions values, research is needed to expand future pathways. Moderate for post-implementation as best practices are deployed.	
Example case studies:	CA Energy Commission Autothermal Pyrolysis Demonstration; Cornell University's Leland Pyrolysis Kiln Demonstration; U.S. 45Q tax credit, enhanced weathering, enhanced photosynthesis	
Risks / Barriers to success	Possible mitigants	
<ol style="list-style-type: none"> 1. Verification and confidence in CDR technologies whose results go beyond net zero and achieve enduring negative GHG emissions 2. Deployment of CDR projects, costs, land-use trade-offs 3. Many emerging technologies will need to advance to commercialization 	<ol style="list-style-type: none"> 1. Regular CDR certification and monitoring 2. Provide long-term incentive value 3. Invest in research to establish standards for lifecycle benefits to prioritize investments in the most impactful strategies 	

Enabling initiative – Net negative Carbon Dioxide Removal (CDR)

Components required for delivery <i>(Brief description of action required)</i>	Implementation lead <i>(Entity responsible for completing)</i>	Time to implement <i>(Time required to implement)</i>	Other key stakeholders <i>(Entities that need to be engaged)</i>
Set clear goals and standards regarding the need for net negative removal, evaluate solutions viable today and monitor solutions that could be viable in the future	NYSERDA, DEC	2 years	Legislature, Cornell CALS, SUNY ESF
Identification of verifiable and maintainable CDR technologies and pathways	NYSERDA, SUNY ESF	2-3 years	DEC, industry partners, IBI, National labs (LLNL, Argonne)
Develop RD&D agenda and priorities, Initial work to focus on nature-based CDR pathways while examining the role of technology-based pathways in the future	NYSERDA, DEC, SUNY ESF, Cornell CALS	1 year	SUNY, AGM
Fund demonstration projects	NYSERDA	3-5 years	ESD, NYPA, DEC, USDA, USDOE, private investors, philanthropies

Enabling initiative – Net negative Carbon Dioxide Removal (CDR)

Anticipated Benefits and Impacts

Disadvantaged communities	Many CDR technologies provide associated positive externalities (e.g., ecosystem services, improved air quality, reduced agricultural pollution) and would benefit communities that have disproportionately experienced harm from negative externalities of current energy mix.
Health and co-benefits	Many CDR feedstocks (e.g., agricultural waste, dedicated energy crops) provide ecosystem and bioremediation services during growth. CDR technology biochar shows promise for urban organics management, or as a replacement for fly ash in concrete. Net negative CDR can provide permanent storage of atmospheric carbon
Just transition: businesses and industries, workers	Significant opportunities exist for CDR project worker training, especially within disadvantaged and rural communities, including partnering with local labor unions and community colleges. Many CDR pathways are enabling technologies for the broader transition to a decarbonized economy.
Other	Correction of market failure caused by lack of externality internalization.

Carbon Farm Study

Jurisdiction:	<i>Cornell University, NYS Department of Agriculture and Markets</i>
Context:	<i>New York Agriculture and Climate Change: Key Opportunities for Mitigation, Resilience, and Adaptation completed in 2020, ranks the most promising GHG mitigating strategies for agriculture in NYS based on co-benefits, measurability, achievability, ease of implementation, and time scale per the Carbon Farming Act (A3281). Note, this study also provides many additional case-studies and references critical to the development of Agriculture and Forestry Advisory Panel recommendations.</i>
Description of action(s):	<i>Five practices were selected for priority implementation because they are the most cos-effective and permanent opportunities using currently available technologies and realistic verification methods. Analysis offered provided baseline for the mitigation strategies for meeting the agricultural goals under the Agriculture and Forestry Advisory Panel of the CAC.</i>
Type of action(s):	<i>Research paper; Voluntary incentive-based opportunities</i>
Impact:	<i>14 mmt of GHG reduction opportunities available through alternative manure management, precision feed, forage, and herd management, soil health, crop fertilizer nutrient management, agroforestry practices, and afforestation of idle or underutilized agricultural land. Co-benefits that may apply to practices include soil health, community relations, adaptation to climate change, profitability, air quality, water quality, biodiversity, and energy production potential.</i>
Cost and bearer of cost:	<i>Environmental Protection Fund (EPF) Climate Resilient Farming SFY 2017-2018 budget</i>
Ease of implementation:	<i>Moderate; this is current research for NY agriculture is guiding the development of recommendations from the Agriculture and Forestry Advisory Panel</i>

US Climate Alliance (USCA) Toolkit

Jurisdiction:	<i>US Climate Alliance (USCA), American Farmland Trust (AFT), Coalition on Agricultural Greenhouse Gases (C-AGG)</i>
Context:	<i>The agriculture policy toolkit released in August 2020, provides USCA states a reference for climate and ag policy in the US developed in support of Natural and Working Lands (NWL) initiatives. It focuses on programs and policies driving adoption of agriculture pathways that reduce GHG emissions and increase carbon sequestration.</i>
Description of action(s):	Agriculture can be a solution to climate change and sharing highlights and recommendations of state agricultural policies and programs with climate benefits including case studies of effective and innovative state policies and programs.
Type of action(s):	Case Study and Toolkit; Voluntary incentive-based opportunities
Impact:	<i>Agriculture plays an important role in the economies of USCA states. Climate change negatively affects agriculture overall and agriculture is a net emitter of greenhouse gases. Agriculture can be an important climate mitigation solution.</i>
Cost and bearer of cost:	Varied examples of public and private funding
Ease of implementation:	Moderate; Lessons learned from several policies and programs highlighted can be integrated into recommendations being put forward.

Cornell Characterization of Soil Health in NYS

Jurisdiction:	<i>Cornell College of Agriculture and Life Sciences (CALS), Cornell Soil Health Laboratory, NY Soil Health Working Group</i>
Context:	<i>Soil health concepts, practices, and testing have generated a growing awareness of soil's central role and highlights that sustainable soil management requires an understanding of biological, physical, and chemical processes and that management can significantly degrade or improve the quality of the soil. The NYS Soil health dataset was compiled from 1,456 soil samples collected from 2014 to 2018.</i>
Description of action(s):	Soil health in New York is affected by both soil type and cropping system differences that relate to carbon cycling and soil disturbances. Metrics for quality standards and goals are common for many natural resources (air, water, etc.) soil health goals can help farmers calibrate their management and target policy efforts.
Type of action(s):	Soil health standards for improved soil health and carbon sequestration
Impact:	<i>Building soil organic carbon offers an opportunity for carbon storage for negative emissions on-farm. Carbon sequestration and soil health improvements are aligned for a win-win of on-farm and statewide GHG reduction goals.</i>
Cost and bearer of cost:	Soil health testing is paid for by the farm and can be supported by state cost-share programs.
Ease of implementation:	Easy; this is current research for NY soil health that can be used to develop a soil health standard for NYS.

Payment for Ecosystem Services for Vermont

Jurisdiction:	<i>University of Vermont, State of Vermont</i>
Context:	<i>Payment for Ecosystem Services (PES) when aligned with water quality goals has the potential to protect water quality while aiding the struggling agricultural economy. University of Vermont Gund Institute's white paper issued September 2019 highlights that to support economic viability for farmers with a PES program that is voluntary, flexible, and equitable will incentivize innovative and sustainable agricultural land management that provides multiple ecosystem services (for nutrient and/or GHG reductions).</i>
Description of action(s):	Voluntary financial incentive program compensating farmers for performance gains that provide multiple ecosystem services.
Type of action(s):	<i>Research paper on voluntary incentive-based program to increase efforts to reduce phosphorus entering Lake Champlain in order to meet the Total Maximum Daily Load (TMDL) set by the state.</i>
Impact:	<i>A PES program that is performance-based would quantify ecosystem service provisioning from farms and reward farmers for their measured contributions to public goods. Programs that incentivize performance reward farmers based on quantifiable outcome but have historically been too expensive and burdensome to monitor and verify. Advances in measurement and modeling tools have created an opportunity for performance-based payment programs.</i>
Cost and bearer of cost:	Setting the right rates enables the desired level of farmer participation and ecosystem service outcomes. The rate per unit will have to be calculated. Public and private funding sources.
Ease of implementation:	Moderate; examples of program logistics exist but the rate per unit offered and quantification verification may take time to research and set standards for.

WAC Nutrient Management Credit Program

Jurisdiction:	<i>NYC Watershed, Watershed Agricultural Council (WAC) , NYC Department of Environmental Protection (NYC DEP)</i>
Context:	<i>The Watershed Agricultural Council (WAC) created the Nutrient Management Credit Program (NMC) in early 2000's to provide financial incentive to offset some of the added costs associated with properly implementing a farms Nutrient Management Plan. Program participants receive \$10/acre plus an animal unit rate for following and monitoring their Nutrient Management Plan.</i>
Description of action(s):	Voluntary financial incentive program including technical assistance provided to participating farms
Type of action(s):	<i>Voluntary incentive-based program; created as part of NYC watershed filtration avoidance plan</i>
Impact:	<i>140 farms participate reducing phosphorus in the watershed. On average each farm participating receives \$3,900 credit towards eligible expenses relating to nutrient management. The reduction of phosphorus has improved water quality in the NYC watershed and has aided in meeting the filtration avoidance plan. Technical assistance necessary for plan implementation supports jobs for agricultural planning and on-farm management. This model could be implemented to track and incentivize GHG emissions reductions on-farm as well as other types of Ecosystem Services.</i>
Cost and bearer of cost:	Costs are covered through NYC DEP. Annual cost of program in 2020 was ~\$560,000.
Ease of implementation:	Moderate technical assistance is important for accurate planning and implementation and oversight of record keeping.

Silvopasture Examples in New York

Jurisdiction:	Cornell University, Cornell Cooperative Extension (CCE) of Schuyler County and the SCNY Ag Team, Case study location: Angus Glen Farms, LLC Watkins Glen, NY
Context:	Silvopasture is a land management system that sustainably integrates trees, livestock and forage. When properly implemented, silvopasture may increase carbon sequestration through increasing the number and growth rate of trees, increasing the longevity of trees, growing trees for long-lived products, increasing soil carbon, and reducing the clearing of forest for pasture. Case studies of Angus Glen Farms from 2015 to date provide examples of woodlot Silvopasture and plantation Silvopasture management.
Description of action(s):	Silvopasture is utilized in most other regions of the world but has not been widely adopted in the Northeast. Although successful examples of silvopasture exist in NY, increased awareness and support would improve the rate and scale of adoption.
Type of action(s):	Land use and land management
Impact:	Estimated potential in NYS: 2 million acres – defined as development of silvopastures on existing woodlands that can be profitably and sustainably managed. This acreage would increase significantly if new and expanded grazing operations create opportunities to feasibly incorporate small and fragmented parcels that may not be profitable in isolation. Additional benefits include enhanced food security, local jobs and rural economic development.
Cost and bearer of cost:	Net Present Value (NPV, 5% discount rate) of silvopasture is \$1,200/acre vs. \$600 for timber only vs. \$60 for hay only. Additional benefits not factored in to the NPV calculation include increased animal performance, reduced vegetation (invasive species) management costs, and a locally-grown source of grass-fed meat and fence posts (reduced transportation costs).
Ease of implementation:	Moderate; technical assistance and outreach is important for implementation.

Silvopasture Examples in New York



NRCS Carbon Planning Guidance

Jurisdiction:	<i>USDA Natural Resource Conservation Service (NRCS)</i>
Context:	<i>A carbon plan is a whole-farm conservation plan that when implemented will enhance soil health, increase carbon sequestration, and reduce GHG emissions. Planning guidance from NRCS from 2018 provide a pathway for developing carbon plans.</i>
Description of action(s):	<i>The planner and farmer develop a plan to identify carbon sequestration and GHG mitigation potential.</i>
Type of action(s):	Voluntary plan to address on-farm resource concerns with a focus on opportunities for carbon sequestration and GHG reduction.
Impact:	<i>Site-specific conservation practice systems implemented with known and/or quantifiable greenhouse gas benefit.</i>
Cost and bearer of cost:	Cost-share assistance is needed and technical assistance for plan development. Public and private funding could be used.
Ease of implementation:	Moderate; planning templates and tools need to be customized to New York. Planning infrastructure exists and a Carbon Planning element can be added.

Cornell Nutrient Management Spear Program

Whole Farm Nutrient Mass Balance Assessment

Jurisdiction:	<i>Cornell College of Agriculture and Life Sciences (CALS), Nutrient Management Spear Program</i> http://nmsp.cals.cornell.edu/NYOnFarmResearchPartnership/MassBalances.html
Context:	<i>Farm Nutrient Mass Balances (NMB) help farmers and their advisors find ways to increase nutrient use efficiency on farms and, thereby, decrease nutrient imports and reduce loadings to watersheds. Balances provide a useful and achievable metric for assessing nutrient loadings and potential losses on farms, include N2O, as losses could be significantly reduced if fewer nutrients were imported onto the farm in the first place.</i> <i>[from http://nmsp.cals.cornell.edu/NYOnFarmResearchPartnership/MassBalances.html].</i>
Description of action(s):	<i>The NMB of a farm is the difference between the amounts of nitrogen (N), phosphorus (P), and potassium (K) imported as feed, fertilizer, animals, and bedding, and nutrients exported via milk, animals, crops, and manure. With the development of feasible farm nutrient mass balance guidelines, farmers and advisors are better able to identify farm-specific opportunities to reduce nutrient loadings. This collaborative approach among farmers and advisors providing confidential, farm-specific summaries for benchmarking by farmers and anonymized statewide summaries offers an example for the benchmarking and monitoring enabling initiative prioritized in the Panel recommendations.</i>
Type of action(s):	<i>Extension program; Voluntary, incentive-based opportunities.</i>
Impact:	<i>Work with hundreds of farms in NYS has shown reductions of between 29%-41% in nitrogen balances over the last decade (https://doi.org/10.3168/jds.2015-9776).</i>
Cost and bearer of cost:	<i>Long-term funding for NMB program staff; for field staff from Cornell Cooperative Extension, Soil and Water Conservation Districts, and AEM Planners; and as incentives for farmer participants.</i>
Ease of implementation:	<i>Moderate; MNB work has been underway for over two decades, but more funding, technical assistance and outreach is important for expanded implementation.</i>

USDA BioPreferred procurement program

Jurisdiction:	<i>U.S. Department of Agriculture, United States</i>
Context:	<i>Created in 2002 and expanded in 2018 by Congress, the BioPreferred Program's purpose is to increase the purchased of biobased products. It uses a mandatory purchasing requirement for federal agencies/contractors and a voluntary labeling initiative for qualifying products. The Program was created to support U.S. energy security but has since been expanded to also support U.S. environmental security.</i>
Description of action(s):	<i>Mandatory government procurement program.</i>
Type of action(s):	<i>Created by legislative act and implemented by executive branch.</i>
Impact:	<i>Covers 139 categories (e.g., cleaners, carpet, lubricants, paint, etc.) of biobased products that displace fossil products. Estimated to support 4.2 million domestic jobs (direct, indirect, and induced) and contribute \$393 billion to U.S. economy (\$127 billion direct sales and \$266 billion spillover sales). Jobs growth has been concentrated in rural/lower-income areas. Covered biobased products are estimated to displace 300 million gallons of annual U.S. petroleum consumption, which is equivalent to removing 200,000 cars from the roads.</i>
Cost and bearer of cost:	<i>Costs are borne by federal government agencies.</i>
Ease of implementation:	<i>Moderate to implement (need to establish biobased product criteria) and easy to maintain.</i>

Dutch Ministry of Infrastructure and the Environment (RWS) tenders

Jurisdiction:	<i>Rijkswaterstaat (Dutch Ministry of Infrastructure and the Environment), Netherlands</i>
Context:	<i>Created by the Netherlands House of Commons, the RWS tenders purpose is to encourage the minimization of environmental impacts related to infrastructure building. It required that green criteria be included in all RWS tenders by 2015.</i>
Description of action(s):	RWS tenders require two sustainability criteria, one on energy savings, efficient use of materials, and use of renewable energy; and a second on the environmental impacts of the use of materials specified in a contract.
Type of action(s):	<i>Created by legislative act and implemented by the executive branch.</i>
Impact:	<i>Incentivizes bidders that can prove via life cycle assessment (“CO2 performance ladder”) that their operations lead to significant CO2 operations. Utilizes sustainable construction logistics and “Social Return on Investment” to quantify full impacts across the supply chain. Employs DuboCalc software to calculate the full environmental effects of a material, building, or method as an environmental cost indicator that utilizes life cycle environmental impacts in 11 areas.</i>
Cost and bearer of cost:	Costs are borne by national government agencies.
Ease of implementation:	Moderate to implement (need to establish sustainability criteria and calculators) and easy to maintain.

EPA Green Suppliers Network

Jurisdiction:	<i>Washington D.C.; U.S. federal government</i>
Context:	<i>Created by U.S. EPA in collaboration with U.S. Department of Commerce National Institute of Standards and Technology's Manufacturing Partnership in order to help small-, medium-, and large-sized manufacturers stay competitive and profitable while reducing their impact on the environment.</i>
Description of action(s):	The U.S. EPA's Green Suppliers Network works with manufacturers to engage their suppliers in low-cost technical reviews to identify strategies for improving process lines, using materials more efficiently, and reducing waste. Technical assistance is provided on the measurement and improvement of energy efficiency and GHG emissions across the supply chain.
Type of action(s):	<i>Executive</i>
Impact:	<i>Participating manufacturers and their suppliers have been able to quantify the environmental impacts of their supply chains and improve their profitability while minimizing energy losses, pollution, and GHG emissions. Participants further report improvements to their sustainability commitments, risk mitigation efforts, and ability to meet customer demand for greener products.</i>
Cost and bearer of cost:	Cost not available; cost of technical assistance borne by EPA; cost of implementing improvements borne by participating manufacturers and their suppliers.
Ease of implementation:	Moderate due to need to establish network, although implementation ease has increased as major retailers have adopted their own supply chain sustainability metrics.

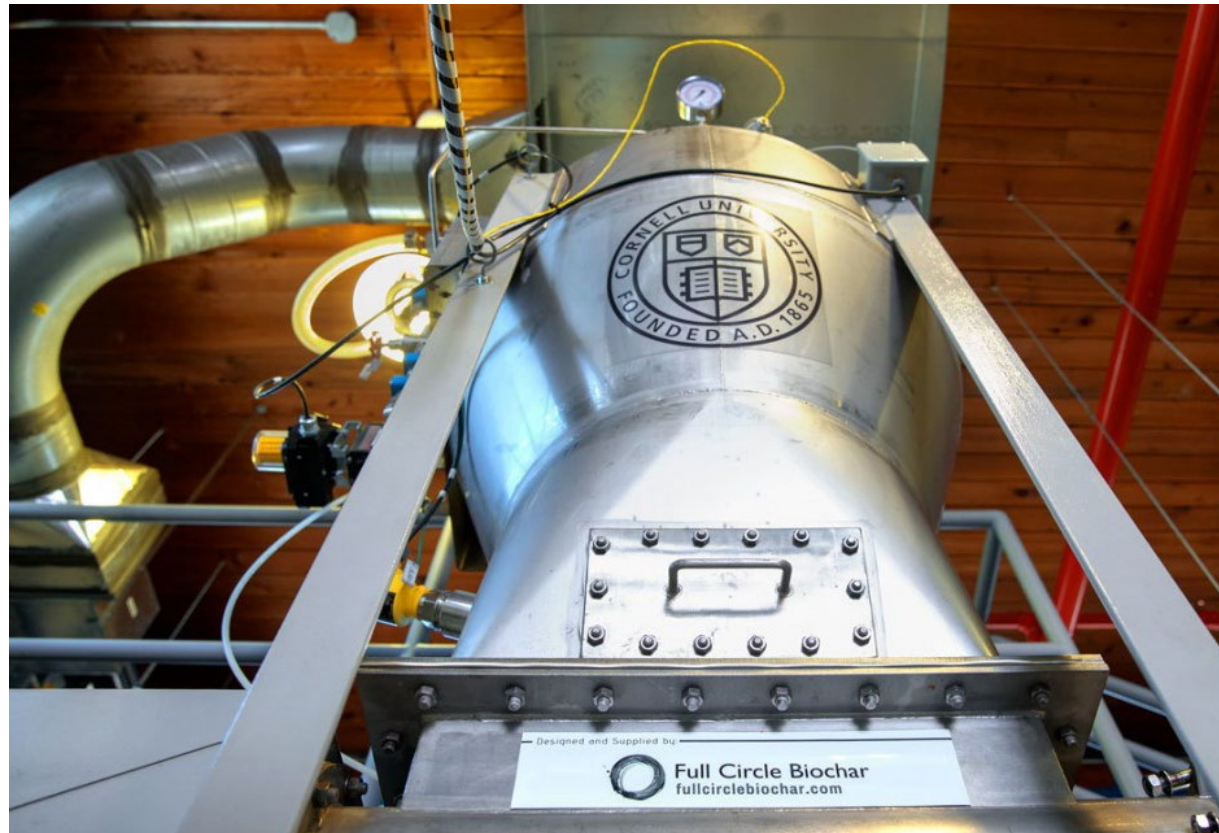
Södra pulp mill biomethanol production facility

Jurisdiction:	<i>Project Location: Mönsterås, Sweden; Entity: Södra pulp mill</i>
Context:	<i>Announced in 2017 and operational in 2020. Biomethanol production facility constructed on-site at existing pulp mill to increase energy efficiency and contribute to circular economy. Biomethanol is sold to Danish biodiesel producer Emmelev A/S as input that displaces natural gas consumption. Resulting biodiesel is incentivized as part of Denmark's transportation decarbonization targets.</i>
Description of action(s):	<i>Installation of biomethanol production capacity that utilizes forestry waste generated at an existing pulp mill.</i>
Type of action(s):	<i>Commercial low-carbon product investment in response to national decarbonization policy and the European Union's Renewable Energy Directive 2.</i>
Impact:	<i>The use of biomethanol to produce biodiesel results in a biodiesel that is 100% renewable and achieves a lower carbon intensity than biodiesel that does not utilize biomethanol as an input. Increases the economic sustainability of Sweden's existing low-carbon feedstock supply chain and creates additional jobs at an existing pulp mill. Produces 5,000 tons of biomethanol annually.</i>
Cost and bearer of cost:	<i>Cost not available; cost borne by Södra pulp mill.</i>
Ease of implementation:	<i>Moderate due to novelty of biomethanol production capacity integrated with existing low-carbon feedstock supply chain.</i>

Cornell University's Leland Pyrolysis Kiln Demonstration

Jurisdiction:	<i>Project Location: Ithaca, NY; Entity: Cornell University</i>
Context:	<i>Began operations in 2018 for the purpose of converting waste and sustainable biomass to biochar (sequestered CO2). Funded through a philanthropic gift to Cornell's Atkinson Center for a Sustainable Future. Designed to achieve commercially representative operations of biogenic carbon sequestration in NYS.</i>
Description of action(s):	Construction and operation of pyrolysis kiln that processes 50 kg/hr of organic feedstock at temperatures of up to 600°C. The kiln yields 15-20 kg/hr biochar and is capable of utilizing a wide range of feedstocks, including ag waste, woody biomass, animal waste (manure, poultry litter), etc.
Type of action(s):	<i>R&D</i>
Impact:	<i>Biochar produced by the kiln achieves stable sequestration of the feedstock's biogenic carbon content, resulting in a net-negative GHG emissions pathway. The use of high temperatures neutralizes any pathogens contained in the feedstock (e.g., dairy manure). In addition to carbon sequestration, biochar has been found to increase crop yields, reduce nutrient run-off, and achieve other ecosystem services/bioremediation benefits in some applications.</i>
Cost and bearer of cost:	Funded through a \$5 million gift from philanthropist Yossie Hollander.
Ease of implementation:	Easy due to availability of equipment for demonstration-scale facility.

Cornell University's Leland Pyrolysis Kiln Demonstration



California Energy Commission Autothermal Pyrolysis Demonstration

Jurisdiction:	<i>Project Location: El Dorado Hills, CA; Government: State of California</i>
Context:	<i>In 2017, the California Energy Commission (CEC) solicited proposals for projects to demonstrate production of bio-oil that was suitable for upgrading to fungible low carbon fuels. The project team of Lawrence Livermore National Laboratory (LLNL), Iowa State University (ISU), Frontline Bioenergy (FBE), and Sierra Pacific Industries (SPI) received an award.</i>
Description of action(s):	<i>The project team is designing, constructing, and fabricating a modular, autothermal pyrolysis system to convert 50-ton-per-day of wood waste into bio-oil suitable for upgrading into low carbon “drop-in” hydrocarbon transportation fuel. Deliverables of the project include 50,000 gallons of bio-oil, technical demonstration of the hydroprocessing of the bio-oil into transportation fuel, and an economic and life cycle analysis of the overall process.</i>
Type of action(s):	<i>R&D</i>
Impact:	<i>The project supports California goals of reducing greenhouse gas emissions; expanding the supply of alternative fuels; and expanding the capacity of forests to remove CO₂ from the atmosphere.</i>
Cost and bearer of cost:	<i>Total project cost: \$7.397 million. Bearer of cost: CEC (\$5.7 million); FBE (\$0.72 million); ISU (\$0.305 million); LLNL (\$0.291 million); SPI (\$0.38 million).</i>
Ease of implementation:	<i>Easy due to leveraging of existing technological pathways and use of modular equipment.</i>

California Energy Commission Autothermal Pyrolysis Demonstration

