Chapter 9
Agriculture, Forestry, and Waste Management Mitigation

Sector Vision for a Low-Carbon Future

The Agriculture, Forestry, and Waste Management (AFW) Technical Work Group, comprised of stakeholders from government agencies, industry, academia, and nonprofit organizations, developed visioning statements for the agriculture, forestry, and waste management sectors.

A Vision for New York State's Agriculture Sector in 2050

A carbon-negative New York agricultural sector will help to meet the state's food and fiber needs, while also making a significant contribution to the energy supply mix. Farms will be profitable, valued by society, and highly adapted to a changing climate. Farmers will be unable to recall the time when managing single-resource concerns was the norm, or when the number and the area of farms declined each year because single-product farms could not compete in a fossil-fuel dependent world undergoing major climate shifts.

More specifically, New York's agriculture sector will have the following characteristics:

Energy: New York farms will be net exporters of energy, including market-ready electricity and biogas; farms will serve as a direct source of heat and electricity for surrounding communities, providing consistent, baseload power to the grid from on-farm anaerobic digestion of organic wastes and waste heat for onsite and offsite use. Farms will supply feedstocks for transportation fuels, as advances in bio-technology will have dramatically increased yields of dedicated bio-energy crops.

Agricultural practices and technology: Farming practices and technology will capitalize on the inherent strengths of natural systems, will effectively re-couple animal and crop production, and will manage carbon flows using system-oriented approaches like those developed for nutrient management, soil conservation, and water quality protection. The public will recognize working landscapes, including farms, as ecosystem service providers.

Land use: Smart growth policies have arrested and reversed the erosion of the agricultural land base. Farms will make selective use of land suited for intensive cultivation for crop production and for carbon storage, incorporating into the soil millions of tons of compost and biochar each year. Production of closed-loop energy crops, soil carbon capture, and low-carbon food production methods will be fulfilling their promise as the largest available land-based greenhouse gas (GHG) reduction opportunity. An improving market will have encouraged the return of as many as two million acres of high quality, well-drained, formerly agricultural land into the farm economy.

Adaptation: The agricultural sector will have adopted management strategies and technologies that support adaptation to unavoidable changes in climate and enable agricultural and economic success in a carbon-constrained environment. Farm management practices will deal successfully with the greater intensity of rain events and longer dry periods.

Production of food, fiber, and feedstocks: New York farms will supply food and fiber for in-state consumption, along with feedstocks for chemicals and bioplastics. Advanced bio-technology will have made it possible to breed crops for specific end uses (e.g., fiber crops destined for the green-building industry).

Economy and quality of life: Reshaping of the agricultural industry will have substantially increased rural employment in job categories that cannot be readily outsourced, resulting in a sustained resurgence of the rural economy. The abundance of local food, energy, jobs, and scenic landscapes will make New York a vibrant, sought-after place to live and a global model for a sustainable society.

A Vision for New York State’s Forestry Sector in 2050

Rural forest land conversion will be rare and long-term storage of carbon at its maximum. Urban green space and trees will reduce building heating and cooling loads. Working together, land owners, government officials, and the public will maximize the long-term carbon sequestration and bio-energy potential of the state’s forests. Forests will deliver co-benefits that are vital to the economy and to New Yorkers’ quality of life, maximizing the value of forest lands to private forest owners and to the public.

More specifically, New York’s forests will have the following characteristics:

Management in accordance with a stewardship ethic: New York’s forest lands will be managed for sustainable biomass production and carbon sequestration or will be conserved in perpetuity under state law. With support by landowners and the public, policies and regulations will motivate retention, expansion, and beneficial management of forest lands, while discouraging deforestation. Land-use policies will maximize ecosystem services, especially carbon benefits.

Carbon sequestration: Forest carbon sequestration will be promoted and monitored, with the aim of achieving optimal carbon storage on all forest lands. Wood will be used sustainably and efficiently for durable wood products. An effective monitoring system will track forest carbon pools.

Fuel substitution: New York’s million-plus acres of formerly idle agricultural land will have been brought back into tillage or are producing woody biomass crops for energy. Woody biomass species substitute as needed for fossil fuels in high-performance, low-emission bio-energy systems and other industrial applications. State-of-the-art biofuel production and combustion technologies achieve net neutral (or even net negative) GHG emissions and play an important role in producing low-carbon liquid fuels for the aviation and shipping industries. Life-cycle costs and benefits are taken into account in decisions to derive energy from woody biomass.

Climate change adaptation: The capacity of the state's forest lands to both mitigate and adapt to climate change will be fully developed. Forest pest invasions will be anticipated and controlled.

A Vision for New York State's Waste Management Sector in 2050

New York will have a sustainable and energy-efficient materials economy in which environmental stewardship is pursued as a common societal value and environmental considerations inform purchasing, production, and materials management, minimizing waste and reducing risks to human health and the environment. Materials management systems and infrastructure will maximize the recovery and re-use of water, wastewater, and other materials in ways that capture their economic value, conserve embedded energy, and minimize net life-cycle emissions of GHGs and other pollutants.

More specifically, New York will have a materials management system with the following characteristics:

GHG reduction: Waste disposal technologies will efficiently capture the material and energy value of different types of waste and incorporate carbon-neutral or carbon-negative methods for disposing of residual wastes. Any landfills still in use will employ every available technology and method to reduce emissions of methane and other GHGs, and the GHG footprint of wastewater treatment plants will have been reduced as far as possible.

Co-benefits: Residual materials will be composted or otherwise beneficially used. Water treatment systems will yield waste heat and waste gas for productive uses. Wastewater treatment plants and similar facilities will host solar, wind, and hydraulic turbine power generation.

Materials management: Products and packages will be designed for maximum incorporation of recycled materials, and for full recycling or reuse after useful life. Infrastructure will be in place to distribute, recover, and reverse-distribute goods.

Response to an evolving market: Comprehensive planning for materials management, stormwater and wastewater management will ensure that GHGs, energy use, and other harmful by-products of waste management are minimized as the marketplace for both materials and energy evolves. Comprehensive planning for materials management will ensure that energy and natural resources are conserved and GHG emissions are minimized as the marketplace for both materials and energy evolves.

Overview of GHG Emissions

The AFW sectors are responsible for a relatively small portion of New York's current GHG emissions. The total AFW contribution to carbon dioxide equivalent (CO_2e) gross emissions in 2008 was 12 million metric tons (MMt), or about 5 percent of the state's total. The reader should understand three important concepts related to the AFW inventory and forecast (I&F) and the forecasted GHG reductions from AFW mitigation options:

- The AFW I&F only covers non-combustion-related GHG emissions.

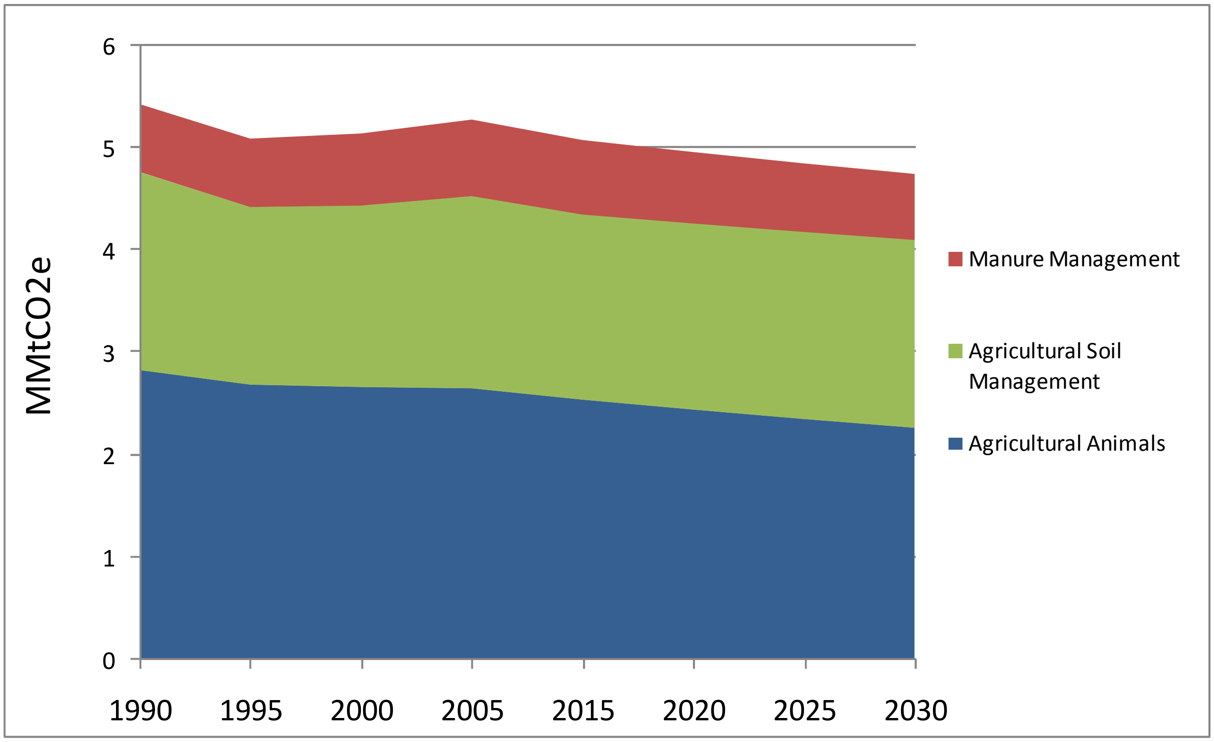
- The embedded emissions within the AFW sectors are significant, especially within waste disposed at landfills, but are not counted in the I&F.
- The AFW policy recommendations will impact GHG emissions within and outside the AFW sector and both in-state and out-of-state.

It is important to note that the AFW sector I&F emissions exclude fossil fuel combustion-related GHGs, such as diesel fuel consumption in the agriculture sector and waste management sector fuel use. These fuel combustion emissions are included as part of the industrial fuel combustion sector (and covered in the Residential, Commercial/Institutional, and Industrial [RCI] Mitigation chapter). The emissions that result from the generation of electricity consumed within the AFW sectors are included in the Power Supply and Delivery (PSD) sector I&F.

Agricultural emissions include methane (CH_4) and nitrous oxide (N_2O) emissions from enteric fermentation (referred to as Agricultural Animals in Chapter 3), manure management, and agriculture soils. As shown in Figure 9-1, emissions from livestock (primarily dairy cows) make significant contributions to the sector totals in both manure management and enteric fermentation. Sector emissions also include N_2O emissions resulting from activities that increase nitrogen in the soil, including fertilizer (synthetic and livestock manure) application and production of nitrogen-fixing crops (legumes).

Overall, the agriculture sector accounted for about 2 percent of New York's total gross emissions in 2008, with the same approximate contribution estimated in 2030. The CH_4 emissions occurring from enteric fermentation are a large contributor to the state's total agricultural GHG emissions by 2030, the contribution from this source is estimated to be about 48 percent of the total agriculture emissions. The next-highest contributor in 2030 is forecasted to be agricultural soil management, at about 39 percent. Methane emissions from manure management are declining slightly due to lower animal populations; however, they are forecasted to contribute around 13 percent in 2030.

Figure 9-1. Historical and Forecasted Gross GHG Emissions from the Agriculture Sector, New York, 1990–2030



Notes: The Agricultural Soil Management category includes incorporation of crop residues and nitrogen fixing crops (no cultivation of histosols estimated in New York). Soil carbon sequestration is not shown.

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent.

Note that, in keeping with U.S. Environmental Protection Agency (EPA) methods and international reporting conventions, the New York inventory and forecast covers sources of GHGs from human activities. There could be some natural sources of GHGs that are not represented in the inventory and forecast; however, these are not addressed in the New York Climate Action Plan process.

The forestry and land-use sector can include both emissions sources and carbon sinks, which are calculated from estimates of the net CO_2 flux[1] from forested lands, urban trees, and landfilled yard trimmings in New York .The inventory is divided into two primary subsectors: the forested landscape and urban trees/land use. Both subsectors capture net carbon sequestered in forest biomass, urban trees, landfills, and harvested wood products.

As shown in Table 9-1, USFS data suggest that New York's forests sequestered about 19.5 $MMtCO_2e$ per year in 2005 (this excludes estimates of carbon flux from forest soils based on recommendations from the USFS). The negative numbers in Table 9-1 indicate a CO_2 sink rather than a source. Hence, throughout the policy option period, forest carbon losses due to forest conversion, wildfire, and disease were estimated to be smaller than the CO_2 sequestered in forest

[1] Flux refers to both emissions of CO_2 to the atmosphere and removal (sinks) of CO_2 from the atmosphere stored in plant tissue or soils.

carbon pools, such as live trees, debris on the forest floor, and forest soils, as well as in harvested wood products (e.g., furniture and lumber) and the disposal into landfills of forest products. Emissions of CH_4 and N_2O during forest wildfires and prescribed burns were not estimated due to a lack of data; however, it is not expected that these emissions will contribute substantially to Forestry sector totals. This expectation is based on work in other states, as well as wildfire activity in New York. The forecast for the sector to 2030 remains a net sequestration of 19.5 $MMtCO_2e$.

Table 9-1. Forestry and Land-use Flux and Reference Case Forecasts ($MMtCO_2e$)

Subsector	1990	1995	2000	2005	2015	2025	2030
Forested Landscape (excluding soil carbon)	–23.9	–22.6	–22.6	–22.6	–22.6	–22.6	–22.6
Urban Forestry and Land Use	–3.6	–3.0	–2.9	–2.9	–2.9	–2.9	–2.9
Sector Total	**–27.5**	**–25.6**	**–25.5**	**–25.5**	**–25.5**	**–25.5**	**–25.5**

CH_4 = methane; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; N/A = not available; N_2O = nitrous oxide. Note: Positive numbers indicate net emission. Based on USFS input, emissions from soil organic carbon are left out of the forestry sector summary due to a high level of uncertainty.

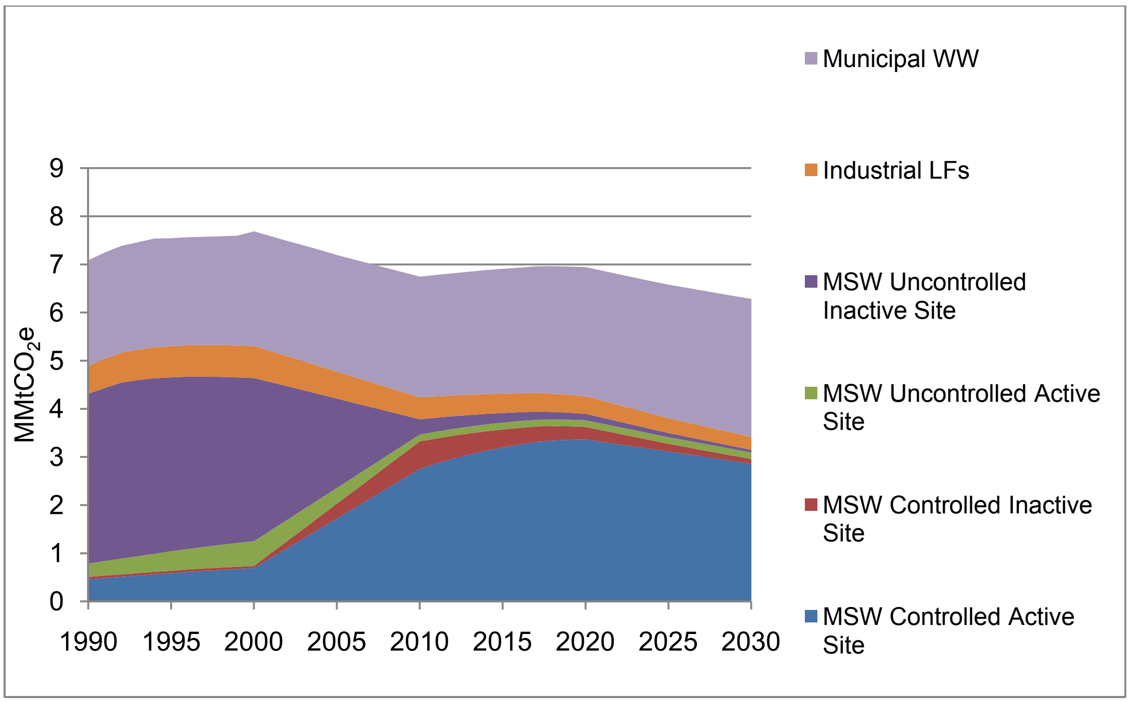
Figure 9-2 shows estimated historical and forecasted emissions from the management and treatment of solid waste and wastewater. Emissions from waste management consist largely of CH_4 emitted from municipal solid waste (MSW) and industrial landfills, while emissions from wastewater treatment include both CH_4 and N_2O. Emissions are not included for MSW combustion, as all waste combustion facilities in New York recover the energy. Therefore, waste combustion emissions are counted in the PSD sector I&F. Available data were insufficient to include emissions from industrial wastewater treatment. Composting in New York results in a sink (not included in Figure 9-2) of 0.11 $MMtCO_2e$ per year. This is the result of accumulated stable carbon in compost, which is eventually applied as a soil amendment. CH_4 and N_2O emissions at composting facilities are not included but are expected to be minimal.

MSW landfill sites were grouped into four categories according to available control equipment and operational status at the site: (1) controlled active, (2) controlled inactive, (3) uncontrolled active, and (4) uncontrolled inactive. As seen in Figure 9-2, between 2000 and 2010, emissions from active controlled landfills increased, while emissions from controlled inactive sites decreased. This is likely a result of three changes: disposal of more MSW at landfills with landfill gas controls in place, implementation of landfill gas control at more landfills, and decrease of landfill gas emissions from inactive landfills as MSW is no longer disposed at these landfills. Industrial landfill emissions are estimated to be 7 percent of the potential emissions (before methane destruction at controlled landfills) at MSW landfills, per EPA default methodology.

Municipal wastewater emissions estimates are estimated based on population and are relatively stable through the inventory and forecast period. The level of composting has also remained relatively stable since 1990, and estimates of emissions from composting are based on 2006 composting data.[2]

Overall, the waste management sector accounted for about 3 percent of New York's total gross emissions in 2008. Emissions from this sector are expected to decline slightly to only 2 percent of the state's total by 2030. As mentioned above, the estimates for solid waste management do not include the embedded emissions in generated waste, which could increase the total fuel-cycle emissions of waste disposal by an order of magnitude, nor do the emissions include those from waste exported from the state.[3] Inclusion of these emissions would make the waste sector a much larger contributor to New York's totals.

Figure 9-2. Estimated Historical and Forecasted Gross GHG Emissions from Solid Waste and Wastewater Management in New York, 1990–2030[4]



$MMtCO_2e$ = million metric tons of carbon dioxide equivalent; MSW = municipal solid waste; LFs = landfills; WW = wastewater.

The embedded GHG emissions of waste generated in New York are significant. These embedded emissions occur during the extraction of raw material, manufacturing of material into goods and packaging, and transportation of the material. Climate action plans developed in other states, such as Michigan, show that embedded emissions can exceed direct landfill emissions by a factor

[2] L. Lim. 2009. New York State Department of Environmental Conservation, personal communication with R. Anderson.

[3] According to 2008 data submitted by DEC, more than 50 percent of MSW disposed at landfills (about 6 million tons) is exported for disposal outside New York State.

[4] Composting is not included in the graph, as composting is a net carbon sink.

of 10.[5] These emissions largely take place outside New York State, except for the emissions that are counted within the PSD, RCI, and Transportation and Land Use (TLU) sectors. In addition, a sizable fraction of solid waste is exported from New York for disposal in other states. The emissions associated with the management of exported waste are not included within the direct emission estimates shown in Figure 9-2. If the emissions associated with waste exports and the full fuel cycle were to be included in the state's inventory and forecast, contributions to total statewide AFW emissions would likely exceed 25 percent, instead of the 5 percent cited above.

Overview of Policy Options and Estimated Impacts

The combined agriculture, forestry, and waste sectors contribute a small portion of total state GHG emissions (4.8 percent), but many of the mitigation and sequestration options offered by these sectors are relatively low-cost and low-tech approaches, making these viable options.

The proposed policies are fundamentally resource management options ranging from energy production and use to natural resources and materials management and waste. The suite of proposed policies adds reduction of CO_2 and other GHGs as a resource management objective. If implemented properly, these approaches offer significant environmental, economic, and social benefits beyond GHG reductions, including the provision of improved water and air quality, increased agricultural and forest products, and green job creation.

The proposed policy options seek to accomplish the following:

- Reduce energy-related emissions through the deployment of renewable energy technologies, including bio-based energy solutions, and energy efficiency policies and measures that address direct and embedded energy usage;
- Conserve the embedded energy in materials through maximized reuse and recycling;
- Reduce methane (global warming potential (GWP) =21-25) and nitrous oxide (GWP=296-310), the predominant agriculturally generated and waste-related GHGs, through the deployment of a combination of systems;
- Capitalize on agriculture and forestry's ability to store carbon in natural systems;
- Incorporate adaptation strategies wherever possible.

Energy from biomass represents an opportunity to reduce GHGs through the displacement of higher-carbon fossil-based energy sources while at the same time increasing in-state circulation of energy dollars and providing significant economic opportunities. However, the use of biomass for energy carries inherent risks. Each step of the process from field or forest to conversion to end-use has environmental, economic, and social benefits and costs. Properly managed biomass

[5] Michigan Climate Action Council. 2009. *MCAC Final Report*. Appendix J: Agriculture, Forestry and Waste Management Sectors – Policy Options. Available at Hhttp://www.miclimatechange.us/ewebeditpro/items/O46F21205.pdfH

production systems offer an opportunity to realize net carbon benefits. The proposed policies seek to capitalize on the state's ability to achieve GHG reductions through sustainable production and wise use of this renewable resource.

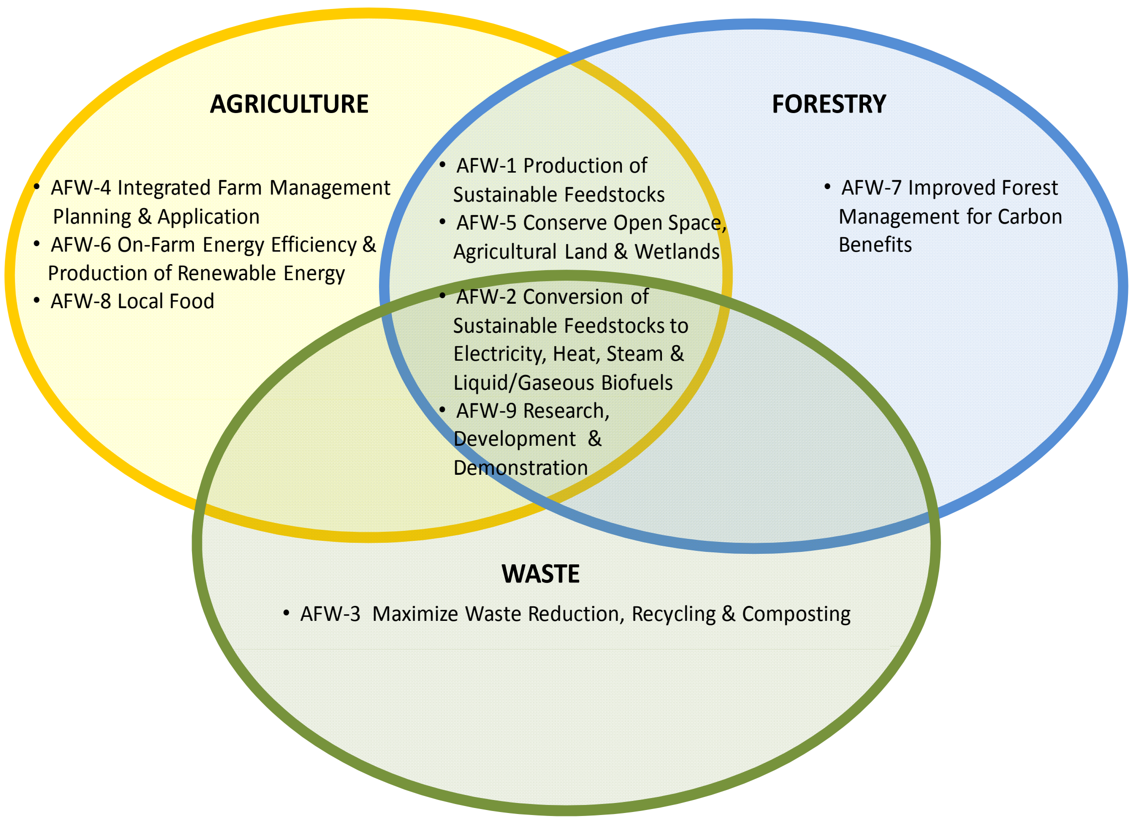
Waste disposal currently makes up a significant portion of GHG emissions in the AFW sectors. In the coming decades the current method of waste disposal—relying primarily on landfills—will become increasingly unsustainable. The solution to achieving long-term meaningful reductions from this sector is through a dramatic reduction in the amount of waste destined for disposal. Redirecting the materials currently in the waste stream to higher-value uses not only reduces methane generation at landfills but also captures the embedded energy in the products and materials currently going to waste and reduces energy and emissions related to their extraction, processing, and manufacturing. Therefore, from a lifecycle perspective, increasing reuse and recycling will have significant energy conservation and GHG benefits. The proposed policy is aggressive and uses a combination of tools to achieve the necessary reductions.

While energy is a focus of many of the policies, it is not the exclusive focus. Since carbon dioxide is not the primary GHG emitted by the agricultural sector, the policy options take an integrated, site-specific approach to managing farm emissions.

Our existing landscape is a critical component of the carbon cycle. Several of the policy options seek to enhance the state's existing carbon sinks through a combination of improved land management and land-use protection measures.

All of the policy options presented rely on management system changes at the most basic level on the farm, in the forest, at businesses, and at home. Incorporating GHG reduction and sequestration strategies into existing management systems and stewardship principles will require a high degree of behavioral change. Developing the education, outreach, job training and decision-making tools necessary to engender this level of behavioral change is an immediate challenge.

Figure 9-3. Agriculture, Forestry and Waste Policy Options



Policy Scenario Quantification Summary Table

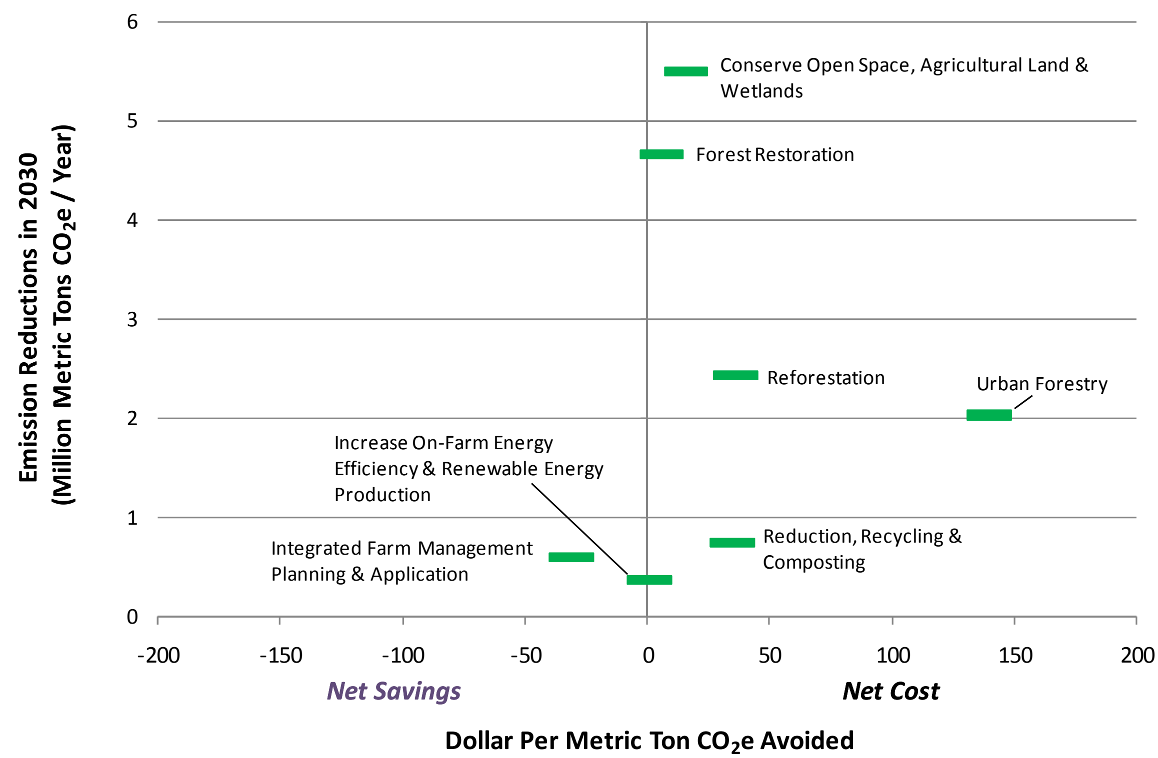
Policy No.	Policy Option	In-State GHG Reductions ($MMtCO_2e$)			Net Present Value: Cost/Savings 2011–2030 (Million 2008$)	Net Cost/Savings per Avoided Emissions ($\$/tCO_2e$)
		2020	2030	Total 2011–2030		
AFW-1	Production of Sustainable Feedstock for Electricity, Heat, Steam Production, and Liquid/Gaseous Biofuels	*GHG reductions and costs included in fuel-cycle analysis of PSD-2, PSD-6, RCI-3, and TLU-4.*				
AFW-2	Conversion of Sustainable Feedstock to Electricity, Heat, Steam Production, and Liquid/Gaseous Biofuels	*GHG reductions and costs quantified under PSD-2, PSD-6, RCI-3, and TLU-4.*				
AFW-3	Maximize Waste Reduction, Recycling, and Composting—In-State Only	0.5	0.7	8.0	$280	$35
AFW-4	Integrated Farm Management Planning and Application	0.3	0.6	6.5	-$201	-$31
AFW-5	Conserve Open Space, Agricultural Land and Wetlands	4.5	5.5	95	$1,500	$16
AFW-6	Increase On-Farm Energy Efficiency and Production of Renewable Energy	0.2	0.4	3.8	$3.0	$1
AFW-7	Forest Restoration	2.3	4.7	49	$290	$6
	Urban Forestry	1.0	2.0	22	$3,200	$140
	Reforestation	1.8	2.4	34	$1,200	$36

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $\$/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Negative values represent savings.

The numbering used to denote the above policy recommendations is for reference purposes only; it does not reflect prioritization among these important policy recommendations. The policy numbers that appear in this table are not consecutive because they reflect only those policies for which quantification has been completed and not all policies are amenable for quantification.

Figure 9-4. Estimates of Cost and GHG Emissions Reductions for AFW Policy Options



NOTE: Scenario results are not additive as synergies and overlap have not been estimated.
Additional economic analyses need to be conducted to assess macroeconomic impacts and co-benefits.

PRODUCTION of SUSTAINABLE FEEDSTOCKS for ELECTRICITY, HEAT, STEAM PRODUCTION, and LIQUID/GASEOUS BIOFUELS (AFW-1)

Policy Summary

This policy option seeks to increase the amount of agricultural and forest biomass available on a sustainable basis to support low-carbon energy development while accounting for the environmental, economic, and social impacts of expanded biomass feedstock production.

Objectives include the following: (1) Defining sustainability criteria that address the social, economic, and environmental dimensions of biomass-derived energy, including the ability for a production system or technology to survive without public subsidies, and the development of full life-cycle carbon analysis that can support objective comparisons with other renewable and non-renewable energy sources; and (2) Developing and encouraging the use of best management systems for the establishment and harvest of feedstocks. These systems should be designed to ameliorate local impacts of storage, pre-processing, and distribution of feedstocks at conversion facilities.

The primary implementation mechanism is the creation of a state-level Biomass Energy Program. The program would provide overall coordination to encourage regional consistency in sustainability criteria, track and maintain a biomass inventory employing appropriate sustainability indicators to monitor changes in the flow of biomass, provide for the coordination of research to ensure that the development of a sustainable bio-based economy proceeds in an orderly fashion, and facilitate the development and leveraging of public/private partnerships.

Quantification

The GHG reductions and costs for this policy are quantified in the fuel-cycle analyses of PSD-2, PSD-6, RCI-3, and TLU-4. The baseline assumptions for AFW-1 and AFW-2 state that all GHG reductions from the AFW-1 and AFW-2 targets are accounted for in the analyses of the policies from the other Technical Work Groups (PSD-2, PSD-6, RCI-3, and TLU-4). Each of the other Technical Work Groups (PSD, RCI, and TLU) have been allocated one-third of the total potential sustainable biomass supply as provided by the Biomass Resource Assessment.

Although the in-state biomass feedstock scenarios included in the New York State Renewable Fuels Roadmap analyses were selected to minimize the likelihood of significant indirect land use change (iLUC) impacts, the quantification described for PSD-2, PSD-6, RCI-3, and TLU-4 related to biomass feedstocks does not include iLUC factors and effects on GHG reductions. The science behind assessing GHG emissions from iLUC is evolving, and both EPA and the California Air Resources Board are refining models and improving key input variables to reduce the uncertainty associated with quantifying land-use change and indirect effects analyses. The Roadmap will continue to follow iLUC issues and update its findings as appropriate during its annual updates. Furthermore, New York State along with the 10 other states in the Northeast and Mid-Atlantic regions have committed to including non-*de minimis* direct and indirect emissions, such as those attributed to land-use changes from fuel production, as part of their Low-Carbon Fuel Standard Memorandum of Understanding and framework development.

Special Considerations

- GHG reductions will be realized through the end use of biomass feedstock to displace higher carbon forms of energy and reductions will vary accordingly.
- The availability of in-state produced sustainable biomass feedstock must parallel, and often times precede, the development and growth of biomass conversion facilities if New York State is to maximize GHG reductions and economic benefits.
- Development of sustainability criteria related to the production and harvest of biomass should be pursued on a regional basis.
- Continued research focused on improving cradle-to-grave efficiencies (increasing yields, improving conversion technologies, understanding and improving sustainability criteria) will impact the rate at which biomass production occurs.
- This policy option provides significant rural revitalization potential. The Renewable Fuels Roadmap estimates feedstock supply jobs account for over 80 percent of the job growth potential associated with the increased production of sustainable feedstocks.
- State and federal policies related to renewable portfolio standard (RPS) and renewable fuel standard (RFS) will impact the rate at which biomass production occurs.

- The on-farm production of biomass feedstocks on idle and marginal land represents a crop diversification strategy for the purposes of adapting to climate change.
- While biomass production potential will increase with longer, warmer growing seasons, this could be limited by nutrients and drier, midsummer and fall soils.
- This is a cross-cutting policy with overlap in AFW-2, AFW-5, AFW-6, AFW-7, Adaptation, TLU, PSD, and RCI.

CONVERSION of SUSTAINABLE FEEDSTOCKS to ELECTRICITY, HEAT, STEAM PRODUCTION, and LIQUID/GASEOUS BIOFUELS (AFW-2)

Policy Summary

Sustainable feedstocks can be converted to liquid, gaseous, and solid fuels. These biofuels can offer important solutions to carbon management needs. This policy option would advance the development and commercialization of low-carbon biomass conversion processes, which for some pathways can be an area with considerable technical and financial risk. Feedstock supply and the consumption of the fuels are addressed elsewhere in this Interim Report.

The policy option acknowledges the need to support the biomass conversion industry along the development and commercialization continuum. The nature of the public support can transform from grant support at the research stage to market or production-based tax incentive programs to encourage market transformation following commercial introduction. From a GHG perspective, it is critical that production-based incentives focus on low-carbon pathways, and not all biomass conversion process are low-carbon pathways (e.g., corn to ethanol is not necessarily a low-carbon pathway).

A long-term commitment of public (primarily federal) sector funding will be necessary to partner with industrial funding to support the development of new biomass conversion technologies and the realization of the lessons learned from market experience. Research will be needed in both academic and private laboratories. Publicly funded programs should be implemented in a manner that promotes the commercial use of new intellectual property.

After the initial research stage, new products must move through a demonstration and market assessment stage of development. The relative level of investment to move a new product or process toward commercialization will increase substantially at this stage. Public funding is critical to help demonstrate the market potential and value of new technology. If New York wants to stimulate creation of this industry in the state, support for demonstration should be considered.

When the technology is ready to be developed at a commercial scale, public support could be in the form of low-cost financing or other innovative mechanisms to reduce the technical uncertainty of the new technology to the private investment community. Innovative risk-sharing programs can be implemented to share the technical and market uncertainty and promote private investment. The U.S. Department of Energy and the U.S. Department of Agriculture have advanced several types of loan guarantees that play a very important role in these markets; these federal efforts should be continued.

Beyond the point of commercial-scale manufacturing, public support is critical to ensure that all actors along the supply chain are positioned to move the product to the consumer. Public incentives, either grants or tax incentives, can be critical at this stage. While federal incentives can be important, at this stage of market transformation state initiatives could be significant in helping to develop the industry base in New York State.

Quantification

This policy option was not quantified. Quantification was captured in the end-use application, assuming that the feedstock supply will be allocated equally to the three primary end uses for power (PSD-2), transportation fuel (TLU-4), and buildings and industry (RCI-3).

Special Considerations

- Additional analyses will be conducted in the next phase of the Climate Action Plan process to separately quantify the potential benefits and costs of utilization of biomass for application in the AFW sector.
- There will be competition among the liquid, bioheat, and gaseous fuels markets for the limited sustainable feedstock resource. It is likely that the feedstocks will move where the highest profit can be realized. Realizing the carbon reduction benefits from the conversion to fuels will require a consistent and major commitment to developing the sustainable resource base (AFW-1).
- Sustainable feedstocks can also serve as the building block for more than biofuels. Conversion processes already on the verge of being commercially viable and technologies that will be developed in the future will allow for the development of bio-based products that may also have an impact on carbon reduction. These products may serve as substitutes or alternatives to products that are inherently carbon-intensive.
- Federal policies (e.g., the RFS) will drive the majority of market activity in this sector. The ability of New York to capitalize on advanced conversion technologies will be, in large part, determined by regional policies and programs. New York markets do not operate in a vacuum.
- Indirect land-use change was a topic of discussion in the Technical Work Group. Since the feedstock estimates used in AFW1 and AFW2 were based on the assessments found in the Roadmap and would not impact current agricultural or forestry production, the discussion focused on the need for additional global-scale research as a short-term need.
- Co-benefits include economic revitalization, primarily in rural areas but also statewide, by keeping energy dollars in-state, and improved ecosystem benefits, if done properly.

MAXIMIZE WASTE REDUCTION, RECYCLING, and COMPOSTING (AFW-3)

Policy Summary

This policy option includes a combination of programmatic, regulatory, and legislative actions that aim to reduce or eliminate waste, including diversion of materials for reuse, recycling (including organics recycling), and composting. The actions include updating, strengthening, and expanding the state's regulatory and statutory authority; dedicating resources to build the infrastructure for reuse, recycling (including organics recycling), and composting; expanding existing, and launching new programs at the state and local levels; and coordinating cooperation from all levels of government, the private sector, and individual New Yorkers.

This policy is related to the new draft statewide solid waste management plan, *Beyond Waste: A Sustainable Materials Management Strategy for New York* State.[6] This policy also works in concert with two other AFW policies. AFW-2 includes the conversion of municipal solid waste to electricity, heat, steam or liquid fuels; and AFW-4 aims to develop on-farm sources of renewable energy that will likely involve the recycling of organic materials from other, off-farm sources through anaerobic digestion.

Quantification

Two scenarios were quantified for this policy. Each scenario assumed that the amount of MSW going to disposal (landfills and waste to energy) is reduced from 4.1 lb/person/day to 0.6 lb/person per day and that all other materials are reduced, reused, recycled, or composted.

The first scenario presented below captures maximized waste reduction, recycling, and composting only within New York State. Quantification does not include potential increases in recycling and reduction in the disposal of construction and demolition debris, industrial waste, or biosolids.

The GHG reduction potential, total cost or savings (as measured by net present value), and cost effectiveness (as measured by dollars per metric ton of carbon dioxide equivalent [\$/tCO_2e]) for the policy scenarios quantified by the Technical Work Group are presented below.

GHG Reductions (MMtCO_2e)		Net Present Value: Cost (Million \$)	Net Cost per Avoided Emissions (\$/tCO_2e)
2030	Total 2011–2030		
0.7	8.0	\$280	\$35

\$/tCO_2e = dollars per metric ton of carbon dioxide equivalent; GHG = greenhouse gas; MMtCO_2e = million metric tons of carbon dioxide equivalent.

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[6] This report is available at http://www.dec.ny.gov/chemical/41831.html.

A second scenario, presented below, quantifies the full energy cycle for maximized waste reduction, recycling, and composting.

GHG Reductions ($MMtCO_2e$)		Net Present Value: Cost (Million $)	Net Cost per Avoided Emissions ($/t$CO_2e$)
2030	Total 2011–2030		
32	248	$280	$1.0

$/t$CO_2e$ = dollars per metric ton of carbon dioxide equivalent; GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent.

Special Considerations

- The potential obstacles to achieving the objectives of this policy include the following:
  - **Political will:** This policy calls for a significant change in how materials are managed in New York. This change will require the engagement of all New Yorkers, including residents, businesses, municipalities, state legislators, and policy makers.
  - **Financial resources:** Significant resources will be needed in the short- to medium-term to achieve the objectives of this plan. Resources include public and private investment capital, as well as operating resources for municipalities and the state. Efforts to expand the resources dedicated to waste reduction, recycling, and composting at the federal, State, and local levels should continue.
  - **Technical constraints:** Achieving these objectives will require the efficient deployment of new and additional recycling technologies, particularly those related to organics recycling and composting.
- The global GHG reduction impacts of achieving these waste and recycling reductions are significant; however, much of that reduction may happen out of state. Most of the GHG emissions that can be reduced through aggressive waste prevention and recycling are achieved through the life cycle of products and packaging; i.e., when a recycled material is substituted for a virgin material, or when a material is not manufactured at all, thereby avoiding the mining, extraction, and much of the production impact. While many of the reductions related to organics recycling and composting would occur in-state, the export of the waste generated by half the state's population (in New York City, and Nassau and Suffolk counties) further complicates the analysis of reductions within the state's boundaries.
- This policy has several additional benefits. This policy could result in substantial opportunities for the creation and expansion of businesses in New York State. DEC estimates that this policy could create more than 70,000 jobs. The jobs and businesses would generate much needed tax revenue for the state. In addition, reducing the amount of waste going to disposal reduces the environmental and public health impacts of waste handling, transfer, transport, and disposal. While such a reduction benefits all New York State communities, it is of particular relevance to environmental justice communities, which often bear a disproportionate burden with respect to the solid waste management facilities and

infrastructure.

INTEGRATED FARM MANAGEMENT PLANNING and APPLICATION (AFW-4)

Policy Summary

This policy option introduces a farm-level system-based integrated approach to reducing agricultural GHG emissions and proactively positions New York State agriculture for a carbon-constrained future. Integrated Farm Management Planning and Application will provide the resources necessary for farms: (1) to develop comprehensive, farm-specific plans to reduce GHG emissions, increase carbon sequestration, and address agricultural adaptation challenges resulting from a changing climate; and (2) to implement the necessary suite of practices to achieve those objectives. This policy adds managing GHGs as an on-farm resource management objective.

The existing New York State Agricultural Environmental Management program, outfitted with technical standards and practices for GHG mitigation and carbon management, could be employed to develop farm-specific, GHG conservation plans to coordinate implementation of the best suite of GHG practices for the farm.

Providing producers with a suite of possible practices to improve on-farm environmental performance ensures that the diversity inherent in New York State agriculture is recognized and that the potential synergies among climate, air quality, and water quality benefits of individual practices and technologies are captured and capitalized upon.

Quantification

The policy scenario includes: (1) by 2013, develop a comprehensive catalog and process for planning and implementing GHG management practices and systems; and (2) by 2015, complete training and certification of conservation professionals to develop site-specific GHG management plans. The scenario for 2030 is 100 percent of mid-sized to large livestock farms have developed and fully implemented comprehensive GHG management plans (835,000 dairy cows and 1,670,000 acres); 30 percent of small livestock farms, 80 percent of grain and vegetable farms, 90 percent of orchards and vineyards, and 100 percent of greenhouses have developed GHG management plans; and 10 percent of small livestock farms, 33 percent of grain and vegetable farms, 10 percent of orchards and vineyards, and 10 percent of greenhouses have fully implemented GHG plans.

This policy option bundles a number of behind-the-farm-gate mitigation practices under the umbrella of a comprehensive GHG management plan. These practices include feed management, manure management, nutrient management, soil management, composting, grazing, pest managemen,t and water efficiency. Metrics and timelines that recognize the size and type of farm have been established for each component practice.

Anaerobic digestion of livestock waste is included under this policy option as it is an integral component of manure management systems.

Soil carbon management practices related to changes in tillage practices were not quantified due to uncertainty of net carbon benefits presented in recent research.

The GHG reduction potential, total cost or savings (as measured by net present value), and cost effectiveness (as measured by $/tCO$_2$e) for the policy scenario quantified by the Technical Work Group are presented below.

GHG Reductions ($MMtCO_2e$)		Net Present Value: Savings (Million $)	Net Savings per Avoided Emissions ($/tCO$_2$e)
2030	Total 2011–2030		
0.6	6.5	-$201	-$31

$/tCO$_2$e = dollars per metric ton of carbon dioxide equivalent; GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent.

Negative values represent savings.

Special Considerations

- Quantification of an integrated comprehensive approach on a practice-by-practice basis may not capture the cumulative GHG reductions that may occur.
- Improved soil carbon practices could increase carbon-sequestration gains in the future, but additional research is required.
- These practices have significant water and air quality benefits; therefore, there is an opportunity to leverage additional resources to implement practices.
- There may be an opportunity to use current and future carbon market mechanisms to increase implementation rates.
- As with several of the other AFW policy options, the level of technical capacity and behavior change required to achieve these changes is significant.
- Since this policy is based on development of a Comprehensive Farm-Level GHG Management Plan, this policy works in concert with AFW-1: Production of Sustainable Feedstocks, AFW-6: On-Farm Energy Efficiency and Production of Renewable Energy, AFW-5 Conservation of Open Space, AFW-7 Improved Forest Management, and AFW-3: Waste Reduction. Through these linkages, AFW-4 is secondarily related to components of PSD, RCI, TLU (biomass supply, energy efficiency, and renewable energy, respectively).
- As the primary means of delivering outreach, education, and technical assistance to the agricultural community, this policy is designed to incorporate significant components of adaptation to climate change within individual farm GHG management plans.

ON-FARM ENERGY EFFICIENCY and PRODUCTION of RENEWABLE ENERGY (AFW-6)

Policy Summary

This policy option seeks to achieve meaningful GHG reductions through energy efficiency by employing a coordinated approach that addresses all forms of on-farm energy consumption including embedded energy. These efficiency gains can be realized through a comprehensive energy audit, which is a multi-disciplinary approach to energy-use analysis including equipment, structural, and management related energy use, as well as identification of renewable energy opportunities. Deployment of these energy efficiency measures will require shifts in farm-level management practices.

The agricultural sector's natural capacity (sun, wind, land area, available biomass) to generate energy exceeds its energy demand. This policy also seeks to capitalize on agriculture's ability to produce energy using multiple sources and renewable energy technologies. Included in this policy is recognition that multiple technologies at varying scales can be co-located at individual operations.

As an implementation mechanism it is recommended that a State-level Agricultural Energy Program be established to facilitate energy efficiency and renewable energy efforts at the distributed generation level to achieve this aggressive policy. A sector-specific approach is necessary due to the unique nature of the agricultural sector. One of the challenges in meeting these changes is the diversity of the agricultural sector. The numerous types of operations (the dairy segment alone has multiple production systems each having very different infrastructure requirements) have very specific energy needs and present specific energy efficiency opportunities. The diversity within any given segment of the sector is due to a number of variables including age, location, and size of operation. This is very different from other sectors in which standardization of production and retail sales is the norm. The age of the agricultural building stock and infrastructure alone presents a significant opportunity for energy efficiency improvements.

The second challenge is financing on-farm energy efficiency and renewable energy measures. Farmers operate in very volatile markets with high risk and relatively small returns. Dairy, the primary segment of our agricultural economy, operates in a controlled market (i.e., price of milk is set at the federal level). The ability to invest significant amounts of planning time and capital in energy efficiency and renewable energy measures with rates of return that span multiple years predicated on unknown climatic (e.g., weather, disease, pest) and market forces (e.g., commodity recall unrelated to individual farm) completely outside of the control of individual farms is severely limited. An Agricultural Energy Program would begin to address these challenges. The program would be responsible for coordinating and administering comprehensive energy audits, coordinating efforts to streamline federal and state funding opportunities to maximize energy efficiency and renewable energy implementation as identified in the comprehensive energy audit, coordinating with utilities to facilitate interconnection, offering grant application assistance to interested farmers, tracking implementation and documenting results, supporting and coordinating research efforts related to energy efficiency and renewable energy, and technology improvements required to achieve farm-level carbon efficiency.

Quantification

The policy scenario is a 40 percent fossil-based energy reduction, and quantification assumes 26,778 farms deploying energy efficiency measures. Quantification is based on a limited number of currently available energy efficiency measures for which cost data exist. To achieve the renewable energy deployment for 65 percent of farms (23,660), quantification assumes the mix of generation will be 25 percent wind technology, 30 percent solar thermal technology, and 45 percent solar photovoltaics (PV). Quantification is based on currently available renewable energy technologies for which cost data exist (PV, wind, solar thermal). Quantification is based on the extrapolation of current renewable energy deployment rates for PV and wind. Quantification is sensitive to cost of energy efficiency and renewable energy implementation and the type of technology ultimately deployed.

The GHG reduction potential, total cost or savings (as measured by net present value), and cost effectiveness (as measured by $/tCO$_2$e) for the policy scenario quantified by the Technical Work Group are presented below.

GHG Reductions (MMtCO$_2$e)		Net Present Value: Cost (Million $)	Net Cost per Avoided Emissions ($/tCO$_2$e)
2030	Total 2011–2030		
0.4	3.8	$3	$1

$/tCO$_2$e = dollars per metric ton of carbon dioxide equivalent; GHG = greenhouse gas; MMtCO$_2$e = million metric tons of carbon dioxide equivalent.

Special Considerations

- This policy builds on existing RPS-Customer-Sited Tier program goals by significantly increasing renewable energy deployment rates after 2015.
- Since anaerobic digestion (AD) is an on-farm management system that influences many other farm management systems, quantification of AD is included under AFW-4.
- There may be significant interconnection and reliability concerns related to the scale of distributed generation in rural areas.
- This policy represents an adaptation strategy regarding heat stress in livestock, which results in decreased milk yields and reproduction rates. Increasing the cooling capacity in livestock housing will increase energy usage. Energy efficiency and renewable energy technologies can mitigate negative impacts resulting from increased energy uses.
- Renewable energy technology requires significant upfront capital investment. It is possible that without coordinated and/or increased state and federal assistance that New York farms will be unable to purchase renewable energy technology on the scale outlined in this policy.
- This policy is cross-cutting with overlap in several areas, including AFW-4, PSD, and RCI. This policy also impacts existing state policies, including RPS, the energy efficiency portfolio standard, and the Regional Greenhouse Gas Initiative.

- This policy provides significant workforce development and community-scale energy opportunities in rural areas.

CONSERVE OPEN SPACE, AGRICULTURAL LAND, and WETLANDS (AFW-5)

Policy Summary

This policy option reduces the rate at which open space, including agricultural lands, forests, and wetlands are converted to developed uses and increases the acreage in open space. Conversion may be prevented through conservation land grants, landowner incentives, regulation, fee acquisition, and purchase of conservation easements by State and local governments, or nonprofit land preservation organizations. Support for agriculture and forest products may reduce the risk of conversion to an undesirable land use.

Quantification

The policy scenario is described as follows:

- Increase New York State agricultural land, as defined by the National Agricultural Statistics Service, 25 percent by 2050 without converting mature forest. Restore 475,000 acres of agricultural land (25 percent of the acreage lost since 1984) by 2020 and restore a total of 950,000 acres of agricultural by 2030. Permanently protect, through the State's Farmland Protection Program, 200,000 acres by 2020 and 400,000 additional acres by 2030 of agricultural land with the highest risk of conversion to higher-carbon intensive uses.
- Maintain or increase forestland acreage, without converting agricultural land to forest, unless the agricultural land would have higher carbon sequestration potential. Extend protections to an additional 700,000 acres of forestland under threat of conversion by 2030 through a number of tools, including private land stewardship programs, working forest conservation easements, and tax incentives. Work to maintain or increase the parcel size of private forestland.
- Protect and restore freshwater and tidal wetlands through acquisition of fee or easement and regulation to prevent releases of GHGs which will allow existing freshwater and tidal wetlands to continue to sequester carbon and mitigate the effects of more intense storm events caused by climate change.

  The GHG reduction potential, total cost or savings (as measured by net present value), and cost effectiveness (as measured by $\$/tCO_2e$) for the policy scenario quantified by the Technical Work Group are presented below.

GHG Reductions ($MMtCO_2e$)		Net Present Value: Savings (Million $)	Net Savings per Avoided Emissions ($\$/tCO_2e$)
2030	Total 2011-2030		
5.5	95	$1,500	$16

Special Considerations

Uncertainties

- Price of fee and easements can vary greatly with location of the parcel and the terms of an easement.
- Viability of farm operations is vitally linked to the health of available markets for farm products.
- Ability of agricultural land and forestland to produce current crop species is climate dependant. Shifts in climate may alter the species that can be grown. The flux of sequestered carbon in a shift of plant species is an uncertainty.
- Leakage in the case of forest land protection is a concern because development could still happen on unprotected acres within the state, or could be shifted out-of-state. Connecting this policy with smart growth strategies is of upmost importance to avoid leakage issues.
- Existence of wetlands is dependent on climate and rainfall patterns. If these patterns shift, existing wetlands may disappear and new wetlands may form. The balance of this flux remains uncertain.

Feasibility Issues

- Increasing agricultural land and forest land are not mutually exclusive strategies. Shifts between agricultural and forest land must be evaluated on a case by case basis.
- Funding: Consistent funding is needed to ensure the protection of valuable open space, and agricultural and wetland resources to mitigate and adapt to climate change. A diversity of funding and capacity is needed at all levels of government, federal, State and local, as well as private investment through non-governmental organizations, landowners, and private citizens.
- Local government capacity: New York is a home rule state, and the vast majority of land-use decisions are made at the local level. Capacity building at the local level is necessary to help local governments make good decisions. Many land conservation projects are dependent on local government capacity to fund and complete projects.

Adaptation

- The change in climate will have an impact on some plant species' ability to grow and thrive. Longer growing seasons potentially increase biomass productivity if not limited by drought or nutrients.
- Increased winter rain and increased total runoff could expand some wetlands. Increased summer evaporation will decrease the hydroperiod of some wetlands.
- There is a need for additional riparian corridor protection and restoration to mitigate effects of predicted increase of intensity and duration of storm events, and possible extended periods of drought.
- Connectivity between wildlife habitats will be needed to facilitate climate related migrations.

- The balance among carbon sequestration, adaptation, and other ecosystem services must be examined.

Co-benefits

- Co-benefits include water quality protection, flood mitigation through riparian buffers, wetlands and storm water retention, clean air and reduced pollutants, improved quality of life, wildlife habitat protection and connectivity for migration and adaptation, and avoided additional costs of sprawling development.

Environmental Justice

- Lack of open space, waterfront access, stormwater management, and the destruction of wetlands are significant environmental justice concerns for many overburdened and low-income communities. Many of the specific proposed actions in this policy area could help to address one or more of these concerns in such communities.

IMPROVED FOREST MANAGEMENT for CARBON BENEFITS (AFW-7)

Policy Summary

This policy option seeks to develop a renewed and improved stewardship ethic among decision makers that control rural forest lands and existing and potential urban planting spaces. Through a wide variety of incentives, education, and technical assistance and support, both proven and innovative practices could be applied to New York's forests and urban areas to sequester additional carbon, save energy, and, at the same time, supply New Yorkers with additional and improved co-benefits supplied by improved forest management and green infrastructure related practices.

Policy actions will be led by developing and implementing a system for identifying recently unmanaged or neglected and degraded forest lands that are not stocked with trees to full potential. A similar system will be developed for identifying vacant rural land that is unsuitable for agriculture but suitable for reforestation with native trees.

Subsequent actions include the following:

- Using various methods for forest management, site preparation, and wildlife management allow for natural regeneration of trees at appropriate levels for optimum stocking levels;
- Developing forest management plans and applying methods and technologies that increase overall forest productivity, heath, and benefits while increasing the rate and levels of carbon sequestration in trees, soil, and durable wood products;
- Increasing forest cover and associated carbon stocks by planting native tree species on vacant lands that are unsuitable for agricultural use; after establishment, employing forestry practices that maintain and enhance the ability of the forest to sequester carbon and provide forest related benefits;

- Maintaining and improving the health and longevity of existing trees in urban settings and increasing tree cover area by planting new trees;
- Developing and supporting prevention, early detection, and rapid response programs that prevent invasive and destructive forest pests and mitigate or eradicate the impacts of current or future introductions that threaten forest carbon stores.

Quantification

Three scenarios were quantified under this policy option. The GHG reduction potential, total cost or savings (as measured by net present value), and cost effectiveness (as measured by $/tCO$_2$e) for the policy scenarios quantified by the Technical Work Group are presented below.

1. Identify and treat 25 percent of all under-stocked forest stands on timberland by 2025 in order to achieve full stocking level.

GHG Reductions (MMtCO$_2$e)		Net Present Value: Cost (Million $)	Net Cost per Avoided Emissions ($/tCO$_2$e)
2030	Total 2011–2030		
4.7	49	$290	$6.0

$/tCO$_2$e = dollars per metric ton of carbon dioxide equivalent; GHG = greenhouse gas; MMtCO$_2$e = million metric tons of carbon dioxide equivalent.

2. Increase tree canopy cover in cities, villages, or hamlets by 50 percent by 2030.

GHG Reductions (MMtCO$_2$e)		Net Present Value: Cost (Million $)	Net Cost per Avoided Emissions ($/tCO$_2$e)
2030	Total 2011–2030		
2.0	22	$3,200	$140

$/tCO$_2$e = dollars per metric ton of carbon dioxide equivalent; GHG = greenhouse gas; MMtCO$_2$e = million metric tons of carbon dioxide equivalent.

3. Identify and reforest 50 percent of all suitable vacant idle land in the state by 2025.

GHG Reductions (MMtCO$_2$e)		Net Present Value: Cost (Million $)	Net Cost per Avoided Emissions ($/tCO$_2$e)
2030	Total 2011–2030		
2.4	34	$1,200	$36

$/tCO$_2$e = dollars per metric ton of carbon dioxide equivalent; GHG = greenhouse gas; MMtCO$_2$e = million metric tons of carbon dioxide equivalent.

Special Considerations

- The establishment of new forests by planting native trees on vacant land conflicts with the establishment of dedicated energy crops on vacant land proposed in AFW-1. In addition, overlap exists with the AFW-1 proposal to identify vacant lands suitable for tree planting.

- Improving forest management practices in rural forests for carbon sequestration and other benefits is a challenging proposition for a number of reasons. For example, goals and objectives of owners for their forests may require management that does not take into account societal benefits that accrue from improved carbon management. In addition, the long-term nature of forest growth and the extended timeframe of revenues from timber harvesting provide challenges such as investment of capital or willingness to accept opportunity costs needed to improve forest growth and benefits.

INCREASE THE AVAILABILITY OF LOCALLY PRODUCED FOOD (AFW-8)

Policy Summary

Increasing the availability of locally produced foods to New York State residents can reduce the energy required for transportation, packaging, and marketing; enhance rural economic development; improve health and nutrition; and increase food security and food safety. However, for this small but growing share of U.S. agricultural production there remains a lack of empirical evidence to definitively support the claims of GHG reductions associated with local foods. Recently the U.S. Department of Agriculture Economic Research Service (ERS) released a comprehensive literature review of the current understanding of local food systems.[7] The study had the following key findings:

- Local food markets account for a small but growing share of total U.S. agricultural sales.
- Production of locally marketed food is more likely to occur on small farms located in or near metropolitan counties.
- Consumers who value high-quality foods produced with low environmental impact are willing to pay more for locally produced food
- Empirical research has found that expanding local food systems in a community can increase employment and income in that community.

Although much research remains to be completed on the direct reduction of GHGs resulting from local foods, this policy option promoting increasing the availability of local foods is complementary to several other GHG mitigation policy options, including AFW-5 and TLU-11 by encouraging an alternative land use to development in those areas experiencing the greatest land-use conversion pressure; TLU-10 by enhancing local open space conservation efforts; and AFW-3 by encouraging minimal processing and packaging of locally produced food. Direct to consumer sales also provide producers with a higher rate of return, which further reduces the rate

[7] Martinez, Steve, et al. *Local Food Systems: Concepts, Impacts, and Issues,* ERR 97, U.S. Department of Agriculture, Economic Research Service, May 2010.

of land conversion to developed uses and better positions producers to cope with potentially costly adaptation strategies.

Building on the work of the New York State Council on Food Policy this policy option seeks to employ a multi-faceted approach to increase the availability of locally produced food to New York State consumers.

Quantification

This policy option is currently not quantifiable.

Since this is an emerging field of research it is fully expected that in the future, as additional empirical studies are completed, it will be possible to quantify GHG reductions for this policy.

Special Considerations

- Several of the proposed policy initiatives involve significant levels of federal funding and subsidies including food assistance programs and school meal programs. State policies that encourage or incentivize local foods within these programs must be consistent with federal policies.
- Technical: Currently New York-specific data quantifying food miles traveled and the resulting benefits have not been thoroughly studied. Additionally, it must be recognized that food-mile reductions must be assessed on a product-by-product basis that includes life-cycle analyses of the numerous crop specific inputs and concomitant production methods.
- Financial: In the short term, increased public funds will be needed to expand existing direct marketing programs; this may be somewhat problematic during austere budget times regardless of the benefits.
- Political support: According to a recent Cornell University survey "Imported food is a concern for 72.6 percent of shoppers surveyed and "Local" is sought by almost 70 percent of shoppers."

RESEARCH, DEVELOPMENT, AND DEMONSTRATION NEEDS FOR THE AGRICULTURE, FORESTRY, AND WASTE SECTOR (AFW-9)

See Chapter 10 for a complete presentation of Research, Development, and Demonstration needs for this sector.