Mid-Hudson Regional Sustainability Plan

Draft – November 30th, 2012

Prepared For:
Mid-Hudson Planning Consortium
County of Orange, Co-Chair
Town of Greenburgh, Co-Chair

Prepared By:

ecology and environment, inc.

This Plan is funded through the Cleaner Greener Communities Program, New York State Energy Research and Development Authority

CLEANER GREENER COMMUNITIES

DISCLAIMER

This planning effort was funded as part of the New York State Energy Research and Development Authority's (NYSERDA) Cleaner Greener Cities program. This plan is in accordance with Orange County Agreement No. 26206 with NYSERDA. NYSERDA has not reviewed the information contained herein, and the opinions expressed in this report do not necessarily reflect those of NYSERDA or the State of New York.

The present document is a working draft. Content from this document should not be used nor cited until the final version has been approved by NYSERDA and published.

Table of Contents

List of Attachments

List of Tables

List of Figures

Acronyms

B-MRF – Building Material Reuse Facility

C & D – Construction and Demolition

CAFE – Corporate Average Fuel Economy

CSA – Community Supported Agriculture

DCRRA – Dutchess County Resource Recovery Agency

DEF – (Westchester County) Department of Environmental Facilities

EPA – Environmental Protection Agency

HHW – Household Hazardous Waste

H-MRF – Household Materials Recovery Facility

HVRC – Hudson Valley Regional Council

IWS - Interstate Waste Services

MMtCO2e – Million Metric Tons of carbon dioxide equivalent

MMWG – Materials Management Working Group

MPO – Metropolitan Planning Organization

MRDC – Municipal Recycling Drop-off Center

MRF – Materials Recovery Facility

MSW – Municipal Solid Waste

MTA – Metropolitan Transportation Authority

MWC – Municipal Waste Combustor

NJ TRANSIT – New Jersey Transit

NYC – New York City

NYS – New York State

NYSDEC – New York State Department of Environmental Conservation

PAYT – Pay As You Throw

rbST - Somatotropin

RCSWMA – Rockland County Solid Waste Management Authority

REDC – (Mid-Hudson) Regional Economic Development Council

RHRF – Recyclables Handling and Recovery Facilities

RRF – Resource Recovery Facility (Waste-to-Energy)

SSL – Source Separation Law

SWMP – Solid Waste Management Plan

T & D – Transport and Disposal

TLU/LC WG – Transportation & Land Use / Livable Communities Working Group

UCRRA – Ulster County Resource Recovery Agency

VMT – Vehicle Miles Traveled

Acknowledgements

Mid-Hudson Regional Consortium

Orange County, Co-Chair
Dave Church, Planning Commissioner
Kelly Dobbins, Senior Planner
Kate Schmidt, Planner
Martha Boulanger, Account Clerk

Town of Greenburgh, Co-Chair
Thomas Madden, Commissioner
Keith Eversly, Project Coordinator

Dutchess County
Kealy Salomon, Planning Commissioner
Mark Debald, Transportation Council

Putnam County
John Tully, Deputy County Executive
Patricia Simone

Rockland County

Sullivan County
Luiz Aragon, Planning/Environmental Commissioner
Dick Riseling, SASD

Ulster County
Dennis Doyle, Planning Director
Amanda Lavalle, Coordinator, Dept. of Environment

Westchester County
Edward Buroughs, Planning Commissioner

CRREO - SUNY New Paltz
Gerald Benjamin, Director
K.T. Tobin, Assistant Director

Pace University - Land Use Law Center

Mayors' Redevelopment Roundtable
Mary Foster, Mayor, City of Peekskill
Judy Kennedy, Mayor, City of Newburgh
Jessica Bacher, Land Use Law Center
John Nolon, Land Use Law Center

New York Council of Nonprofits
Audrey Grifel, Capacity Building Advisor
Susan Weinrich, Vice President

Northern Westchester Energy Action Consortium (NWEAC)
Herb Oringel
Michael Gordon

Southern Westchester Energy Action Consortium (SWEAC)
Nina Orville
Nicola Coddington

Mid-Hudson Regional Economic Development Council

Aimee Vargas, Director

March Gallagher, Ulster County Deputy Director for Economic Development – Project Liaison

Luiz Aragon, Sullivan County – Project Liaison

Working Group Co-Chairs

Agriculture and Open Space

Deborah Dewan, Rondout Valley Growers
MaryAnn Johnson, Hudson Valley Agribusiness Development Corp
Dick Riseling, Sullivan County

Economic Development
Herb Oringel, NWEAC
Jeff Rumpf, Clearwater
Dave Church, Orange County

Energy
Michael Gordon, NWEAC
Richard Thomas, NY Affordable Reliable Electricity Alliance
Dick Riseling, SASD
Thomas Madden, Town of Greenburgh

Land Use, Livable Communities and Transportation
Nadine Lemmon, Tri-State Transportation Campaign
Daniel Richmond, Zarin & Steinmetz
Dennis Doyle & Amanda Lavalle, Ulster County

Materials Management
Gerald Benjamin, CRREO – SUNY New Paltz
Anna Roppolo, Rockland County Solid Waste

Water
Scott Cuppett, NYS DEC, Hudson River Estuary Program
Russell Urban-Mead, the Chazen Companies
Dave Church, Orange County

Project Consultants

Ecology & Environment, inc. (E & E)
Michael Wironen, Lead Project Manager
Daniel Herrera
Julie Chang
Bob Singer
James Dumpert
Nermin Ahmad
Nicole Parganos
Thomas Heins
David Weeks

Regional Plan Association (RPA)
Dan Schned, Project Manager
Osman Dadi
Petra Todorovich
Fiona Zhu
Rob Lane
Jeff Zupan
Corey Piasecki

Vanessa Hangen and Brustlin, Inc. (VHB)
Owen Wells, Project Manager
John Saccardi
Emmanuelle Humblet
Lauren Wang

Croton Energy Group
Leo Wiegman, Project Manager
Ed Robin

Clearwater, Inc.
Victor Melendez, Project Coordinator

Working Group Members

Agriculture/Foodsheds

Michael Baden
Gail Beverly
Jan Blaire
Sarah Brannen
Ava Bynum
Betsy Calhoun
Craig Cashman
Tara Collins
Jose Colon
Carrie Davis
Jim Delaune
Samantha Diliberti
Kelly Dobbins
Mimi Edelman
Phil Ehrensaft
Olivia Farr
Stefan Gieger
Steve Gold
John Grazinski
Dan Guenther
Liz Higgins
Eileen Hochberg
Liana Hoodes
Noela Hooper
Jan Howard
Virginia Kasinki
Sharon Kroeger
Jennifer Mall
Mary Marster
George Michaud
Ken Migarelli
Allison Morrill
Chatrchyan
Althea Mullarkey
Brian Obach
Corey Piasecki
Cheryl Rogowski
Penny Steyer
Lauri Taylor
Ryan Trapani
David Weeks
Daniel Young

Economic Development

Kevin Bailey
Ron Bartley
Lea Cullen Boyer
Mark Castiglione
Anthony Davidowitz
Jim Delaune
Melissa Everett
Gennaro Faiella
March Gallagher
Dani Glaser
Susan Habel
Rick Herbeck
Ralph Huddleston
Shawn Joyce
Judy Kennedy
Erin Loosen
Victor Melendez
Ryan Meres
Bernard Molloy
Michael Oates
Laurence O'Connell
Jim Pinto
Linda Puoplo
John Saccardi
Kathy Schibanoff
Jeremy Schulman
Allan Scott
Christopher Steers
Gregg Swanzey
Mary Kay Vrba
Lauren Wang
Eric Zamft

Energy

Neil Alexander
Rick Alfandre
Bob Alpern
Robert Backus
Tino Baguio
Chris Bernabo
Edward Blundell
Kippy Boyle
John Burke
Betsy Calhoun
George Calvi
Anthony Campagiorn
John Carton
Allison Chatrchyan
Andy Chintz
Nicola Coddington
Hartley S. Connett
Mark Courtner
Pat Courtney-Strong
Bill Cox
Vince Cozzlino
Sue T. Crane
Michael D'Arcy
Joe Del Sindico
David Dell
Charles P. Duffy
Robin Ed
Colleen Emery
Melissa Everett
Charles Feit
Stephen Filler
Drew Fixell
Ginny Forni
Ross Gould
Manna Jo Greene
Alexander Gromack
John Hall
William Hanauer
Paul Heuston
Daniel Higgins
Laurie Husted
Eric Ilowsky
Craig Jacobs
Jeff Jones
Tom Kacandes
Ron Kamen
Kerry-Jane King
Peggy Kurtz
Vincent Lander
Daniel Leary
Ron Leonard
Rick Lewandowski
John J. Lynch
William Makofske
Frank Maricic
John Maserjian
Kelly Meyers
Paul Moskowitz
Carol Murphy
Libby Murphy
Mary Beth Murphy
Phillip Musegaas
Deborah Newborn
Meridith Nierenberg
Brian Nieves
Todd Olinsky-Paul
Nina Orville
Allan Page
James M. Palmer
Patricia Pomeroy
Linda Puglisi
Pete Robbins
Alexander Roberts
Lee V.A. Roberts
Dan Rosenblum
Baiyina Salahuddin
William Schlesinger
Rudy Scott
Charles B. Strome, III
Peter Swiderski
Harry Terbush
Mark Thielking
Pamela Timmins
Brad Tito
Cindi Vasta
Bruce Walker
Gary Warshauer
William Weaver

Dan Welsh
Leo Wiegman
Samantha Wilt
Zywia Wojnar
Abraham J.Zambrano

Transportation & Land-Use

Jeff Anzenvino
Jessica Bacher
Keith Betensky
Jennie Nolon Blanchard
Catherine Borgia
Marlene Connor
Neil Curri
Justin Datino
Mark Debald
Joseph D'Onofrio
Fran Dunwell
Doug Foster
Fred Frank
David Gilmour
Laura Heady
CJ Hoss
Gerald Jacobowitz
Jolanda Jansen
Guy Kempe
Robert LaColla
Rob Lane
Milagros Lecuona
William Long
Ian MacDougall
Jamie Martinez
Peter McCartt
Robert McKeon
John Nolon
Jim Osborne
Mark Porterfield
Linda Puoplo
Steve Rieger
Laura Rossi
Anthony Ruggiero
Candace Schafer
Dan Schned
William Schuster
Eleanor Sharpe
Peter Smith
Nortrud Spero
Padraic Steinschneider
Andy Stewart
KT Tobin
Petra Todorovich
Meg Walker
Nicholas Ward-Willis
Owen Wells
Dan Welsh
Jason West
Laura Woznitski

Waste

Michelle Bergkamp
James Best
Lindsay Carille
Christopher Crane
Neil Cutler
William Cutler
Matt De la Houssaye
James Dumpert
Keith Eversley
John Gebhards
Evadne Giannini
Kenneth Greehan
Emilie Hauser
Tom Heins
Anne Jaffe-Holmes
Terry Laibach
Christian Paggi
Mary Rice
Zoie Riel
Gary M. Ritchie
Timothy Rose
Mary-Jane Shimsky
MJ Wilson

Water

Aliesa Adelman
Matt Alexander
Bob Alpern
Bridget Barclay
Henry Bartosik
Jay Beaumont
Alison Boak
Tracy Brown
Brian Brustman
Michael Budzinski
Janet Burnet
Jordan Christensen
Kelly Dobbins
Fran Dunwell
Phil Ehrensaft
Stuart Findlay
Mark Gilliland
Simon Gruber
Steven Gruber
Peter Harckham
Emilie Hauser
Paul Heisig
Manna Jo Greene
Lorraine Keckeisen
Barbara Kendall
Carolyn Klocker
Peggy Kurtz
Diane Lewis
Cesare Manfredi
Mary McNamara
Arlene Miller
Dan Miller
Joseph Nicoletti
Steve Noble
Steve Osborn
Christian Paggi
Ryan Palmer
Nicole Parganos
Fran Perchick
Brian Rahm
Jessica Ridgeway
Bill Schlesinger
William Shaw
Bob Singer
Sacha Spector
Don Steinmetz
Ira Stern
Emily Vail

Letter from the Consortium Chairs

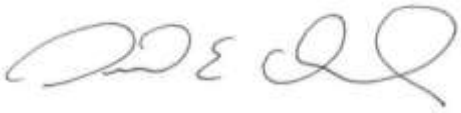
November 15, 2012

We are proud to present the draft Mid-Hudson Regional Sustainability Plan. The Mid-Hudson Region has a long tradition of stewardship of our natural environment. This nationally unique document summarizes a wealth of research, discussion, debate and activity centered on defining what "sustainability" means for our Region. The Mid-Hudson Regional Sustainability Plan is an important step and will help guide the Region towards a sustainable energy future that will dramatically reduce greenhouse gas emissions from current levels. This Plan promotes innovative solutions to real world problems and challenges residents, businesses, municipalities and organizations to take action to improve our Region. We hope in these pages to help define what those of us that live and work in this Region can do to act - first and foremost as members of the resident municipalities, organizations, and businesses that make the Mid-Hudson special.

Our Regional Sustainability Plan is published with the support of the Cleaner Greener Communities Program administered by the New York State Energy Research and Development Authority (NYSERDA). Thanks also go to Governor Andrew Cuomo and NYSERDA leadership for their vision in providing us the guidance and support to pursue this effort. Most important, we want to thank the hundreds of volunteers and professionals who actively participated in bringing their diverse needs, concerns, ideas, and projects that so enrich this Plan.

On behalf of the Mid-Hudson Planning Consortium, including representatives from seven (7) counties and numerous governmental and non-governmental leaders, we hope when you read this Plan that you consider something you can do to make our Region sustainable today and for future generations. By working together to take on this challenge our collective actions can and will make a difference in solving a large global problem on a regional scale.

Mid-Hudson Planning Consortium Co-Chairs



David E. Church, AICP
Commissioner of Planning
Orange County

Thomas Madden, AICP
Commissioner
Community Development & Conservation
Town of Greenburgh

Executive Summary

To be inserted – InDesign Layout

1 Introduction

This Chapter provides background and context needed to understand this planning effort and its outcomes. It includes a brief:

1. Introduction to the Mid-Hudson Region Sustainability Plan and its content
2. Description of New York State's *Cleaner, Greener Communities* program
3. A brief overview of the Mid-Hudson Region's land use patterns, geography, demographics, socio-economic trends, culture and history,
4. A guide to navigating the plan

1.1 The Mid-Hudson Regional Sustainability Plan

The Mid-Hudson Region of New York State (NYS) consists of the seven counties located immediately north of New York City (NYC): Westchester County, Rockland County, Orange County, Putnam County, Dutchess County, Ulster County, and Sullivan County (see Figure 1.1).

The Mid-Hudson Regional Sustainability Plan ("the Plan") was developed through research and consensus building processes including a series of stakeholder meetings held throughout the Region. The eight-month process included the formation of a planning Consortium consisting of senior representatives of each of the Region's seven counties as well as local non-governmental organizations representing business, municipalities, and engaged citizens. Six working groups were formed, comprised of over 300 volunteers. This unprecedented collaborative engagement was used to set

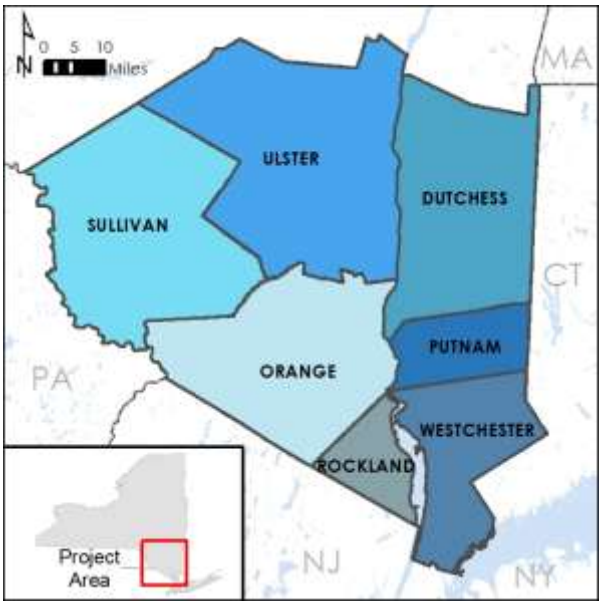


Figure 1.1 The Mid-Hudson Region

realistic yet ambitious objectives for the long-term sustainable development of the Region, each of which is supported by initiatives and projects that can be implemented in the short, medium, and long term. The proposed actions reflect and build on the Region's unique social, cultural, and natural history, with the goals of promoting economic development, environmental sustainability, and enhancing the quality of life for the Region's residents.

1.1.1 The Cleaner, Greener Communities Program

The Plan was developed as part of the New York State Energy Research Development Authority's (NYSERDA) *Cleaner Greener Communities* program, announced by Governor Andrew M. Cuomo in his 2011 State of the State address. This program is intended to empower the ten regions of NYS to take charge of sustainable growth in their communities by identifying and funding smart development practices. It provides a vehicle for planning teams throughout NYS to partner with public and private experts across a wide range of fields, along with community residents, to encourage discussion and lead the development of regional sustainability plans.

The participants in the *Cleaner, Greener Communities* program were asked to think through current conditions, consider various scenarios to optimize growth, and identify, shape and collaborate on actual projects that, when implemented, would significantly improve the economic and environmental health of their respective Region. The results of this effort will guide implementation of integrated solutions – from statewide investments to regional decision making on land use, housing, transportation, infrastructure, energy, and environmental practices – that can maintain and improve local quality of life.

> The Plan seeks to build on the Region's unique social, cultural, and natural history, while promoting economic development, environmental sustainability, and enhancing the quality of life for the Region's residents.

In adapting the over-arching goals of the *Cleaner, Greener Communities* program to the sustainability needs of the Mid-Hudson region, the Consortium identified five focus areas:

- Land Use, Livable Communities, and Transportation
- Agriculture and Open Space
- Energy
- Materials Management

- Water

In addition to the five core focus areas, the Consortium identified four cross-cutting topics:

- Climate Change Mitigation
- Climate Change Adaptation
- Economic Development
- Governance

A discussion of climate change mitigation and adaptation is woven into each core focus area chapter. Economic development is discussed with regard to the Region's recent Economic Development Strategy and the Plan's implementation strategy. Governance is discussed as part of the Plan's implementation strategy. Ongoing initiatives at the regional, county and local level were considered and integrated to the extent information was made available.

1.2 The Mid-Hudson Region

The Mid-Hudson Region covers just over 4,500 square miles, contains 198 municipalities, and is situated immediately north of NYC, sharing a border with the Borough of Bronx. The Region is defined by water, ranging from the coastal areas and tidal flats of Westchester County, to the estuaries of the lower Hudson, through to the mountain streams originating in the Catskills. The Region has a great diversity of human and natural landscapes, including dense, urbanized cities, small towns and villages, rural farms and orchards, and extensive undeveloped forest lands.

> Due to the fact that NYC makes up 42% of the entire population of NYS while occupying less than 1% of the land, it significantly skews state-wide statistics. Hence, many datasets present NYS figures with and without NYC.

1.2.1 Land Use and Development

The Mid-Hudson Region includes 10 percent of NYS' land area,[1] containing approximately 11 percent of its population and housing[2]. Over 900 square miles, or 20.6 percent of the Region, is defined by the 2010 U.S. Census as "urban area," with a minimum population density of at least 500 persons per square mile (see Figure 1.2). This is more than twice the amount of urban

[1] U.S. Census Bureau. 2010. Urban-Rural Classification.
[2] Ibid

area found in New York State (NYS) as a whole (8.7 percent urban area or 8.1 percent excluding NYC).

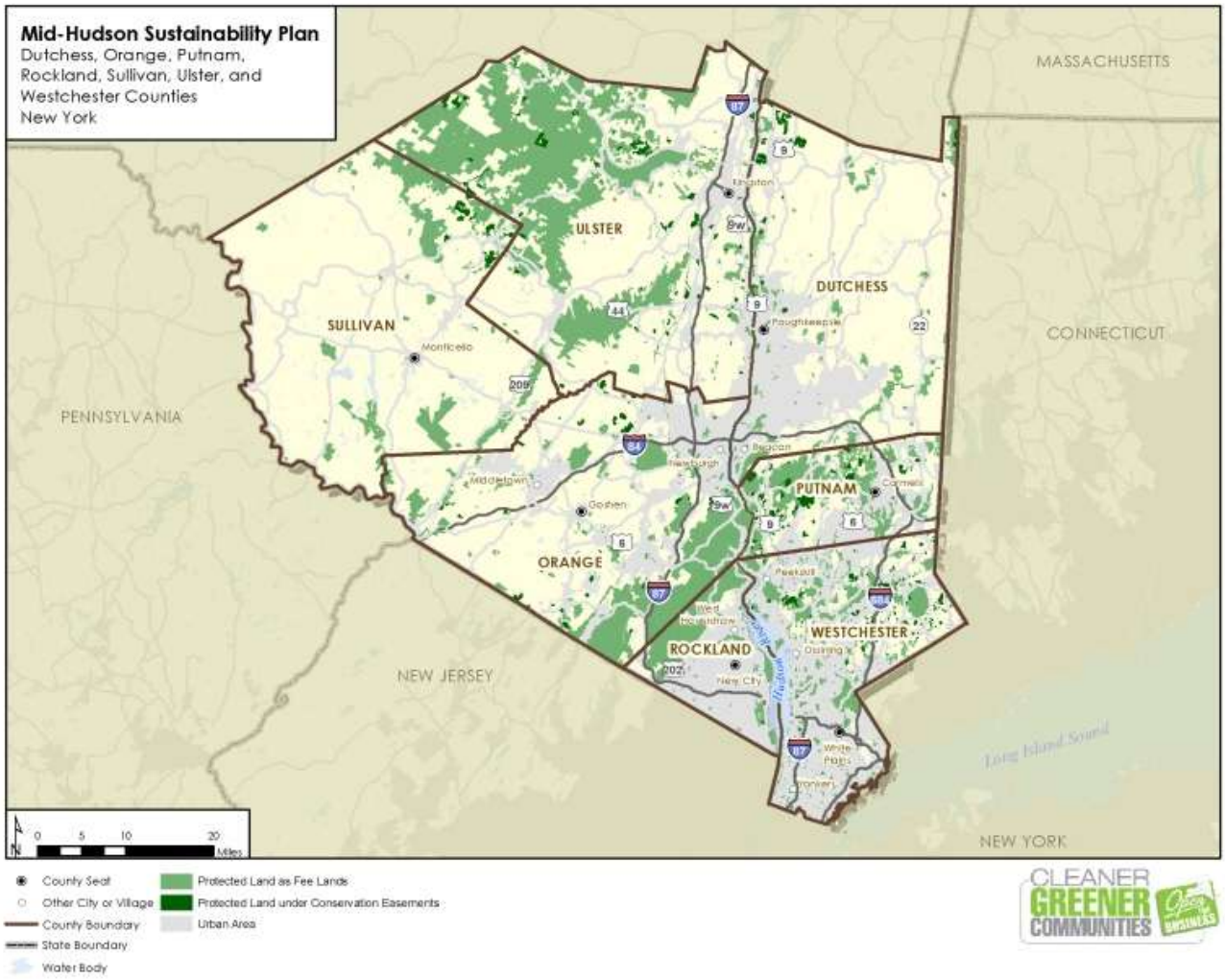


Figure 1.2 Regional Overview, 2010

Although the Region contains a disproportionate density of urban area when compared to NYS averages, such region-wide statistics mask considerable localized diversity. For example, the population density of Westchester County is over 2,200 persons per square mile, more than five times as densely populated as NYS as a whole (including NYC) and nearly 30 times as densely populated as Sullivan County, with only 80 persons per square mile[3]. The density of population, housing, and employment within the Region is concentrated in urban and suburban areas in the southeast and along the Hudson River (see Figure 1.3).

[3] Ibid

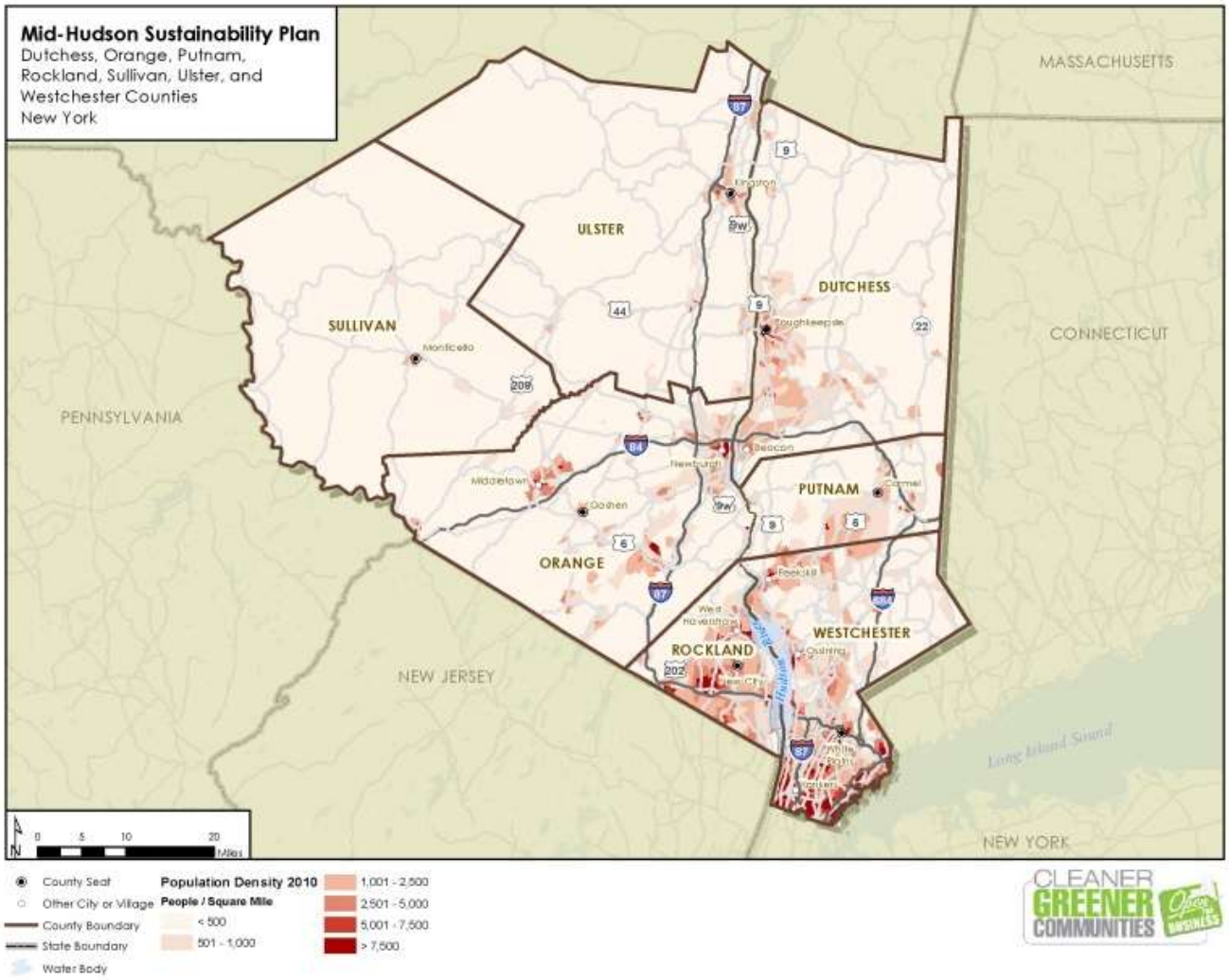


Figure 1.3 Population Density, 2010

While the Region has much developed land, it also has significant forest and open space. According to the Census, there are 531,200 acres of forestland, covering approximately 18 percent of the total area[4]. These data underrepresent the actual amount of forest cover – depending on the data set used, forests covers 60-90% of the Region, although a lot of this is highly fragmented forest interspersed amongst existing areas of development.

Much of the Region's preserved land and large, natural open spaces[5] are located in a greenbelt through the Hudson Highlands in southeast Orange and northwest Putnam counties, in the Catskill Forest Preserve of northwest Ulster and Sullivan counties, and along the Shawangunk

[4] New York State Property Assessment Data. 2012.
[5] Scenic Hudson. 2012. Protected Land.

Ridge in Ulster, Sullivan and Orange counties. According to Scenic Hudson, there are 618,100 acres of land protected from development either through public ownership of development rights or land conservation easements (21% of the Region's land).

Additionally, the Region contains 463,300 acres of park and recreational areas, making up 16 percent of the Region's total land area[6]. Because of this abundance of park and recreational land, more than 60 percent of the Region's population can access parks and recreational areas within one-half mile of their homes[7]. Note that there is considerable overlap among park land, protected land, and forested land.

Finally, in 2010, 323,154 acres were active farmland, representing approximately 11% of the Region's land area[8].

Historically, ferries and steamships were the predominant mode used to cross the Hudson River and travel north-south throughout the Region. However, their use has dropped off dramatically over the past few decades. For a period of time during the mid- to late-20th century there was no ferry service in the Region as people increasingly chose to utilize the Region's bridges and drive across the river. Service resumed in 2000 with the opening of the Haverstraw-Ossining Ferry and increased with the opening of the Newburgh-Beacon Ferry in 2005.

1.2.2 Connectivity

The Hudson River has been a major corridor for trade, transportation, and cultural exchange since before the United States' founding. Many of the Region's communities are built along the banks of the Hudson, connected by an extensive network of bridges, roads, and rail lines. Multiple major highways traverse the Region, connecting it with the rest of the Northeast and Canada.

The presence of the United States' largest city immediately to the Region's south has influenced its development patterns for more than a century. The network of commuter trains and local bus services provides many parts of the Region with a high degree of mass transit service. This allows residents multiple choices of mobility, providing access to jobs and services throughout the Region as well as in NYC. In 2010, 11.7 percent of commuters used public transportation to get to work compared with less than 5 percent of the nation's workers[9]. An estimated 21 percent of the Region's population and 20 percent of their jobs are

[6] Scenic Hudson. 2012. Parks and Recreation Data.
[7] U.S. Bureau of the Census. 2010. Census of Population and Housing.
[8] Census of Agriculture, 2010.
[9] U.S. Bureau of the Census. 2010. American Community Survey.

within one mile of a rail station, and approximately 39 percent of people and 38 percent of jobs are within a half mile of a bus stop[10].

In 2010, the 12 bus operations in the Region carried 50.6 million passengers, who traveled over 182 billion miles. That same year, nearly 30 million passengers boarded a Metro North train. The Region's transit ridership is concentrated in Westchester County, while direct service is also offered in 5 of the Region's 7 counties on both sides of the Hudson River. In 2010, Westchester County had more than twice as many buses in operation as all other counties combined, facilitating ridership. In 2010, there were over 34,000 bus rides taken per 1,000 capita in Westchester compared with 4,100 per 1,000 capita in the rest of the Region. Over 20 percent of Westchester County commuters take transit to work and roughly two-thirds of those commuters take the train[11].

1.2.3 Socio-Economics

The Mid-Hudson Region is home to approximately 2.3 million people, with tremendous diversity from county-to-county. Putnam and Sullivan counties both have populations under 100,000 whereas Westchester County has nearly one million residents, which underscores the significant differences in population density between counties. These demographic differences are reflected in the unique income, housing and employment profiles of each county. Table 1.1 presents the population and number of households in the Region by county. The average household size is 2.71 persons.

TABLE 1.1 POPULATION AND HOUSEHOLD CHARACTERISTICS, 2010

Location	Population	Percentage of Total Population	Number of Households	Population Density per square mile
Dutchess	297,488	13%	106,952	373.90
Orange	372,813	16%	124,379	459.30
Putnam	99,710	4%	34,907	432.94
Rockland	311,687	14%	97,557	1,795.95
Sullivan	77,547	3%	29,722	80.10
Ulster	182,493	8%	70,691	162.33

[10] U.S. Bureau of the Census. 2010. Census of Population and Housing.
[11] Census, American Community Survey, 2010 5-year estimates

TABLE 1.1 POPULATION AND HOUSEHOLD CHARACTERISTICS, 2010				
Location	Population	Percentage of Total Population	Number of Households	Population Density per square mile
Westchester	949,113	41%	345,795	2,204.68
Region	2,290,851	100%	810,003	498.12

Source: 2010 U.S. Census, American Community Survey 5-Year Estimates, 2010.

The Region has a fairly typical rental vacancy rate of 9.3 percent, and most county rental vacancy rates lie within five points of the national average[12]. Vacant housing units in the Region vary widely from county to county from a low of 5.5% in Rockland County to a high of 38.9% in Sullivan County[13]. The reasons for the discrepancy vary[14]. For example, second homes (vacation homes) are counted as vacant, skewing the numbers in places with a significant stock of second homes. Additionally, the varying impacts of the subprime mortgage crisis as well as trends in unemployment have a concomitant impact on vacancy rates.

Median household income was $60,751 in 2010 (see Table 1.2), fifteen percent higher than the national average and nearly ten (10) percent higher than the state average. Income differences likely reflect the Region's concentration of highly educated workers and the effects of labor market spillover from NYC. In 2009, 8.2 percent of the Region's families lived below the poverty line, roughly 6 percentage points lower than both the national and the NYS average.

TABLE 1.2 HOUSEHOLD INCOME AND POVERTY RATE, 2010			
Location	Average Household Income	Median Household Income	Poverty Rate for Families (%)
Dutchess	$85,739	$69,838	5.7
Orange	$83,948	$69,523	7.5
Putnam	$108,365	$89,218	2.5

[12] http://www.census.gov/housing/hvs/files/qtr212/q212press.pdf
[13] http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_11_3YR_DP04&prodType=table
[14] http://www.recordonline.com/apps/pbcs.dll/article?AID=/20110417/NEWS/104170336

TABLE 1.2 HOUSEHOLD INCOME AND POVERTY RATE, 2010			
Location	Average Household Income	Median Household Income	Poverty Rate for Families (%)
Rockland	$105,450	$82,534	7.2
Sullivan	$60,596	$48,103	10.7
Ulster	$73,407	$57,584	6.9
Westchester	$128,127	$79,619	5.8
Region	$92,233	$60,751	8.19

Source: American Community Survey 5-Year Estimates, 2010.

Adults in the Mid-Hudson Region are more likely to have at least a Bachelor's degree than the average American. Strikingly, adults in Westchester and Rockland Counties are more than twice as likely to have a Bachelor's degree as adults in Sullivan County.

Westchester and Rockland Counties also have the highest percentages of non-English speaking adults, with 12.3 and 15.5 percent of adults speaking English less than "very well," respectively. According to the Gini coefficient, a measure of inequality, these two counties also have the highest degree of income inequality. Nonetheless, the Region has lower income inequality than NYS or the United States as a whole.

The number of jobs in the Region has held steady at around 864,000 over the past decade. Wages have increased by almost 50 percent in the service and public sectors, but have not experienced the same growth in goods-producing industries.

The service industry is the main employer, most notably in Westchester County. Service producing industries in Westchester County account for 76 percent of county employment, compared to an average of 68 percent in the Region's six other counties. The top five employing industries in the Region include healthcare, retail trade, hospitality and food services and professional services (see Table 1.3 and 1.4).

TABLE 1.3 INDUSTRIES WITH THE MOST EMPLOYEES THROUGHOUT THE REGION		
Rank	Industry	Number of Employees
1	Health care and social	152,527

TABLE 1.3 INDUSTRIES WITH THE MOST EMPLOYEES THROUGHOUT THE REGION

Rank	Industry	Number of Employees
	assistance	
2	Retail trade	109,907
3	Accommodation and food services	57,619
4	Professional, scientific, and technical services	41,607
5	Other services (except public administration)	40,056

Source: County Business Patterns, 2010.

TABLE 1.4 INDUSTRIES WITH THE MOST BUSINESSES THROUGHOUT THE REGION

Rank	Industry	Number of Businesses
1	Retail trade	8,996
2	Professional, scientific, and technical services	8,126
3	Construction	7,807
4	Health care and social assistance	7,748
5	Other services (except public administration)	6,718

Source: County Business Patterns, 2010.

Consistent with national trends, the Region has seen an increase in unemployment rates during the recent economic downturn. According to the latest projections, the regional unemployment rate is 6.4 percent, with Sullivan County the highest at 8.8 percent. Table 1.5 presents regional labor force characteristics.

TABLE 1.5 LABOR FORCE AND UNEMPLOYMENT RATE, 2010		
Location	Population Over 16 in Labor Force	Unemployment Rate (%)
Dutchess	153,872	7.4
Orange	189,079	7.8
Putnam	52,259	6.6
Rockland	149,048	6.5
Sullivan	37,623	9.1
Ulster	96,182	8.2
Westchester	483,490	6.8
Region	1,161,553	7.5

Source: NYS Department of Labor.

1.2.4 Culture and History

The Mid-Hudson Region has a long and storied history with deep roots in the culture of environmental conservation. First settled by the Dutch in 1610, the Region was the site of famed explorer Henry Hudson's attempt at finding the Northwest Passage. In the 18th century, the Region was home to New York's first capital in Kingston in 1777 until the British burned it down after the Battle of Saratoga, and its second capital in Poughkeepsie from 1777 shortly after the War of Independence until 1783..

The Hudson River has been a critical trade and transportation route since the Region was first settled. With the opening of the Erie Canal, the Hudson served as a major corridor connecting NYC and the rest of the eastern seaboard with the western US.

In more recent years, the Region has become a leader in the United States conservation movement. In the 1960's, a 17 year legal battle over the building of a hydropower plant near Storm King lead to the passage of the National Environmental Protection Act (NEPA) and the creation of local organizations like Scenic Hudson, Clearwater, and Riverkeeper, which work today to conserve the Hudson River and its watershed.

1.3 Navigating the Plan

The Plan – and each focus area chapter – is organized to answer three basic questions with regard to the Region's sustainable development:

- Where are we?
- Where do we want to go?
- How do we get there?

The Plan presents the Guiding Principles and Approach (Chapter 2) used in analyzing and developing an approach for each of the five focus areas (Chapters 3 – 7). A Regional Synthesis (Chapter 8) looks at cross-cutting strategies to achieve the Plan's objectives. An Implementation Strategy (Chapter 9) outlines initiatives needed to sustain regional collaboration and facilitate implementation.

1.3.1 Where Are We?

The first, important step was to develop a clear understanding of the state of the Region's economy, environment, and quality of life. The intent was to provide a foundation for each Working Group to build on, allowing the Region to compare itself to other regions and NYS as a whole. This understanding, based on the best available information, was essential to setting realistic targets over time and planning for transformative change.

To achieve this, a baseline assessment was completed. The planning team collaborated with the Working Groups established around each of the six focus areas to review existing reports, collect data and complete interviews and research in an attempt to map out and understand current trends in each focus area. The results were used to inform the planning process and are documented in Appendix A: Baseline Assessment.

Some key trends and background information emerged that helped frame the discussion of the Region's future. Specific metrics were identified for each focus area to support a quantitative assessment of the Region's sustainability.

1.3.2 Where Do We Want to Go?

Sustainable development couples concern over resource limits and physical thresholds with an interest in mapping out a desirable future. For this Plan, sustainable development is defined as the ongoing effort to enhance environmental, economic and social well-being without

degrading current or future natural, economic and social resources. This is similar to the "triple bottom line" concept often referenced in the context of business. Further discussion of sustainable development is found in Chapter 2.

To help make this concept a little more concrete, general objectives were established for each focus area. These qualitative objectives have been matched with quantitative metrics. Targets were then set for each metric, with discrete milestones in the years 2020, 2035, and 2050. Collectively, each metric and target constitutes an "indicator" of sustainable development (see Figure 1.4). Progress in implementing in the Plan can be tracked using these indicators, helping provide quantitative evidence of the Region's success in meeting the Plan's objectives.

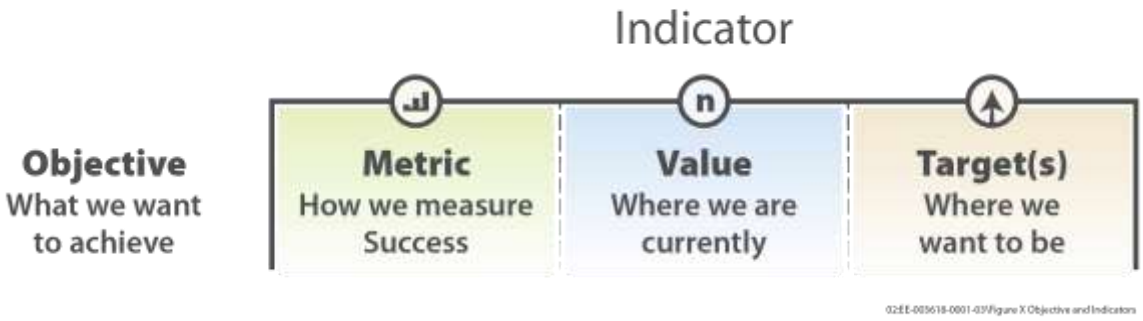


Figure 1.4 Objectives – Indicators

No series of indicators can perfectly capture the myriad trends and issues that comprise economic development, environmental sustainability, and quality of life. This is especially true for a diverse Region, where data availability and quality limit the range of metrics that can be quantified at a regional scale. Recognizing this, two "Tiers" of metrics were proposed and used:

- Tier 1 metrics are those for which good data are available in all seven counties of the Mid-Hudson Region, and thus can be easily calculated
- Tier 2 metrics are those that would be valuable to track, but for which readily-available, high quality data are unavailable region-wide

In the future, as Tier 2 data become more available throughout the Region, it will be possible to track a more robust set of sustainability indicators, and further hone initiatives identified through the Planning process.

1.3.3 How Do We Get There?

The objectives and targets set in the Plan provide a set of performance goals that can guide sustainable development activities in the Region for several decades. This Plan represents a first step – it will need to be updated regularly to ensure that the objectives and targets identified within it continue to reflect the Region's vision and needs, as well as available technologies and best practices.

Many, many projects and programs will need to be planned, launched, and executed over time to meet the targets established in the Plan. To help guide these efforts, a series of project priorities are presented for each focus area. Within each priority category, individual projects are highlighted which exemplify the types of initiatives needed to make real change happen in the Region. Additionally, a series of enabling strategies are presented. These consist of programs, policies, and other initiatives which have the potential to significantly facilitate project implementation, helping achieve the Plan's objectives.

In addition to focus-area specific project and enabling strategies, a series of regional synthesis priorities have been identified. These include efforts which will impact multiple focus areas or have transformative potential at the regionals scale.

The Plan's implementation strategy includes recommendations to sustain and strengthen regional-scale planning, coordination, and action into the future, while also ensuring accountability and facilitating Plan implementation at the local level.

2 Guiding Principles and Approach

This Chapter includes:

1. A review of the guiding principles underlying the Plan including:
    a. Sustainable development that builds on the Region's strengths
    b. Climate change as a cross-cutting challenge faced by the Region
    c. The alignment between the Plan and the Regional Economic Development Strategy
    d. Regional collaboration to achieve sustainable development
    e. Environmental justice as a regional concern
2. A description of the planning process

The Mid-Hudson Regional Sustainability Plan is intended to guide sustainable development activities at the regional and local scale. Regional-scale planning, coordination, and action:

- Facilitate sharing of resources and helps local governments achieve economies of scale
    - Many local governments face challenges that can be more affordably addressed at a larger scale
- Position the Region for more funding opportunities
    - Knowledge networking and collaboration allows the Region to better go after state and federal sources of funding, many of which require grantees to demonstrate regional-scale impacts
- Create consistent regional definitions and data sets
    - Data consistency tracked across a wider area can help identify larger-scale trends and target investments

- Provide a platform for addressing inter-municipal issues
    - Water management, economic development, repurposing of historic building stock, revitalization of aging infrastructure, brownfield reclamation, biodiversity conservation, and many more issues transcend individual municipal or county borders

2.1.1 Sustainable Development that builds on the Region's Strengths

Sustainable development is defined here as the ongoing effort to enhance environmental, economic and social well-being without degrading current or future natural, economic and social resources. For the Mid-Hudson Region, achieving sustainable development will require the Region to build on its historic strengths, including:

- The diverse natural environment, with the Hudson River as a centerpiece
- The vibrant economy, home to global brands as well as thousands of small businesses and start-ups
- Robust transportation accessibility and connectivity within and beyond the Region
- The exceptional quality of life, derived in part due to the Region's setting as well as its long history of social and cultural innovation and its unique historical assets

INSERT GRAPHIC

These four aspects of sustainable development cannot be treated individually, or in isolation. As businesses seek to compete in an increasingly globalized marketplace, quality of life becomes an important factor in attracting and retaining the best employees. If the environment is allowed to degrade, quality of life may decline. By increasing energy efficiency and switching to renewable sources of energy, the Region helps protect the environment while retaining money in the local economy and providing a local test bed for new green enterprises. A strong economy relies on good connectivity both within the Region and with the outside world. A strategy for sustainable development that ignores the close relationship between these elements risks failure.

2.1.2 Climate Change – A Cross-Cutting Challenge

Climate change is a major planning consideration in the Mid-Hudson Region, because the Region is both vulnerable to the effects of climate change and contributes significantly to global greenhouse gas (GHG) emissions. Each focus area addressed contributes to and is affected by climate change, demonstrating how truly it is a cross-cutting challenge.

The Plan has two major goals concerning climate change:

- The first is to reduce the Region's overall contribution to climate change
- The second is to increase the Region's ability to adapt to a changing climate

GHG Emissions

In 2010, the Mid-Hudson Region emitted an estimated 27 million metric tons of GHGs (measured in metric tons of carbon dioxide equivalent [$MTCO_2e$]) – see Table 2.1 – this is equivalent to the amount of emissions produced from burning 317,743 tanker trucks' worth of gasoline. While the Region only represents 0.5% of total U.S. GHG emissions, it still produces a globally significant amount – equivalent to the annual emissions of the country of Ecuador, a nation with more than six times as many people. For a breakdown of GHG emissions by county and per capita see Table 2.1.

TABLE 2.1 REGIONAL GHG EMISSIONS

County	Population	Emissions (MTCO2e)	Per Capita Emissions (MTCO2e/capita)
Dutchess	297,488	3,500,847	11.93
Putnam	99,710	1,644,863	16.57
Rockland	311,687	4,085,902	13.61
Westchester	949,113	9,663,889	10.11
Sullivan	77,547	927,223	12.23
Orange	372,813	4,879,733	12.72
Ulster	182,493	2,248,181	12.39
Totals	**2,290,851**	**26,950,637**	**11.76**[15]

Regional GHG emissions by source are presented in Figure 2.1. The single largest source of GHG emissions across the region is transportation fuel consumption, which accounts for 41.9 percent of regional emissions. More than 90% of transportation emissions result from on-road transportation (cars, trucks, buses, motorcycles). The second largest overall contributor is residential energy consumption, which includes fuels used directly for space and water heating as well as the indirect emissions resulting from the use of electricity. Emissions from residential energy consumption generate over 21 % of the Region's emissions.

[15] Greenhouse Gas Inventory attached to this document

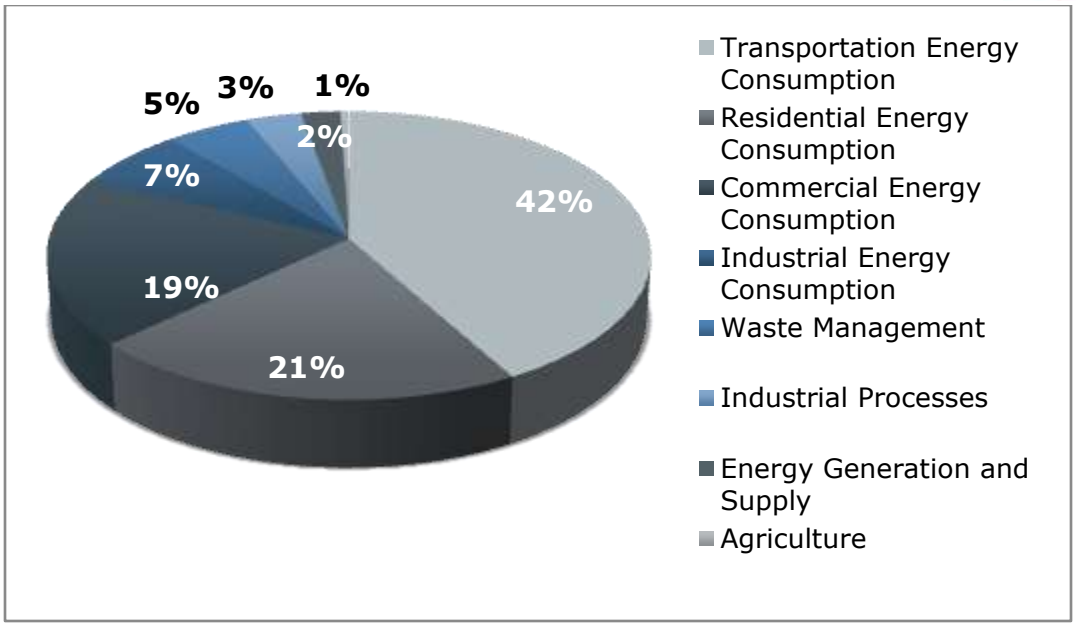


Figure 2.1 Regional Emissions by County

Per capita emissions by county and by source are presented in Figure 2.2. Approximately 36% of the Region's emissions were generated by Westchester County, the most populous county in the Region. However, Putnam County had the greatest per capita emissions rate, due in part to transportation emissions generated by traffic passing through the County. The GHG emissions inventory results, data, and methodologies are discussed in greater detail in each focus area chapter as well as in the complete GHG Inventory Report (see Appendix B).

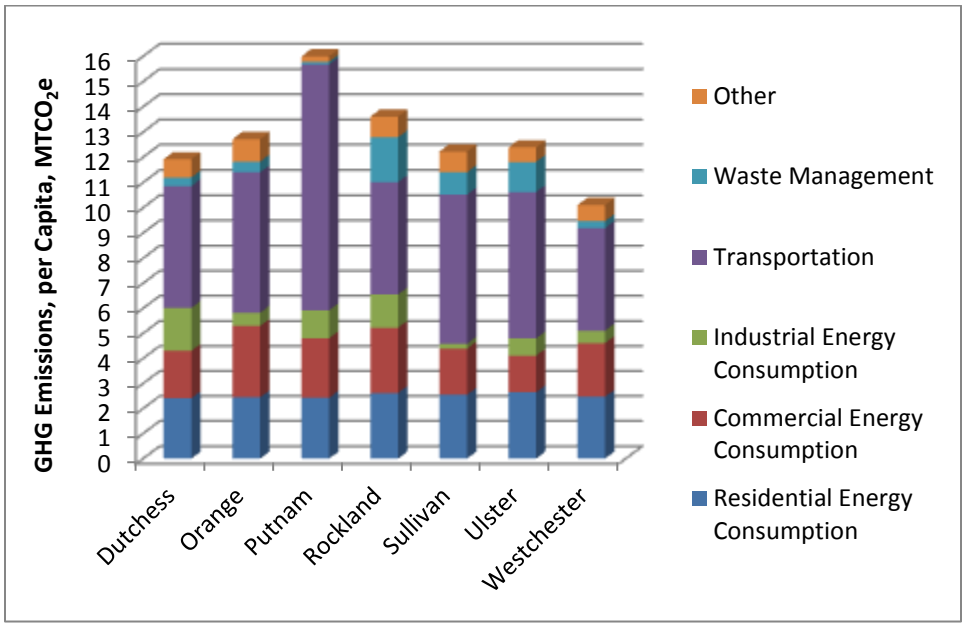


Figure 2.2 Per Capita Emissions by County and Source

Climate Change Vulnerability

The effects of climate change are already being felt in the Region, as evidenced in the steady decrease in Heating Degree Days over the past three decades, among other indicators[16]. Due to the lifecycle of GHGs in the atmosphere as well as ongoing emissions from both natural and anthropogenic sources, climate change will continue to be felt for many years and, according to climate scientists' models, likely will increase in their impact (see Table 2.2).

TABLE 2.2 PROJECTED CHANGE IN TEMPERATURE, PRECIPITATION, AND SEA LEVEL

	1971-2000	2020s	2050s	2080s
Air temperature	48˚F	+ 1.5 to 3.0˚F	+3.0 to 5.5˚F	+4.0 to 8.0˚F
Precipitation	48 in	0 to +5%	0 to +10%	+5 to 10%
Sea level rise		Inches	Inches	Inches
Scenario 1 – Moderate ice melt	n/a	+1 to +4	+5 to +9	+8 to +18
Scenario 2 - Rapid ice-melt	n/a	~4 to +9	~17 to +26	~37 to +50

Source: NYSERDA. "Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation in New York State." Technical Report, 2011.

In the Mid-Hudson Region, models show that climate change may have a number of different effects, including everything from increasing property damage to reducing water quality. Each of these effects stems from either a primary or secondary climate impact. Primary climate impacts are those directly associated with radiative forcing due to GHG emissions, such as sea level rise, changes in precipitation, and changes in temperature. Secondary impacts include flooding, drought, and heat waves. Figure 2.3 provides an example of the link between changes to the climate (in blue), the resulting climate impacts (in yellow), and the effects on human systems (in green). This is not an exhaustive list, but illustrates the change of impacts and effects.

[16] ClimAID reports that between 1970 and 2007, the number of HDD has declined by 46.3 days per decade (NYSERDA 2011).

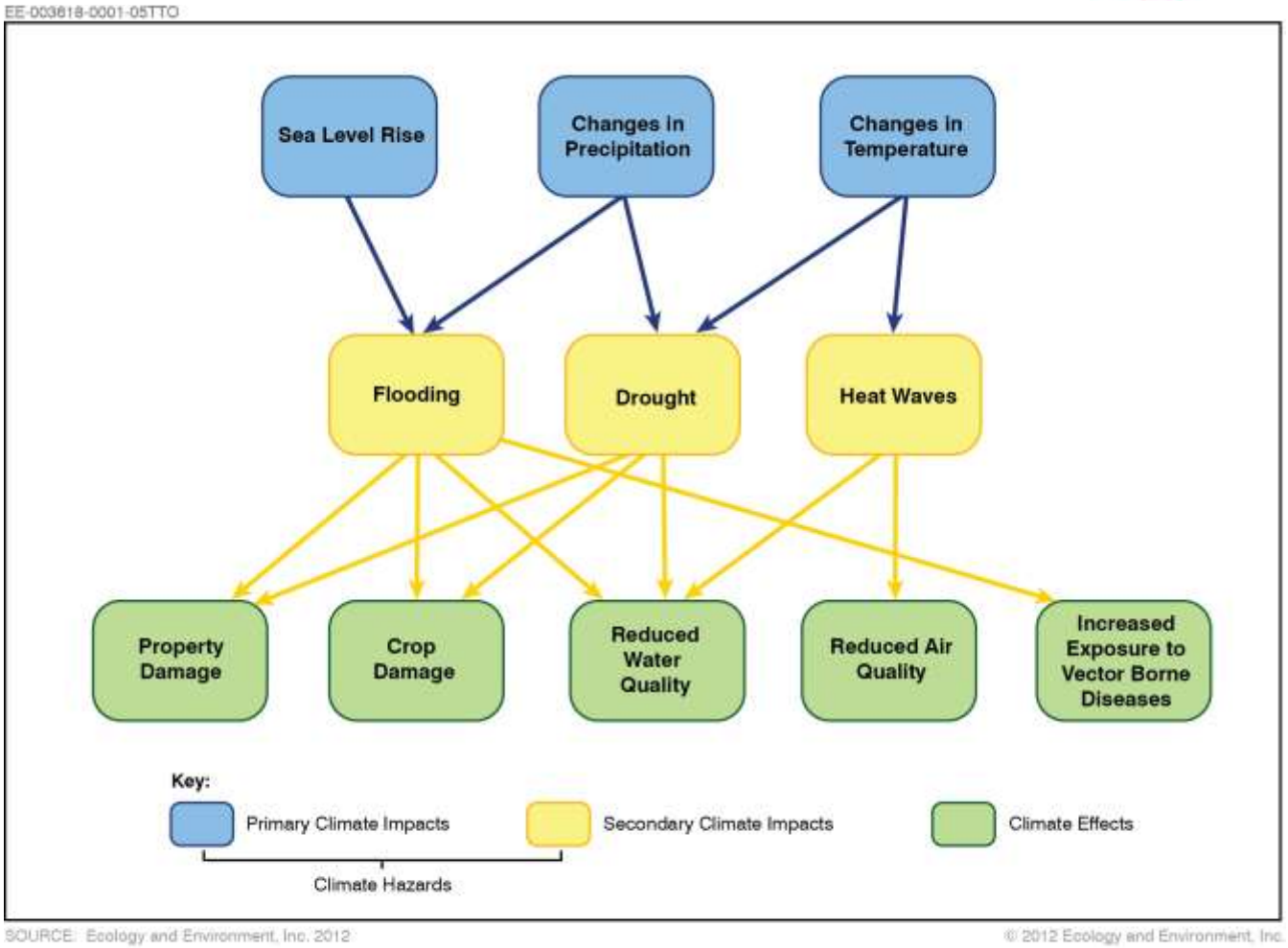


Figure 2.3 Climate Change Impacts and Effects

Critically, climate change can impact the frequency and severity of extreme weather events (see Table 2.3). The Mid-Hudson Region is already challenged by extreme weather events, particularly flooding. From 1997-2010, flooding cost the Region more than an estimated $262 million dollars[17]. By planning for the effects of climate change, the Region can avoid costly damage to infrastructure, life, and health. In each of the focus area chapters of the Plan, the specific potential impacts of climate change are discussed, and with strategies proposed to mitigate their effects. The complete results of the climate change vulnerability assessment completed for the Mid-Hudson Region can be found in Appendix C.

[17] SHELDUS, 2011. http://webra.cas.sc.edu/hvri/products/sheldus.aspx

TABLE 2.3 IMPACT OF CLIMATE CHANGE ON EXTREME EVENTS

		1971-2000	2020s	2050s	2080s
Full range of changes in extreme events: minimum, and maximum					
Heat Waves & Cold Events	Number of days per year with max. temperature exceeding:				
	90˚F	12	13 to 34	16 to 53	21 to 75
	95˚F	2	2 to 10	3 to 20	4 to 39
	# of heat waves per year	2	2 to 5	2 to 7	3 to 10
	Average duration	4	4 to 5	5 to 6	5 to 8
	# of days per year with min. temp. ≤ 32˚F	138	101 to 128	70 to 115	57 to 112
Intense Precipitation	Number of days per year with rainfall exceeding:				
	1 inch	12	10 to 14	10 to 14	10 to 15
	2 inches	2	1 to 3	1 to 3	1 to 3

Source: NYSERDA. "Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation in New York State." Technical Report, 2011.

2.1.3 Building on the Region's Economic Development Strategy

The Mid-Hudson Regional Sustainability Plan seeks to complement and expand upon the economic development strategy crafted in 2011 by the Mid-Hudson Regional Economic Development Council (REDC). The REDC is a public-private partnership made up of local experts and stakeholders from business, academia, local government, and non-governmental organizations. The REDC focuses on a community based, bottom up approach to job creation and economic growth through the distribution of funds provided by NYS. As noted earlier, this is being achieved through a focus on the relationship between environmental sustainability, quality of life, and economic development, and is why the Plan has been designed to align with the following four Focal Strategies promoted by the REDC (see Figure 2.4):

REDC1 - INVEST in Tech: Target job creation investments in identifiable industry "clusters" such as biotech, biomedical and healthcare; advanced manufacturing; and information technology.

REDC2 - ATTRACT & RETAIN Mature Industries: Undertake initiatives to retain and stimulate more mature industries such as distribution, financial and professional services, and corporate food and beverage, as these sectors represent large, vital anchor industries in the Mid-Hudson economy.

REDC3 - GROW Natural Resource-Related Sectors: Leverage the Region's outstanding natural resources, including its unique location between the Hudson River, Delaware River, and Long Island Sound, to sustain and promote waterfront development and industries including agriculture, tourism, artisanal food and beverage, and recreation. Additionally, it is vital that these industries preserve the Region's unique quality of life.

REDC4 - REVITALIZE: Support building projects that improve key regional infrastructure to make the Region more business-ready; foster housing investment to create construction jobs and more housing supply; and support the revitalization of our urban centers as engines of regional prosperity.

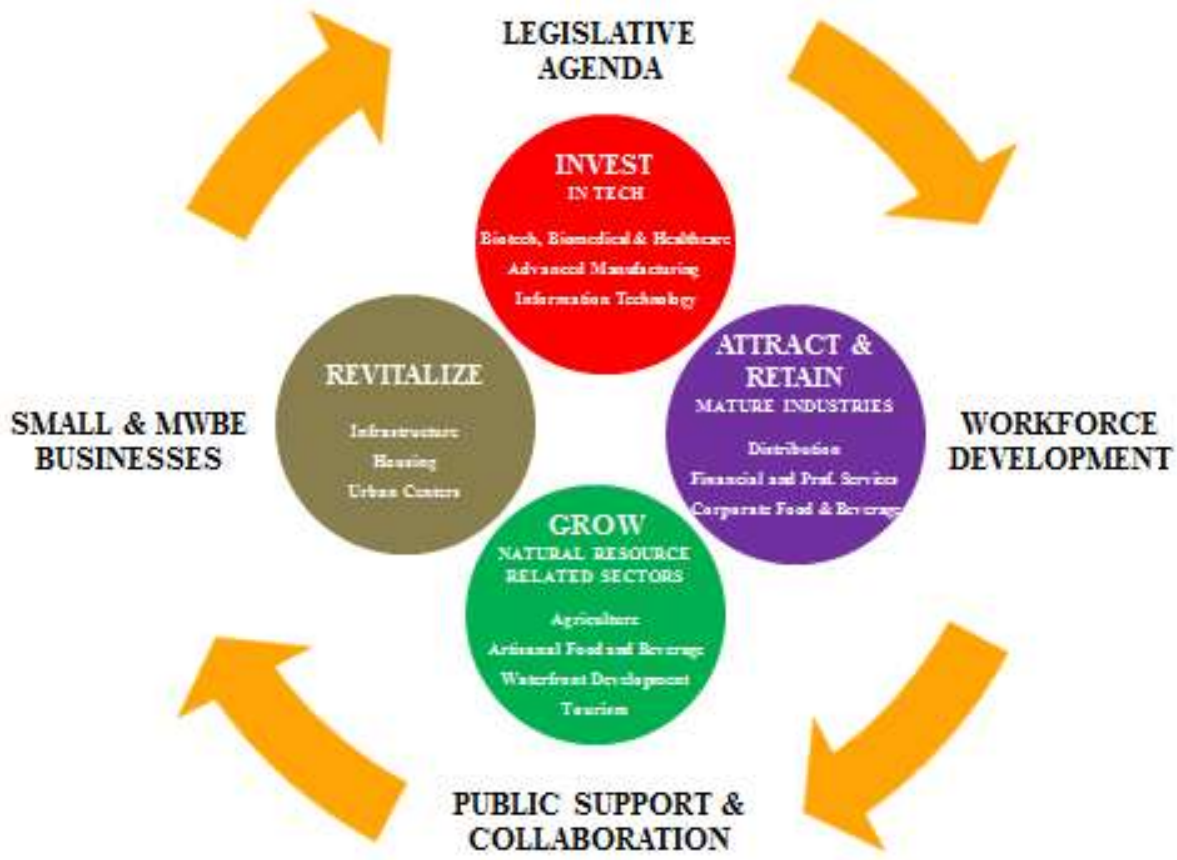


Figure 2.4 REDC Focal Strategies[18]

Table 2.4 captures specific synergies between the objectives of the Regional Sustainability Plan and the four REDC Focal Strategies. Note that the Plan's objectives are presented in much greater detail in subsequent chapters. In general, the Plan's objectives align with many of the strategies proposed by the REDC, with the goal of ensuring that the economic development of the Region also contributes to the Region's quality of life and environmental sustainability.

[18] For more information on REDC strategies please visit http://regionalcouncils.ny.gov/content/mid-hudson

TABLE 2.4 REDC FOCAL STRATEGIES AND PLAN OBJECTIVES

MHRP Objectives ● Strong Synergy ○ Consistency between Plans	REDC Synergies with REDC Focal Strategies			
	INVEST in Tech	ATTRACT & RETAIN Mature Industries	GROW Natural Resource-Related Sectors	REVITALIZE!
TL-1 Strengthen Centers Supported by Transit		○		●
TL-2 Create Complete Communities	○	○		●
TL-3 Reduce Transportation Fuel Consumption and GHG Emissions	●			
TL-4 Improve the Safety and Integrity of Regional Transportation Infrastructure	○			○
EN-1 Become less energy intensive while maintaining a strong regional economy	●	○	○	●
EN-2 Expand renewables as an energy source across the Region	●	○	●	●
EN-3 Lower fossil fuel intensity of the built environment	●			○
EN-4 Improve the continuity of the energy delivery system throughout the Region	●		○	○
MM-1 Reduce the volume of solid waste generated	○	○		
MM-2 Increase the proportion of materials diverted from landfills via reuse, recycling, composting and other organic recycling methods	●		○	
MM-3 Reduce Transportation and Disposal (T&D) Cost	○			
AO-1 Maintain or increase the magnitude of agriculture/silviculture activities in the Region		●	●	○
AO-2 Create greater access to agriculture/silviculture sustainability training and technologies	●		●	
AO-3 Increase intra-regional consumption of food/fiber				○
AO-4 Reduce GHG emissions from farm and farm related activities	●		○	
AO-5 Maintain the economic viability of agriculture/silviculture in the Region	●	○		
AO-6 Decrease forest fragmentation and increase open space				○
WA-1 Increase available water supply by minimizing water consumption	●			
WA-2 Reduce the energy usage and GHG emissions at water and wastewater treatment facilities	●			○
WA-3 Reduce impervious surface area and increase connectivity of permeable surfaces	○		○	○
WA-4 Improve the reliability of water and wastewater treatment	○			●
WA-5 Protect habitat and water quality				●
WA-6 Encourage watershed management planning				●
GO-1 Strengthen and promote the view that "Mid-Hudson Region is a national leader in sustainable development."	●	●	●	●
GO-2 Track progress against indicators				
GO-3 Enforce/oversee Plan implementation and updates		○	○	○
GO-4 Facilitate knowledge sharing	●			
GO-5 Attract funding to the Region	○	●	●	○

2.1.4 Regional Collaboration to Achieve Sustainable Development

The broad-based discussion that has taken place within the Region to help shape the Plan is an important initial step to gaining commitment from individuals, corporations, non-profits, local governments, and many other local actors to take action in a bold and sustained manner. Collaboration across groups can ensure that limited resources achieve maximum impact and that the best ideas are shared widely – this requires careful coordination. This is why a central focus of the Plan's implementation strategy is to develop the governance infrastructure needed to facilitate collaboration and coordinate action.

Collaboration for regional planning and action is already on-going in the Mid-Hudson Region. For example, in 1991, the NYS legislature created the Hudson River Greenway Communities council, a voluntary planning process through which individual communities adopt a set of smart growth planning principles, and in return become eligible for capital grants that support related projects as well as favored scoring in the competitive application process for other state programs. Of 179 eligible municipalities in the six eligible counties (Sullivan County is excluded), 166 have signed on as Greenway Members in one of the Region's more successful efforts in regionalism.

Similarly, Sullivan and Orange counties participate – with their neighbors in Pennsylvania – in several Upper Delaware Valley cooperative efforts including the inter-municipal Upper Delaware Council.

Although covering only a portion of the Mid-Hudson Region, the New York Metropolitan Transportation Council (NYMTC) provides another example of intergovernmental coordination at the regional level. NYMTC is a coalition of county and local governments that serves as the metropolitan planning organization for transportation-related issues for NYC, Long Island, and the lower Hudson Valley. County executives from Putnam, Rockland and Westchester counties, along with government representatives from the rest of its service region, serve as principal council members and vote on key planning, policy and funding decisions. The recent endorsement by NYMTC for the Tappan Zee Bridge replacement proposal is one significant regional transportation issue considered and acted upon through this regional framework.

Orange, Dutchess and Ulster counties each have their own established Transportation Council with similar government and interagency cooperation at the county level. Yet these three counties also work cooperatively under a unified Transportation Management Area process, coordinating transportation and transit planning, funding and capital project investments north of the NYMTC area.

A variety of civic, planning, and environmental organizations also provide a range of leadership on regional planning and land use. Examples include the Hudson Valley Regional Council, Pattern for Progress, Common Waters (in the Upper Delaware Valley), and the Center for Research, Regional Education, and Outreach (CRREO) at SUNY New Paltz, Scenic Hudson, and the Land Use Law Center at Pace University. Additionally, municipal Planning Federations, staffed by county planning departments, exist in four of the seven counties. And all the counties along with non-governmental organizations sponsor recurring educational programs for municipal officials, staff and others.

> In the early 1990s, changes to NYS land use law enabled inter-municipal compacts that allow coordination of planning and zoning, the ability to form joint planning boards, and enforce land use laws on an inter-municipal basis

Counties in the Region also provide leadership on cross-jurisdiction coordination. For example, recognizing that the housing market extends beyond political boundary lines and that the counties faced similar pressures and housing affordability challenges, Ulster, Orange, and Dutchess counties joined together to prepare the Three-County Regional Housing Needs Assessment 2006-2020. This represented a collective effort to analyze housing costs, supply, and future housing needs across the broader three-county area.

Environmental issues have also been a vehicle for regional cooperation. In 1989, the EPA issued new criteria governing filtration for public surface water supplies as a result of amendments to the Safe Drinking Water Act. Facing potentially large capital costs to provide filtration for its water supply system and believing that the high quality water from the Delaware/Catskill system could meet EPA criteria for obtaining a waiver (i.e., filtration avoidance determination), the City of New York successfully negotiated the landmark NYC Watershed Memorandum of Agreement with other stakeholders in the watershed area. The memorandum, which involved numerous local and county governments, environmental groups, and other federal, state, and city agencies, established a cooperative framework for protecting NYC's water supply, enhancing the economic vitality of upstate watershed communities, and implementing a variety of watershed protection programs. It also created a Watershed Protection and Partnership Council, which consists of representatives from the various watershed stakeholders, to serve as a regional forum for the ongoing exchange of ideas and information related to watershed protection and economic development for the watershed communities.

Despite this long and rich history of collaboration, some challenges to regional partnerships remain, such as the primacy of "home rule" in local government, the inconsistent geographic

definition of the Region in many planning efforts, and the wide disparity in resources and capacity of local government and organizations throughout the Region.

2.1.5 Environmental Justice as a Regional Concern

Text and analysis pending.

2.2 The Planning Process

As a part of NYSERDA's *Cleaner, Greener Communities* program, leaders from the Mid-Hudson Region came together to form a planning Consortium. The Consortium, led by commissioners David Church, *AICP* of Orange County and Thomas Madden, *AICP* of the Town of Greenburgh, is made up of the following governmental and non-governmental partners:

- Dutchess County
- Orange County
- Putnam County
- Rockland County
- Sullivan County
- Ulster County
- Westchester County
- Town of Greenburgh
- Center for Research, Regional Education and Outreach at SUNY New Paltz (CRREO)
- Land Use Law Center Mayors' Redevelopment Roundtable
- Northern Westchester Energy Action Consortium (NWEAC)
- Southern Westchester Energy Action Consortium (SWEAC)
- New York Council of Nonprofits (NYCON)

The Consortium is the governance body for the planning process, and steers the work of the larger team of planning participants. This larger participatory group consists of more than 300 people who have come together to form six Working Groups. The Working Groups are made up of stakeholders from throughout the Region who have volunteered their time and energy to develop the Plan. The six Working Groups reflect major focus areas for sustainability in the Region:

- Land Use, Livable Communities, and Transportation,
- Energy
- Materials Management
- Agriculture and Open Space

- Water
- Economic Development (*cross-cutting theme*)

Each Working Group nominated a Climate Adaptation Liaison to ensure that this important cross-cutting theme was addressed. The Consortium and Working Groups were also supported by technical consultants.

The organizational chart for the planning effort is shown in Figure 2.5.

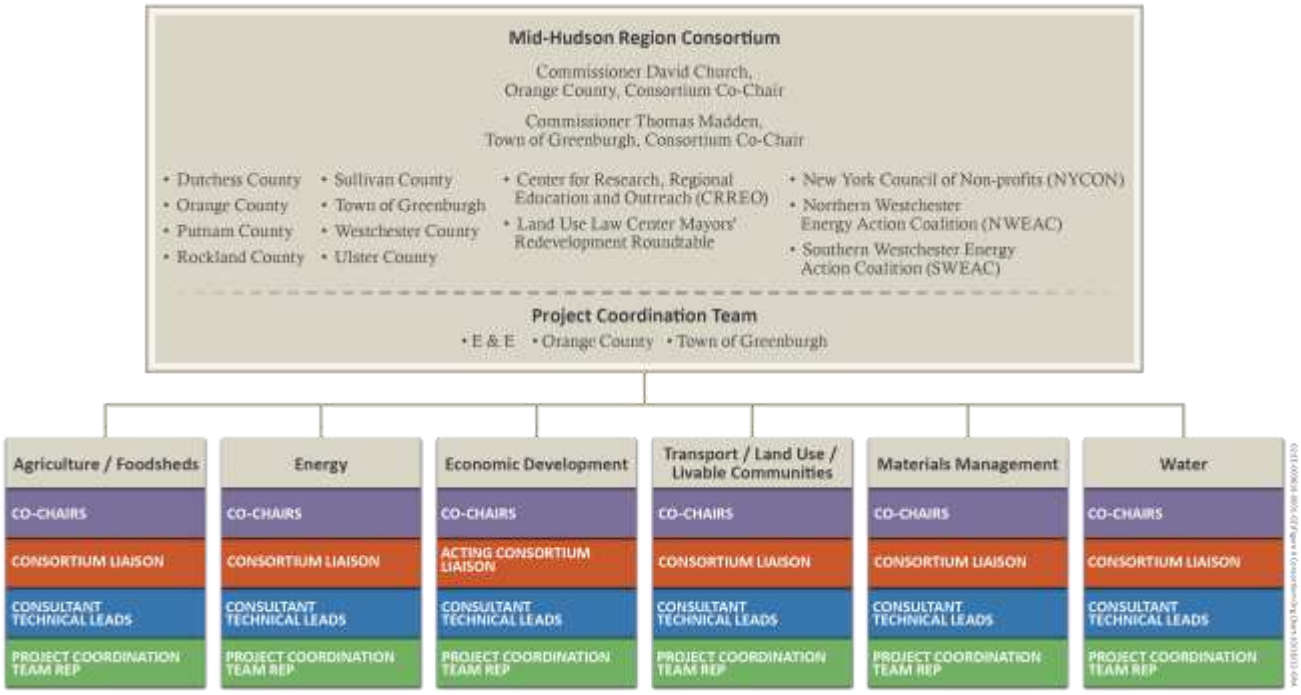


Figure 2.5 Planning Process Organization Chart

In addition to soliciting volunteers for the Working Groups, efforts were made to provide the public with numerous opportunities to participate in the plan development process. Upon publication of the final Plan, these opportunities will have included well-advertised public meetings, a "virtual town hall" website www.engagemidhudson.com, and a public review process for the draft Plan. This process helped to engage citizens and foster a regional sense of identity, as well as capitalize on the existing knowledge in the Region. More information on the public outreach efforts can be found in the public engagement summary in Appendix D.

3 Land Use, Livable Communities, and Transportation

This Chapter includes:

1. A review of the baseline conditions for land use, livable communities, and transportation
2. A discussion of GHG emissions from the land use and transportation sectors, as well as potential climate change impacts
3. A presentation of land use, livable communities, and transportation objectives and indicators
4. A review of priority projects, which include:
    a. Transit Oriented Development (TOD)
    b. Land Efficient Development (LED)
    c. Livability Improvements
    d. Mass Transit Expansion and Upgrades
    e. Transportation Demand and Systems Management to Relieve Highway Congestion
    f. Street and Sidewalk Improvements
    g. Bicycle Improvements
5. A discussion of enabling strategies, including:
    a. Zoning and Planning Legislation
    b. Funding Tools & Strategies

c. Education & Demonstration
d. Vehicle Fuel Efficiency Programs
e. Freight Efficiency
f. Commuter Incentives

The goal for the land use, livable communities, and transportation focus area is to concentrate development in areas with existing service and multiple transit options, strengthening the Region's communities while protecting agriculture and open space from development pressure and inefficient growth patterns.

The goals for the land use, livable communities, and transportation focus area are to:

1. Concentrate development in areas with existing services, employment opportunities, and multiple transit options, which will strengthen the Region's communities while protecting agriculture and open space from development pressure and inefficient growth patterns.
2. Make all communities in the Region more "complete" by ensuring each has an appropriate balance of housing and jobs, as well as a mix of other services, access to parks, recreational facilities, and open space, affordable housing and transportation options, and a healthy environment
3. Create a safe, fuel efficient, multi-modal transportation system

3.1 Baseline Conditions

3.1.1 Land Use

Land use and development patterns in the Mid-Hudson Region are discussed in Chapter 1. To recapitulate:

- More than 20% of the Region's land is classified by the U.S. Census Bureau as urban, compared to less than 9% for state
- Population density varies widely in the Region from approximately 2,200 people per square mile in Westchester County to 80 people per square mile in Sullivan County, with the densest areas located to the south and along the Hudson River
- 21% of the Region's land is protected from development
- 39% of the Region's population lives within a half mile of a bus stop, and 21% lives within one mile of a rail station

- On a per capita basis, an average person living in an urban area in the Region consumes 0.31 acres of land[19]
- From 2000 to 2010, the amount of urban land in the Region grew from 864 to 933 square miles, an 8 percent increase, while the population that lives in those urban areas grew by only 7 percent
- 16% of the Region's land is dedicated to parks or recreational use and 60% of the population lives within a half mile of a park or recreational area

The existing land use and development patterns underscore the importance of transitioning to a smart growth paradigm. This approach would seek to strengthen existing densely populated communities with ready access to transit, while helping preserve the rural, agricultural character of many parts of the Region.

3.1.2 Livable Communities

The Mid-Hudson Region is reputed for the quality of life or "livability" of its communities. Livability is a difficult, subjective concept to define. Many definitions exist within the different levels of government and residents of the Region would be hard pressed to come to consensus. However, certain key factors contribute to making this a desirable place to live – adding to the Region's livability. The diversity of land use patterns, giving the Region's residents easy access to truly rural and urban landscapes (discussed earlier in the Chapter), plays a role, as does the existing transportation infrastructure (discussed later in the Chapter), improving mobility via multiple modes. Additional livability factors include:

- A balance of jobs and housing, and salaries and home values allows residents to live and work in the same community and spend less time traveling
- Affordable housing and transit give residents more choices and greater mobility,
- A diverse mix of housing and transportation options means that residents of all ages skills, incomes, races, and nationalities have a place to live, work, and prosper
- Access to parks and recreational facilities improves resident's quality of life,\
- Proximity to schools, retail, health care, and other services means fewer and shorter trips for resident's everyday activities
- A healthy environment means a healthier population

[19] U.S. Bureau of the Census. 2000 & 2010. Urbanized Area.

The success and traditional character of the Region's communities can be revitalized or reinforced by attracting more jobs, retail, schools, multifamily housing, and other activities to existing transit, commercial, and service hubs. This allows residents to link numerous activities in one trip, such as shopping for groceries, mailing a package, and visiting the dentist, thereby saving gasoline and reducing GHG emissions while protecting the surrounding natural environment from development.

Jobs/Housing and Salary/Home Value Balance

To have people live and work in the same place, and reduce transportation demand and its associated impacts, there needs to be:

- A balance of jobs and housing that is appropriate for the location, in terms of the capacity of the transportation system, surrounding development context, and natural environment. However, this alone is not enough if the workers cannot afford to live there or if the jobs are not aligned with the skills of residents
- A balance of income to home value to ensure that workers can find housing that is affordable or acceptable to them and, vice versa, residents can find jobs that suit their skill sets and meet their income needs. If there is an imbalance between job pay and home values in a community, people will continue to commute long distances

These two ratios are not the sole determinants of where people live and work, but are very important in determine whether a community is self-sufficient, meaning it meets the livability needs of its residents. For example, the recent REDC Economic Development Strategy noted that more than 50% of the Region's residents cross county borders as part of their daily commute (CITE). This suggests that many of the Region's residents must travel significant distances to get to work.

Measuring these variables in a meaningful way is challenging. For example, there may be a perfect balance of income to home value in a community, but the same community may have virtually no jobs and abundant housing. There is no such thing as a "perfect" balance, but looking at them side by side allows one to identify areas with significant imbalances.

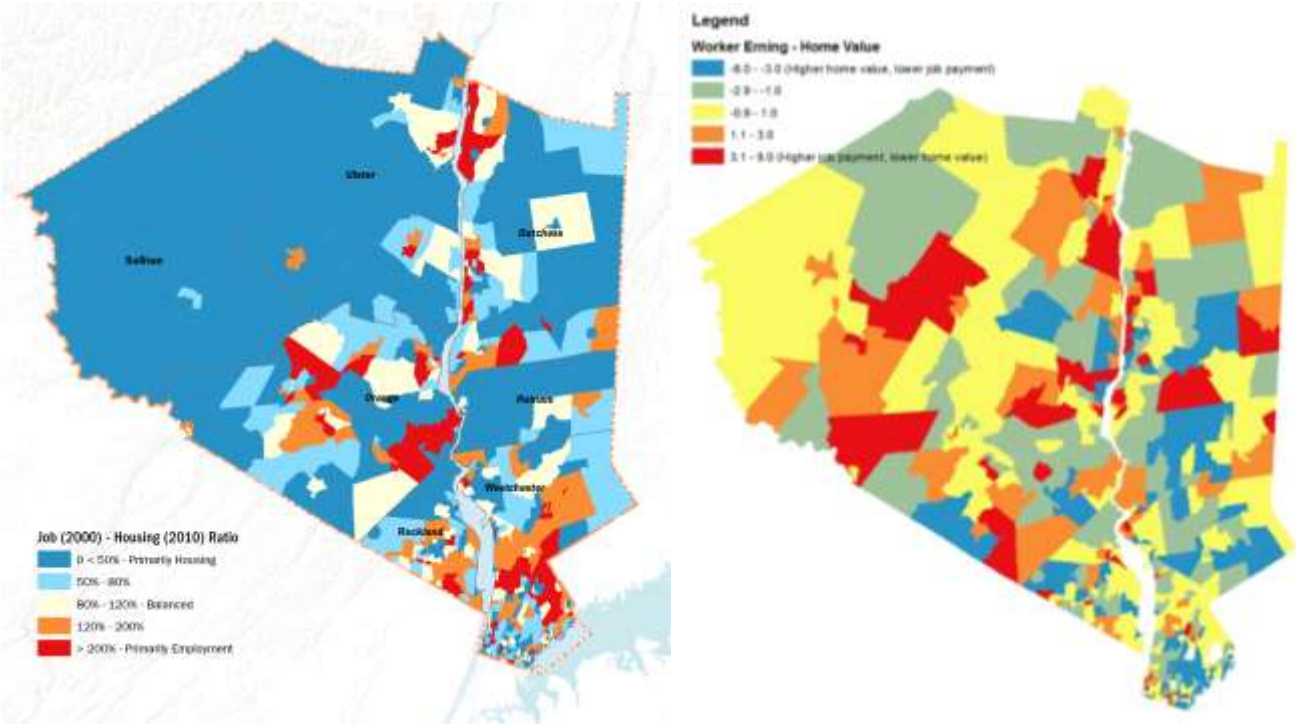


Figure 3.1 Jobs/Housing and Income/Home Value Map

Figure 3.1 shows these two ratios individually mapped by Census tract. Figure 3.2 shows the data on a scatter plot, illustrating the wide divergence in values. The points in the far corner of this chart represent Census tracts with significant imbalances in both ratios. For example, in the far right corner of the chart is a Census tract that contains the Green Haven Correctional Facility, which is surrounded by modest housing. The prison contains a lot of jobs that pay a decent wage, but the presence of the prison has likely lowered the value of the housing. So, there are more jobs at the prison than there are housing units nearby to house the workers and their average pay could potentially allow them to afford larger houses. The result is that most of the workers at the prison likely live elsewhere and commute long distances to get to work; residents near the prison likely work elsewhere too.

A basic statistical analysis shows that, on average, the Region is slightly imbalanced, with more Census tracts containing more housing than jobs – these averages should be viewed with caution. These averages mask considerable diversity and such data are more relevant when used in the context of economic development decisions and land use zoning, where smart growth efforts can guide development to the areas where it is needed most. The Region should strive for this scatter plot to have a tighter cluster around the center of the chart, which would indicate that most of the Census tracts have an appropriate balance in these two ratios.

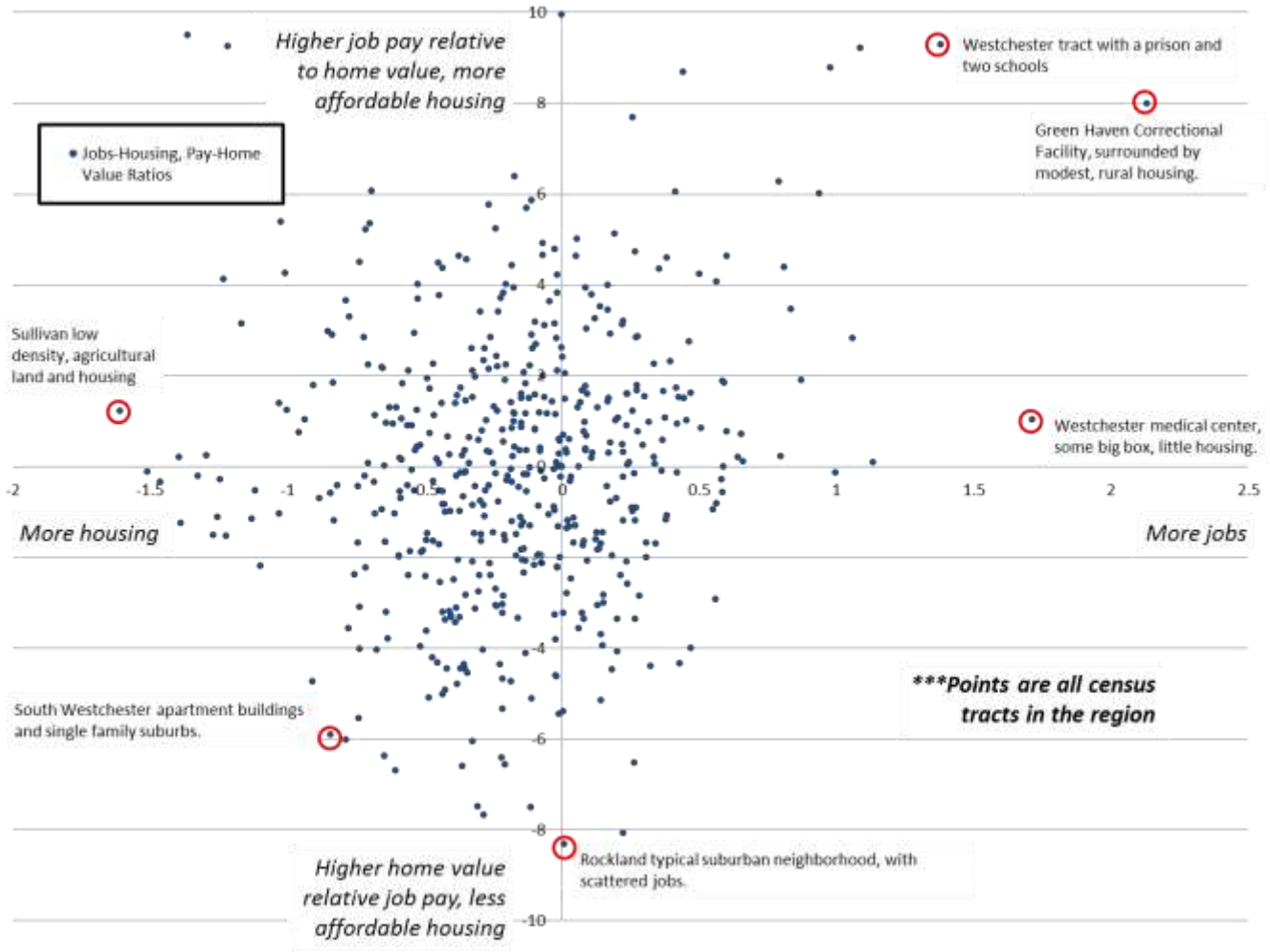
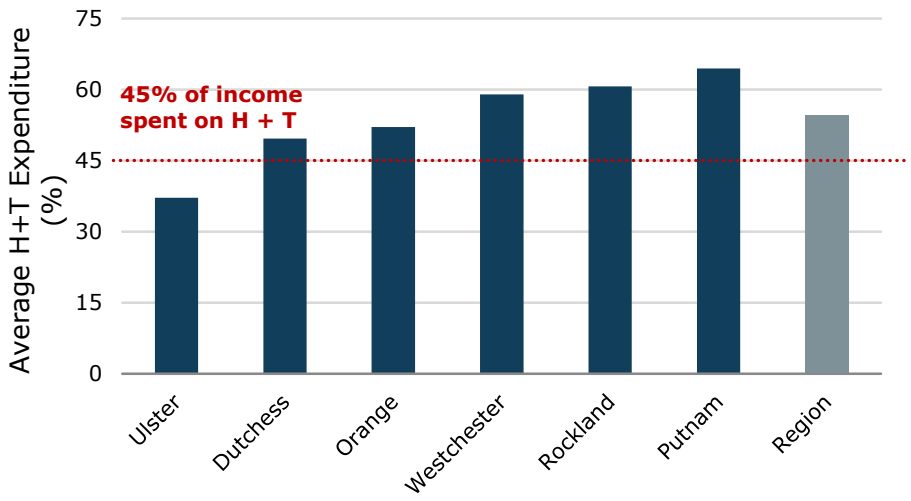


Figure 3.2 Jobs/Housing and Income/Home Value Scatter Plot

Housing and Transportation Affordability

Housing and transportation costs make up a significant portion of resident's budgets in the Region, suggesting that affordability is a challenge for many of the Region's households and workers. According to the Center for Neighborhood Technology, Ulster is the only county in the Region where households spend less than 45% of income on housing and transportation (See Figure 3.3). In Putnam and Rockland County, more than 60% of household income is spent on housing and transportation. Note that HUD recommends households spend no more than 30% of income on housing; spending greater than 30% is considered in indicator of housing unaffordability (CITE).



Source: Center for Neighborhood Technology, 2012. Not shown: Sullivan County (no data available).

Figure 3.3 Housing and Transportation Affordability Index

Housing

From 2000 to 2010, the Region's population and housing unit supply grew by 5.1 and 8.5%, surpassing NYS' average of 2.1 and 5.6%, respectively[20]. Single-family homes predominate, comprising 62% of all housing stock in the Region, compared with 69% in NYS (excluding NYC). Most of the multi-family housing units (more than two units per structure), which make up 36% of the total housing stock, are found in the more urbanized Westchester County. With only 41% of the Region's population, Westchester County has more than 57% of the Region's multi-family housing stock.

Parks and Recreational Land

Approximately 16% of the Region's total land area consists of parks (see Figure 3.4)[21]. Because of this abundance of park and recreational land, more than 60% of the Region's population can access parks and recreational areas within one-half mile of their homes[22].

[20] U.S. Bureau of the Census. 2000 & 2010. Census of Population and Housing.
[21] Scenic Hudson. 2012. Parks and Recreation Data.
[22] U.S. Bureau of the Census. 2010. Census of Population and Housing.

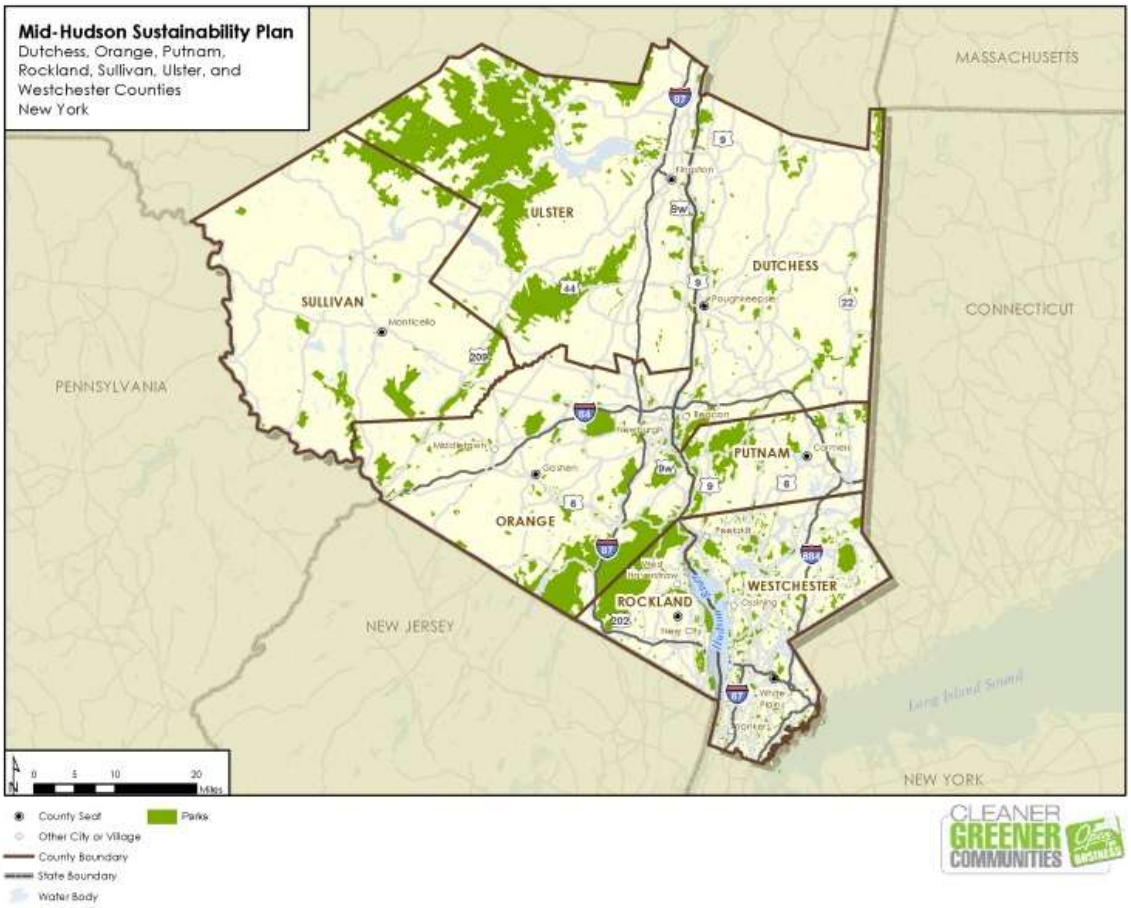


Figure 3.4 Parkland, 2010

Proximity to Schools and Services

PENDING

Environmental Quality

The Region's environmental assets and trends are discussed throughout the Plan – water quality and resources are discussed in Chapter 7, agricultural landscapes and forests in Chapter 6, etc. All of these attributes combine to impact the environmental quality of the Region, which is linked to public health, quality of life, and more. This section includes a brief discussion of several topics closely related to land use and transportation – contaminated sites, air quality, and Lyme disease.

Throughout the Region, there are 2,380 contaminated/brownfield sites or other regulated hazardous waste facilities. These facilities and sites can limit development and, in some cases,

present a risk to surrounding communities if improperly managed. These sites are discussed in greater detail in the context of climate change vulnerabilities.

The Region's air quality needs improvement to meet regulatory standards. Table 3.1 shows the individual counties in the Region and which of them are currently out of attainment for air quality. The Table shows that parts of the Region are out of attainment for particulates (PM-2.5) and ozone, which result from fossil fuel combustion, among other processes.

TABLE 3.1 NON-ATTAINMENT BY POLLUTANT AND COUNTY 2010-2012

	2010	2011	2012
Dutchess	8 Hour Ozone (1997)	8 Hour Ozone (1997)	8 Hour Ozone (1997)
Orange	8 Hour Ozone (1997) PM-2.5 (1997) PM-2.5 (2006)	8 Hour Ozone (1997) PM-2.5 (1997) PM-2.5 (2006)	8 Hour Ozone (1997) PM-2.5 (1997) PM-2.5 (2006)
Putnam	8 Hour Ozone (1997)	8 Hour Ozone (1997)	8 Hour Ozone (1997)
Rockland	8 Hour Ozone (1997) PM-2.5 (1997) PM-2.5 (2006)	8 Hour Ozone (1997) PM-2.5 (1997) PM-2.5 (2006)	8 Hour Ozone (1997) 8 Hour Ozone (2008) PM-2.5 (1997) PM-2.5 (2006)
Sullivan	In Attainment	In Attainment	In Attainment
Ulster	In Attainment	In Attainment	In Attainment
Westchester	8 Hour Ozone (1997) PM-2.5 (1997) PM-2.5 (2006)	8 Hour Ozone (1997) PM-2.5 (1997) PM-2.5 (2006)	8 Hour Ozone (1997) 8 Hour Ozone (2008) PM-2.5 (1997) PM-2.5 (2006)

Despite non-attainment, the Region fares better than the NYS in terms of the number of asthma-related Emergency Department (ED) visits (see Figure 3.5)[23]. However, this number may be skewed by the inclusion of NYC in the statistics.

Air quality is closely linked to transportation and energy, as combustion processes (among other causes) lead to the creation of pollutants. Transitioning to cleaner fuels and reducing vehicle miles traveled can greatly improve air quality.

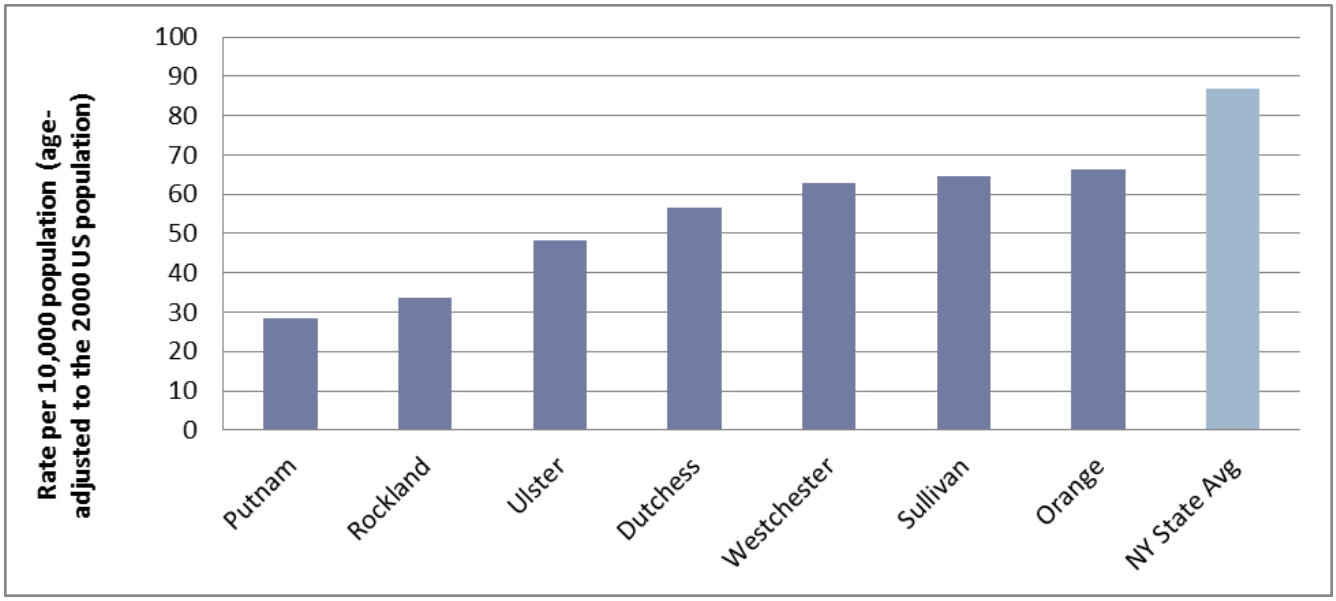


Figure 3.5 Average Asthma ED Visit Rates in the Mid-Hudson Region by County Compared to NYS (2007-2009)

Another environmental quality issue closely related to development patterns is Lyme disease. Each shopping mall, golf course, or any other residential construction or commercial development, old or new, that is in or adjacent to woodlands is a disruption to wildlife and contributes to forest fragmentation. This fragmentation makes life much harder for such predators as coyotes, foxes, rattlesnakes, hawks, owls and other raptors (see Chapter 6). A lack of predator species means that prey populations often grow out of control. Mice and deer, which thrive in disturbed and disrupted habitat, are especially important as they act as carriers to ticks that carry the Lyme bacteria *(Borrelia burgdorferi)* As a result of this increase in carrier

[23] NYS Department of Health. Information on Asthma in New York State. September 2011. http://www.health.ny.gov/statistics/ny_asthma/ (accessed May 30, 2012).

species populations; the Region has become a hotspot for Lyme disease as shown by Table 3.2, with an incidence of the disease 2 to 10 times the NYS average.

In order to help limit the spread of this disease, zoning boards must take into account the forest fragmentation created as a result of permitting development. Municipal health officials also must work to raise awareness of the disease and how development patterns can affect it. Smart growth principles that decrease the fragmentation of forests will allow for better protection of predatory habitat, limiting the spread of Lyme disease vectors in the Region.

TABLE 3.2 LYME DISEASE PER 100,000 POPULATION

	Lyme Disease			Population		
County	2007	2008	2009	Total	2008	Incidence
Dutchess	551	1,141	979	2,671	292,878	304.0
Orange	510	991	1,088	2,589	379,647	227.3
Putnam	140	202	381	723	99,244	242.8
Rockland	200	353	328	881	298,545	98.4
Sullivan	69	118	114	301	76,189	131.7
Ulster	361	778	582	1,721	181,670	315.8
Westchester	360	1,026	659	2,045	953,943	71.5
Region Total	2,191	4,609	4,131	10,931	2,282,116	159.7

3.1.3 Transportation

Roads and Bridges

Only 40% of the Region's population lives in areas that are within easy walking distance of mass transit, and so the road and bridge network is of paramount importance. There are 3,200 miles of limited access highways and 16,700 miles of local roads in the Region[24]. The tolled mainline of the NYS Thruway, or Interstate 87, runs through Westchester, Rockland, Orange, and Ulster counties, connecting NYC and Albany. The Region is also served by:

- I-84, which carries highway travelers from Massachusetts through Connecticut and New York to Pennsylvania
- I-684, which serves Westchester and Putnam counties
- I-95, which serves southern Westchester County
- I-287, between Greenburgh and I-95[25]
- I-86 / NYS Route 17 serving Sullivan and Orange counties
- The Taconic Parkway, serving Dutchess, Putnam, and Westchester counties

The Region's road and bridge network is showing considerable wear and tear. For example, 42% of the Region's 2,691 bridges are either functionally obsolete or structurally deficient, and this share is growing in recent years[26]. The state of repair of roads is also declining. In 2011, the average road in the Region was given a rating of 6.7, or "Fair" condition, meaning that distress in the pavement was clearly visible. In 2002, the average road was rated 7.1, or "Good" condition, meaning that distress was only beginning to show[27].

Bus and Rail

The bus network primarily serves denser urban areas, such as Yonkers, White Plains, New Rochelle, and includes many of the Towns and Villages of the southern half of Westchester County, and in a more limited way smaller cities, towns, and villages, such as Nyack, Spring Valley, Poughkeepsie, New Paltz, Monroe/Kiryas Joel, Middletown, Newburgh and Kingston.

[24] NYS Department of Transportation. 2012. Roads.
[25] Ibid
[26] NYS Department of Transportation. 2012. Bridge State of Good Repair.
[27] NYS Department of Transportation. 2012. Road State of Good Repair.

According to the National Transit Database, in 2010 there were twelve bus operators in the Region[28]:

- Two in Dutchess County
- Five in Orange County
- One in Putnam County
- Two in Rockland County
- One in Ulster County
- One in Westchester County

A few of these operate across county borders[29]. However, in general, there is limited cooperation or inter-operability among the Region's systems, which are primarily county or municipality-operated. Westchester County's Bee-Line service is notable in that it offers service into Bronx County to connect to employment centers and the NYC subway system, as well as parts of Putnam County and Connecticut.

The Region's commuter rail network has five corridors, two emanating from NYC's Grand Central Terminal, one from Penn Station and two from Hoboken, New Jersey.. The Metropolitan Transportation Authority's (MTA) Metro North Railroad has either total or partial responsibility for each of the commuter lines in the Region[30].

Two of the nation's busiest intercity rail corridors traverse the Region. The Northeast Corridor, Amtrak's busiest, has a station in New Rochelle before heading into Connecticut. The Empire Corridor, Amtrak's fifth busiest, has stations in Westchester, Putnam, and Dutchess counties on the east side of the Hudson River.

Other Modes

There are two commercial airports, Westchester County Airport in White Plains and Stewart International Airport in Newburgh. Other local airports cater primarily to private craft, but will rarely handle commercial traffic.

[28] Other bus systems exist in the Region, but are not listed in the National Transit Database either because they are small private or municipal systems that do not volunteer data, or they have never received funds from the Federal Transit Administration.
[29] National Transit Database. 2012. Bus Operators.
[30] MTA. 2012. Metro-North Railroad.

There is a small amount of ferry infrastructure, including docks, piers, and ships, in place to handle passenger service on the Hudson River.

There are nearly 700 miles of bike routes and trails, which amount to 1.6 feet per capita – quite high by U.S. standards[31]. Many of the Region's paths are intended for recreational purposes, as opposed to on-road bike lanes.

Transportation Trends by Mode

In 2009, there were over 1.7 million registered vehicles in the Mid-Hudson Region (one for every 1.35 people) and annual vehicle miles traveled (VMT) exceeded 23 billion, or 10,100 per capita[32]. Average VMT per capita in the U.S. in 2010 was about 9,600[33]. One possible explanation for VMT per capita being higher compared with the country is that a large amount of the Region's VMT is due to freight vehicles and through traffic using the limited access highways, rather than by residents of the Region. Additionally, high VMT per capita is indicated of auto-dependent sprawl.

In general, VMT is not a highly reliable measure of vehicle use, as the data are only sampled on a small proportion of the state's roads by the NYS DOT once every four years. In between these sample years, VMT are calculated through a process of interpolation.

[31] NYMTC. 2012. Bike Lanes.
[32] NYS DOT. 2012. VMT.
[33] U.S. DOT. 2012. RITA.

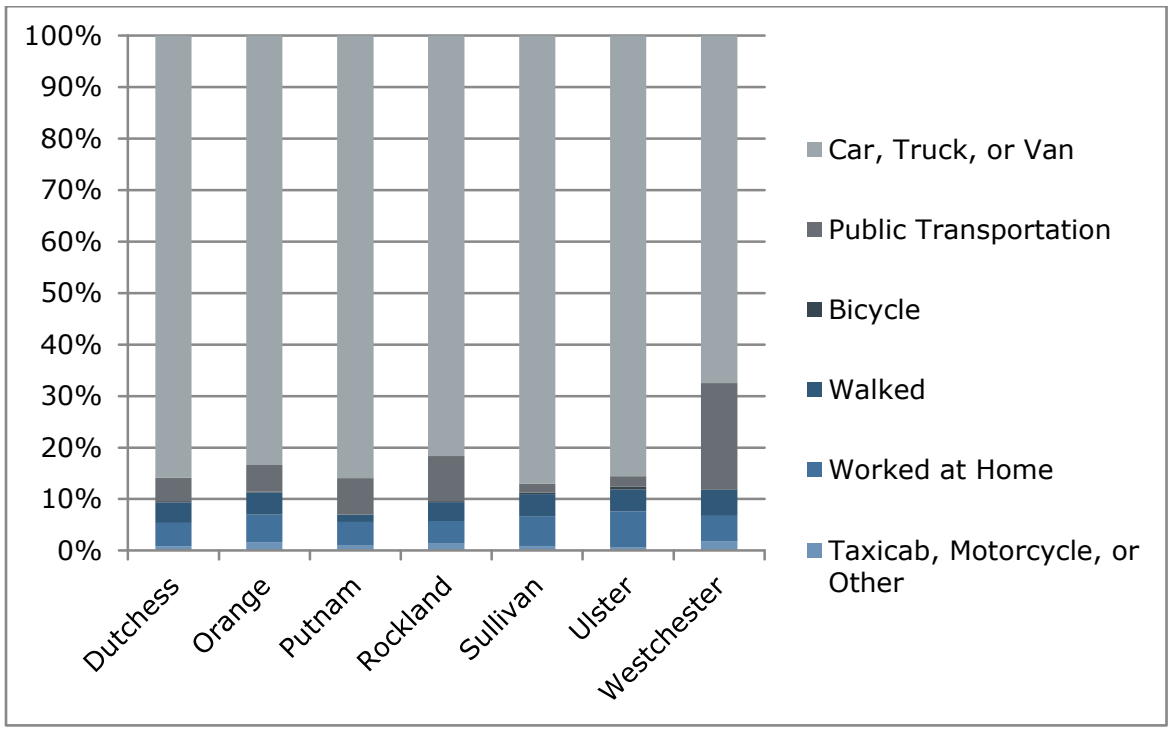


Figure 3.6 Work Trips by Mode, 2010

The Census' American Community Survey, which asks workers to self-report their commuting behavior, is another valuable source of data. In 2010, the Census reported that 77 percent of the Region's workers commuted by automobile (see Figure 3.6). Of that percentage, 88 percent drove alone in their cars and 11 percent carpooled[34]. Fewer commuters drove to work compared to the national average. One of the reasons for this is because many residents work in NYC, which is well served by mass transit from many parts of the Region. Additionally, a small percentage of workers work from home. However, of those commuters that drove, a larger proportion drove alone.

Nearly 12 percent of commuters used public transportation to get to work compared with less than 5 percent of the nation's workers.[35] Ferries make up a negligible proportion of commuter trips, accounting for only 0.02 percent of trips in 2010[36]. Bicycling and walking, while popular for recreation, are less common for commuting compared with other modes. However, biking and walking are slightly more common than in the rest of the country. In 2010, 4.5 percent of

[34] U.S. Bureau of the Census. 2010. American Community Survey.
[35] U.S. Bureau of the Census. 2010. American Community Survey.
[36] U.S. Bureau of the Census. 2010. American Community Survey.

the Region's commuters rode a bike or walked to work, compared with 3.3 percent throughout the U.S[37]. These data may not represent the full extent of bicycling and walking as a commuting mode[38].

A more precise measure of change in vehicle use is the number of annual Hudson River bridge crossings, which are individually tallied by the NYS Bridge Authority and Thruway Authority. As seen in Figure 3.7, in 2011 there were 101.1 million bridge crossings over the Hudson River in the Region.[39] Notably, this traffic is down by 1.6 million crossings (or 1.6%) since 2002. Interestingly, truck traffic at bridge crossings declined by 15 percent from 2002 to 2011.

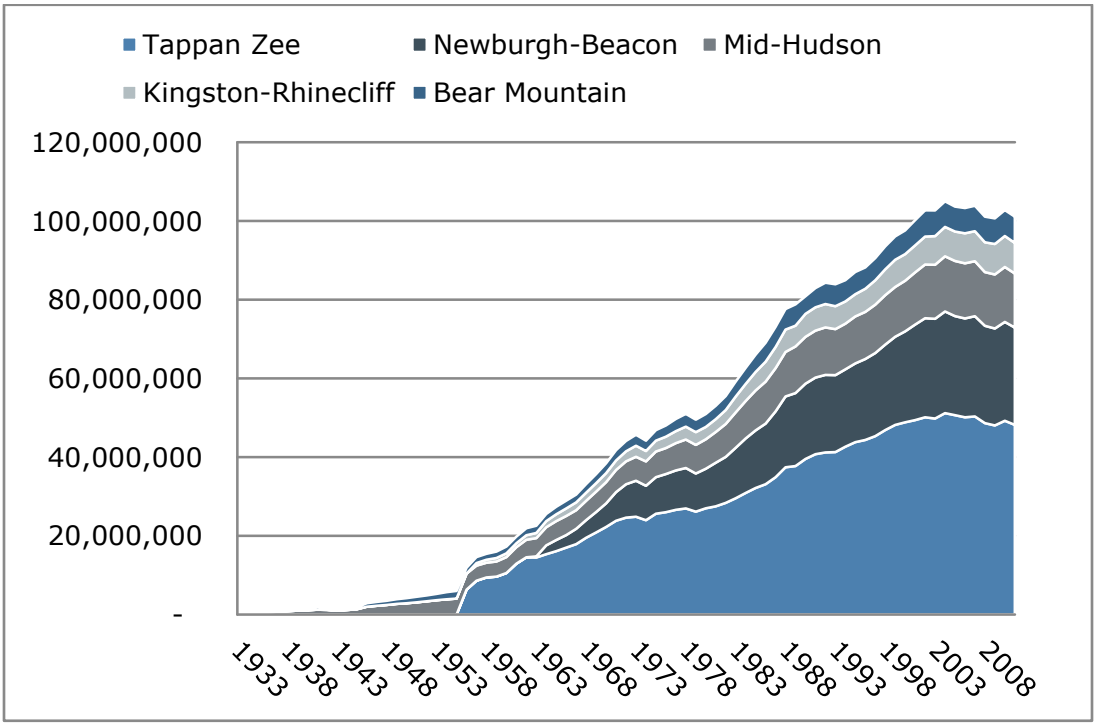


Figure 3.7 Hudson River Bridge Traffic, 1933 to 2011

In 2010, fueling stations in the Region sold nearly 820 million gallons of gasoline, meaning the average vehicle consumed around 480 gallons[40]. While this seems low compared with the

[37] U.S. Bureau of the Census. 2010. American Community Survey.

[38] The American Community Survey asks respondents to report how they "usually" get to work and, if more than one mode is used, they are asked to select the mode they use for the longest distance. This means that commuters that bike or walk to work two days a week will not be counted, and commuters that bike or walk to the train station most likely will not be counted either.

[39] NYS Bridge Authority. 2012. Bridges; NYS Thruway Authority. 2012. Bridges.

[40] NYSERDA. 2012. Gasoline Sold.

national average, which was 530 gallons for light duty vehicles in 2010, it may underestimate fuel consumption[41]. As of July 2012, the combined local, state, and federal gas taxes in NYS added up to 67.7 cents per gallon, compared with 32.9 cents per gallon in New Jersey[42]. As a result, many drivers may go out of their way to purchase gas in New Jersey. Because of this, the volume of fuel that is burned in the Region is likely much greater than the volume of fuel that is purchased here.

Together in 2011, the Region's two commercial airports accommodated 2,317,611 passengers, down nearly 250,000 from 2007. While passenger travel has increased by 252,480 at Westchester Airport, during the same time period passenger travel decreased by over 500,000 at Stewart Airport, a reduction of nearly 55 percent. Both airports also handle freight cargo. In 2010, they handled 119,372 and 16,835 tons, respectively[43]. Comparative year-to-year data are not readily available.

For centuries the Hudson River served as one of the main drivers of economic growth for the Region, carrying freight between major hubs. While there no longer are any major commercial ports, the Port of Albany and the Port of New York and New Jersey are located to the north and south of the Region. In 2011, the Port of New York and New Jersey was the third largest port in the nation and the largest on the East Coast, handling over 85 million metric tons of cargo[44]. Much of the cargo offloaded in the port travels through the Region by rail or truck.

The Port of Albany is smaller, handling just over 305 thousand metric tons in 2011, but is still an important economic driver for the Region[45]. The vast majority of the Port's cargo is outbound, meaning that cargo is collected there by truck or rail and loaded onto ships. In 2011, the Port completed a $12 million renovation project to increase capacity, suggesting that the amount of cargo that the Port handles will continue to grow in the future[46]. In addition, the ships the Port services pass through the Region on their way to Albany and support various related services along the river. For example, the Hudson River Pilots Association

[41] U.S. DOT. 2012. RITA.
[42] U.S. DOT. 2012. RITA.
[43] Port Authority of New York & New Jersey. 2011. Airports.
[44] Port Authority of New York & New Jersey. 2011. Ports.
[45] Port of Albany. 2011. Annual Report.
[46] Ibid.

recently opened the Mid-River Pilot Station in Hyde Park, where ships stop to pick up river captains to safely traverse the stretch of the Hudson River between NYC and Albany[47].

3.2 Climate Change, Land Use, Livable Communities, and Transportation

3.2.1 GHG Emissions

Land Use and Livable Communities

Changes in land use patterns impact the extent and composition of forests in the Region. As land is cleared for development or other uses, the ability of forests to store (or "sequester") carbon in their trees, forest litter, and soils is impacted. Land use changes in the Mid-Hudson Region in 2010 resulted in a net emission (decrease in sequestration) of 5.3 million MTCO2e. Results by county are shown in Table 3.2. These data have significant limitations and should be viewed with a degree of caution – see callout box below.

TABLE 3.2 2005-2010 NET CHANGE IN FOREST CARBON STOCKS

	(GHG Emissions due to Change in Forest Carbon Stocks (MTCO2e)
Dutchess County	1,825,360
Orange County	(1,359,459)
Putnam County	653,119
Rockland County	(703,539)
Sullivan County	4,817,816
Ulster County	833,305
Westchester County	(811,868)
Mid-Hudson Region Total	**5,254,734**

[47] Port of Albany. 2012. Pilotage.

The U.S. Forest Service's Forest Inventory and Analysis database, used to calculate GHG emissions from land use, land use change, and forestry focuses on the amount of canopy coverage and the type and size of trees in forests, which indicate forest carbon sequestration. This is a fundamentally different way of calculating land use change than a method built on data from the U.S. Census Bureau. The Census Bureau measures urban areas mainly using block level population density, which is more indicative of development and transportation infrastructure. The methods are different and direct comparison is difficult.

The Forest Service's dataset is, at its core, based on satellite imagery. Satellite imagery data may not be accurate enough to precisely calculate change in forest cover. For example, the NYS property assessment data show that 18% of the Region is wild, natural forest. The NYS DEC forest fragmentation data suggest that over 90% of the Region is forest. The Forest Service data indicate that 62% of land area is forest.

Transportation

The combustion of fuel in vehicles results in emissions of CO_2, CH_4 and N_2O. The amount of CO_2 emitted by vehicles depends on the amount of fuel consumed, whereas CH_4 and N_2O emissions vary based on control technologies used by vehicles. On-road vehicles are considered to include passenger cars, other 2-axle and 4-axle vehicles, single-unit trucks, buses, combination trucks, and motorcycles.

Total emissions from on-road vehicles in 2009 (proxy for 2010) were approximately 10.3 million MT CO_2e (see Table 3.3). Motor gasoline and diesel accounted for 87 percent and 13 percent of on-road emissions, respectively, while motor gasoline, diesel, and ethanol (primarily included through blending with motor gasoline) account for 82 percent, 12 percent, and 6 percent of energy consumption on the basis of BTU.

TABLE 3.3 TRANSPORTATION GHG EMISSIONS

	GHG Emissions (in MTCO2e)					
	On-Road	Air	Marine	Rail	Off-Road	Total by County
Dutchess	1,253,476	2	8,139	47,371	113,231	**1,422,219**
Orange	1,988,057	40,044	7,614	27,437	117,542	**2,180,694**
Putnam	906,346		4,988	20,717	36,752	**968,803**
Rockland	1,215,184		8,533	10,804	102,364	**1,336,885**
Sullivan	392,347	4	9,189	518	48,117	**450,175**
Ulster	968,418	1	11,683	13,800	63,346	**1,057,248**

TABLE 3.3 TRANSPORTATION GHG EMISSIONS						
	GHG Emissions (in MTCO2e)					
	On-Road	Air	Marine	Rail	Off-Road	Total by County
Westchester	3,529,093	241,184	16,983	7,184	352,960	**4,147,404**
Total by Source	**10,252,921**	**281,235**	**67,129**	**127,831**	**834,312**	**11,563,428**
Percent of Total Emissions	88.7	2.4	0.6	1.1	7.2	100.0

On-road emissions in the Region account for more than 88% of all transportation emissions. The remainder of emissions stem from other sources such as boats, planes, trains, and off-road vehicles and equipment.

3.2.2 Climate Change Vulnerability

Land Use and Livable Communities

Land use patterns play a large role in determining how vulnerable a population, community, or other valued asset is to climate-related hazards. For example, housing and other infrastructure located in low-lying areas may be susceptible to flooding. Natural habitat and biodiversity may be impacted by changing climate. Public health may be put at risk during periods of extreme heat or cold. Table 3.4 presents potential climate effects that impact land use and the livability of communities.

TABLE 3.4 SUMMARY OF LAND USE AND LIVABLE COMMUNITIES-RELATED CLIMATE EFFECTS IN THE MID-HUDSON REGION			
Asset	Climate Impact	Climate Effect	Description
Developed Areas & Open Space	Extreme weather; Flooding	Property damage	Residential, recreational, cultural, and historical properties will experience damage from severe weather events—flooding in particular.
Agricultural Lands	Sea level rise and flooding	Crop loss from flooding	More farmland in the Region may suffer increasing damage from flooding
	Increased temperature	Pests / Invasive Species	Warmer temperatures could allow invasive species to expand their range and have longer breeding seasons. The demand for irrigation may also increase.
Public Health	Extreme heat	Reduced air quality	High heat days result in increased ozone (smog) levels.
	Increase in annual	Increase in vector-	Warmer weather results in longer breeding

TABLE 3.4 SUMMARY OF LAND USE AND LIVABLE COMMUNITIES-RELATED CLIMATE EFFECTS IN THE MID-HUDSON REGION

Asset	Climate Impact	Climate Effect	Description
	average temperature	borne diseases	seasons and ranges for pests such as ticks and mosquitoes that carry diseases including Lyme disease and West Nile virus.
	Extreme heat	Increase in heat-related illness	More high heat days and heat waves can lead to heat-related illnesses such as heat exhaustion and heat stroke.
	Extreme weather: flooding & heat	Disruption of medical service	Flooding and severe weather can prevent care givers from reaching patients and providing medical attention. Certain individuals rely on electricity to run medical devices and are vulnerable to power outages that could result from extreme weather including heat, flooding and other storms.

The coastline in Westchester County along Long Island Sound is particularly vulnerable to sea level rise and storm surges. Figure 3.8 shows how Westchester County will be impacted by flooding, storm surge and sea level rise by the end of the century. Sea level rise and coastal flooding from storm surge are already affecting and will increasingly affect NYS' entire ocean and estuarine coastline from Montauk Point to the Battery and up the Hudson River to the federal dam at Troy. As a result of climate change, some residential areas and parks such as Pelham Bay could be inundated with as little as 18 inches of sea level rise. Land along the Hudson River is also at risk. In addition to flooding from sea level rise, increased frequency and severity of storms could present considerable added risk to communities and facilities located in flood zones in higher elevation areas, such as the Catskills.

Of the 2,380 contaminated, regulated or brownfield sites in the Region, 312 are in the existing FEMA 100-year floodplain; 316 would be in the 2080 floodplain (which incorporates sea level rise). At present, 78 sites are in the existing storm-surge inundation zone and 128 would be located in the 2080 storm surge inundation zone. For these hazard sites that are potentially vulnerable to flooding, standard safeguards and/or remediation engineering solutions may not be appropriate.

Many of the climate hazards discussed in this report have cascading effects that can threaten human health. As the climate warms, air quality will decline due to more high ozone days.

Milder winters will bring more cases of and longer exposure to vector-borne diseases such as West Nile virus and Lyme disease. Heat-related illnesses such as heat exhaustion and heat stroke will increase due to more frequent and more extreme high heat days. In the Mid-Hudson Region, the number of days per year with maximum temperatures exceeding 90^0 F could increase from 12 to 75 days, based on a high emission scenario.

Figure 3.8 Coastal Climate Impacts

Emergency response facilities (critical facilities), such as hospitals, fire stations, police stations and schools (often used as shelters), need to take extra precaution to be protected from hazards such as flooding and sea level rise. Table 3.5 shows facilities that are vulnerable to flooding, storm surge, and sea level rise.

TABLE 3.5 VULNERABLE CRITICAL FACILITIES IN THE MID-HUDSON REGION

	FEMA Floodplain - 2011	2080 Floodplain	Cat. 3 2012	Cat. 3 2080	SLR 2080
Winona Lake Fire	■	■			
Salisbury Mills Fire Dept	■	■			
Cuddebackville Fire	■	■			
Huguenot Fire Dept	■	■			
Goshen Ambulance	■	■			
Planned Parenthood (Goshen)	■	■			
Minisink Fire Co	■	■			
Cataracts Fire Co	■	■			

TABLE 3.5 VULNERABLE CRITICAL FACILITIES IN THE MID-HUDSON REGION

	FEMA Floodplain - 2011	2080 Floodplain	Cat. 3 2012	Cat. 3 2080	SLR 2080
Dikemans Fire Co	■	■			
Yorktown F.D.	■	■			
Sing Sing Correctional F.D.	■	■	■	■	
Banksville F.D.	■	■			
Tarrytown F.D.		■	■	■	
Mamaroneck Village F.D.	■	■		■	
Rye City F.D.	■	■	■	■	

Source: see Appendix XYZ – Climate Change Vulnerability Assessment

Transportation Vulnerabilities

Climate change will impact the Mid-Hudson Region's transportation system in a variety of ways. For example, sea level rise and increased precipitation may inundate low-lying areas and overload drainage systems. Culverts and bridges subject to flash floods that exceed design capacity can cause roads to washout – this is significant given that there are over 2,800 bridges in the Region—half of which cross a river or stream[48]. Chapter 7 discusses this issue in greater depth.

For a complete list of ways that climate change will impact the Region's transportation see Table 3.6.

[48] This number came from GIS analysis using the New York State Department of Transportation's Bridges layer file, a vector point file consisting of bridges that carry or cross a public road.

TABLE 3.6 SUMMARY OF TRANSPORTATION RELATED CLIMATE EFFECTS IN THE MID-HUDSON REGION

Asset	Climate Impact	Climate Effect	Description
Roads & Highways	Flooding and Intense Precipitation	Infrastructure damage	Increased precipitation and sea level rise can cause flooding on roadways. Intense precipitation events can overload drainage systems. Culverts too small to handle the increased water volume can cause roads to washout.
	Extreme Heat	Infrastructure damage; Summertime construction delays; Traffic signal outages	Extreme heat can damage pavement and other materials on roads, runways, and bridges. Heat can also cause delays in construction due to worker heath health, although milder winters will extend the construction season. Power outages during heat waves will affect traffic signals and impact traffic flow.
	Warmer Winters	Increase in potholes, cracks and frost heaves; Reduced salt use in the winter	Warmer winters mean more freeze/thaw cycles which cause potholes, cracks, and frost heaves in pavement. Warmer winters could also reduce costs from snow removal and road salting.
Railroads & Public Transit	Severe storms	Service delays	An increase in severe storms could result in service delays while tracks and roadways are cleared of debris or water. High winds and heavy precipitation can also damage roadway and rail infrastructure.
	Extreme Heat	Infrastructure damage; Service delays; Passenger discomfort	Heat can damage railroad infrastructure such as railroad tracks, electrified third rail, and catenary wires. Heat also causes service delays since trains run slower in the heat and power outages impact rail signals. Extreme heat also creates discomfort for passengers using public transit.
Aviation	Severe Storms	Delays and cancellations	Weather related delays could become more frequent at airports.
	Extreme Heat	Infrastructure damage	Airport runway surfaces may need to be constructed with different materials to cope with more high heat days.
Shipping & Bridges	Severe Storms; Drought	Increase need for dredging; Increase in bridge scour; Bridge closures	Reduced river levels during certain periods of the year and sediment redistribution from storms could increase the need for dredging and/or lead to bridge scour. High winds could also cause temporary closure of larger bridges.
	Warmer Winters	Longer shipping season	Reduced ice cover in the winter will allow for a longer shipping season.

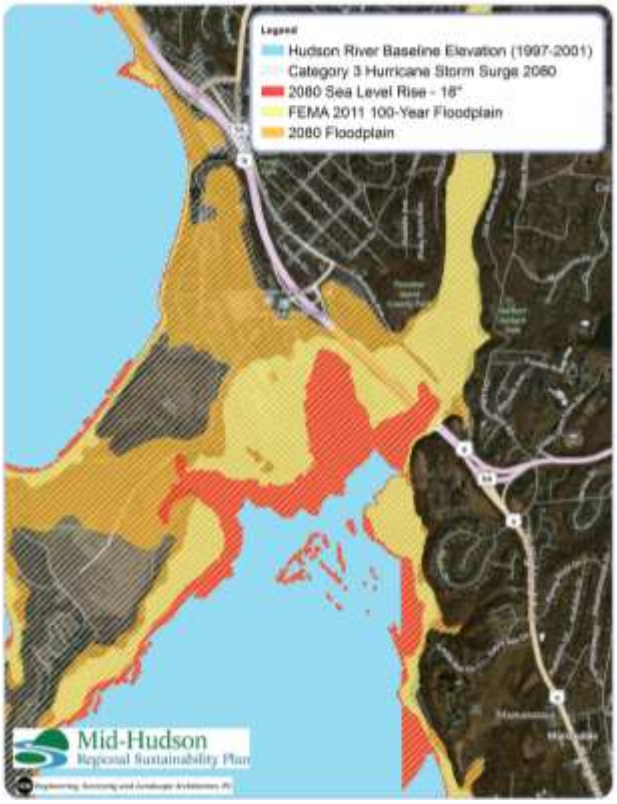


Figure 3.9 Croton Rail/Roadway Flooding

Intense precipitation and storms could compromise rail and road infrastructure. Strong storms bringing high winds often leave debris on tracks causing delays and damage. Flooding and sea level rise along the Hudson River threatens much of the Region's rail infrastructure, which largely runs parallel to the River. Sea level rise may not directly inundate rail infrastructure, however it will likely eliminate the buffer zone that protects this infrastructure from flooding. The Sea, Lake, and Overland Surges from Hurricanes (SLOSH) analysis indicates that, by the end of the century, 237 miles of rail would be vulnerable to inundation during a Category 3 hurricane. Table 3.7 shows how many miles of rail could be inundated under each scenario. Figure 3.9 shows a portion of rail and roadway in Croton that is particularly vulnerable to sea level rise.

TABLE 3.7 MILES OF RAIL WITHIN CLIMATE HAZARD AREAS

	Total in Region	FEMA Floodplains*	2080 Floodplains*	SLOSH – No Sea Level Rise during a category 3 hurricane	SLOSH – 2080 Sea Level Rise during a category 3 hurricane	2080 Sea Level Rise with no storm event
Miles of Rail	**887**	177	212	175	237	10

*** Does not include Putnam and Rockland Counties, because floodplain data was not provided for the study**

3.3 Objectives

TL1 – Strengthen Centers Supported by Transit

- Invest in and revitalize the centers in the Region that are supported by public transit service. The rationale is that these centers are, or have the potential to be, walkable, livable places with multiple transportation options available, allowing people to live, work, and travel in ways that minimize environmental impacts. These places should have enough capacity in their transit, roads, and utilities to attract and absorb growth by making more efficient use of land and existing infrastructure. This can minimize the need to build new capacity, which will be increasingly difficult in the future. Increasing the density of existing centers can also protect open space from development pressure.
- See callout box for further detail.

TL2 – Create Complete Communities

- Make all of the Region's communities – whether urban, suburban, and rural – more "complete" by making them more sustainable and livable. A complete community is one where residents can access jobs, a diverse mix of services, schools, recreational opportunities, and open space within a short distance of their home and via multiple modes of transportation. This would lower household transportation costs, reduce gas consumption, improve air quality, and promote public health in Region.
- See callout box for further detail.

TL3 – Reduce Transportation Fuel Consumption and GHG Emissions

- Create a safer, more efficient multi-modal transportation system that gives residents, workers, and visitors to the Region more transportation choices. Reduce transportation fuel consumption and GHG emissions by improving the modal split and efficiency of the Region's passenger and freight transportation system and by reducing the overall need to travel. Since over 40% of the Region's GHG emissions are created by the transportation sector, shifting travel to carpooling, mass transit services, and non-motorized modes, as well as increasing the amount of clean fuel vehicles in the Region is a critically important step.
- Increasing the sustainability of the Region's transportation system will require a multi-faceted approach, including some new infrastructure; however the focus must be on making better use of existing infrastructure and services. Given current revenues, NYS can only afford to maintain 60% of its transportation infrastructure, so tough choices are on the horizon. Building new transportation infrastructure will be required in the future, but the State and the Region will have to strategically prioritize their

investments to preserve the sustainability, not only of its transport system, but also of its finances.

TL4 – Improve the Safety and Integrity of Regional Infrastructure

- Improve the design of transportation facilities and utility infrastructure, and ensure adequate maintenance to improve safety and maximize the longevity of infrastructure investments. Ensure that vulnerabilities due to climate change and other hazards are addressed in design and/or retrofit of infrastructure. Improving the response to natural disasters when they occur, particularly by preparing hazard mitigation plans, will help understand the risks and ensure that the response creates more resilient communities and infrastructure systems.
- At present, much of the Region's infrastructure, including transportation and utility assets, are unsafe and vulnerable to the effects of climate change, putting the Region's economy at risk in the event of storms, as evidenced by Hurricane Sandy. Many roads and rail lines were not designed to accommodate current traffic volumes or are aging and deteriorating, and have become unsafe and will need to be rebuilt. Other infrastructure assets are located in areas that are susceptible to flooding due to storm surges and will need to be relocated or retrofitted to make them more resilient in the future.

Following Text to be placed in Callout Box

TL1 - Priority Centers

Centers are cities, towns, and villages with above average population, housing, and job densities, robust road, transit, bike, and pedestrian networks, and demographics to support increased transit service, which make them suitable for increased smart growth development. Focusing housing and urban development in priority centers to increase density offers residents and workers more sustainable transportation choices and makes better use of the existing public infrastructure, including transportation and utility assets.

As part of the planning process, a spatial analysis of land use and transportation patterns was completed to identify priority centers in the Region. This analysis defined centers as places with above average connectivity, measured by the density of the street grid, access to rail and/or bus transit services, and the walkability between schools, housing, and other activity centers.

Another factor used to identify centers was Transit Score, an indicator developed by NJ TRANSIT[49] that identifies areas suitable for investment in transit modes, such as fixed route bus services, bus lanes, bus rapid transit, or rail (see Figure 1.10).

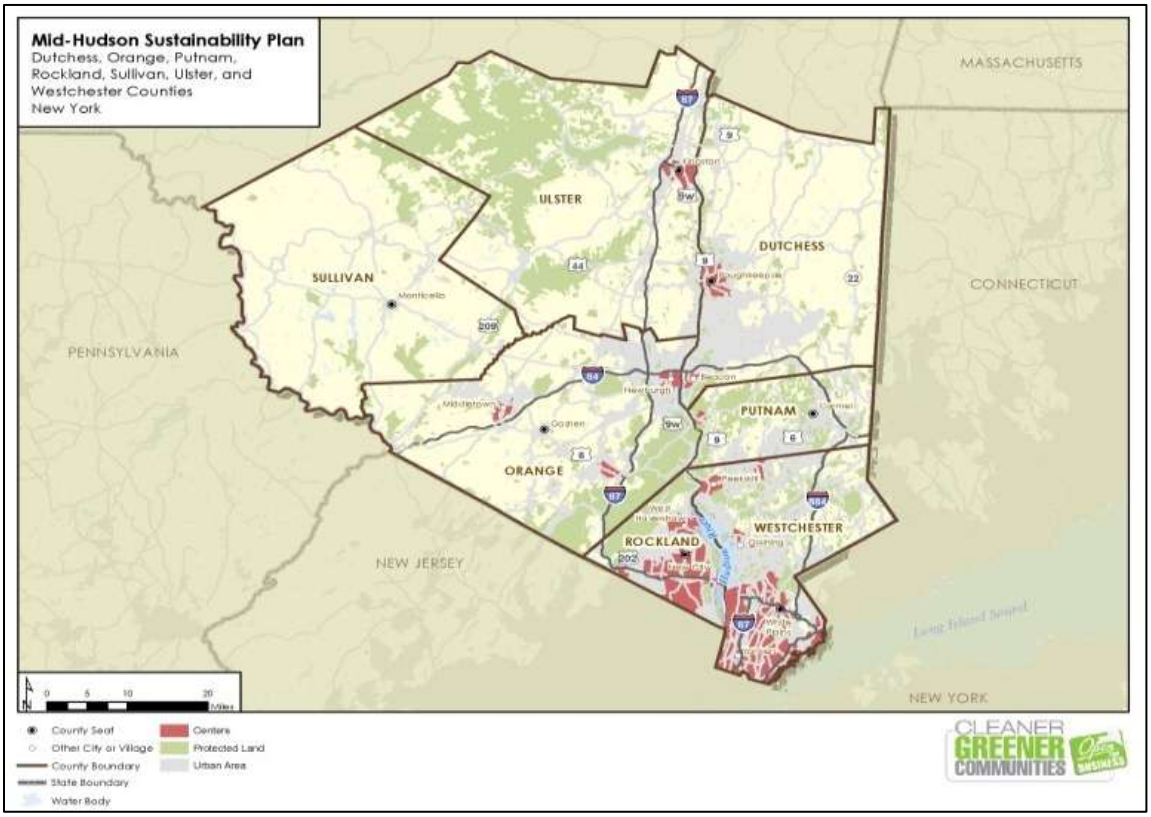


Figure 3.8: Centers

In addition to the quantitative analysis described above, the planning team reviewed the Region's counties' own stated priority growth areas and inspected these areas' land use characteristics using satellite imagery. Ultimately, the methodology used in this analysis, described above, adopts a consistent approach to defining centers across the entire Region.

Centers – Cities and Towns

City/Town Name	County
Beacon city	Dutchess

*Centers – Villages**

Village Name	County
Harriman	Orange

[49] *Note: Transit Score is a method developed by New Jersey Transit and Delaware Valley Regional Planning Commission that incorporates existing population density, employment density, and density of zero-car households into one indicator that measures the potential and suitability for investment in different transit modes.*

Poughkeepsie city	Dutchess
Poughkeepsie town	Dutchess
Middletown city	Orange
Monroe town	Orange
New Windsor town	Orange
Newburgh city	Orange
Port Jervis city	Orange
Clarkstown town	Rockland
Haverstraw town	Rockland
Orangetown town	Rockland
Ramapo town	Rockland
Stony Point town	Rockland
Esopus town	Ulster
Kingston city	Ulster
Eastchester town	Westchester
Greenburgh town	Westchester
Mamaroneck town	Westchester
Mount Kisco town	Westchester
Mount Pleasant town	Westchester
Mount Vernon city	Westchester
New Rochelle city	Westchester
Ossining town	Westchester
Peekskill city	Westchester
Pelham town	Westchester
Rye city	Westchester
Rye town	Westchester
White Plains city	Westchester
Yonkers city	Westchester

Cold Spring	Putnam
Nelsonville	Putnam
Haverstraw	Rockland
Kaser	Rockland
Nyack	Rockland
Spring Valley	Rockland
Suffern	Rockland
West Haverstraw	Rockland
Ardsley	Westchester
Bronxville	Westchester
Dobbs Ferry	Westchester
Elmsford	Westchester
Hastings-on-Hudson	Westchester
Irvington	Westchester
Larchmont	Westchester
Mamaroneck	Westchester
Mount Kisco	Westchester
Pelham	Westchester
Pelham Manor	Westchester
Port Chester	Westchester
Tarrytown	Westchester
Tuckahoe	Westchester

**** Villages are confined within county borders, but some villages cross city/town borders***

TL2 – Complete Communities

A "complete community" is any place, whether it is in an urban or rural setting, where residents can access jobs, a diversity of services, schools, recreational opportunities, and open space within a short distance of their home and via multiple modes of transportation. This is achieved by attracting high-paying jobs, essential services, and retail opportunities to village and hamlet downtowns. Establishing bicycle and pedestrian connections among a community's services, residences, and local schools is also critical to facilitate mobility. Investing in the public realm, including sidewalks, crosswalks, bike lanes, and street trees, while conserving and enhancing connections to surrounding park and recreational areas is also important. The Complete Streets movement is an effective way of promoting this objective – six counties and over 30 municipalities have passed Complete Streets resolutions or policies as of

October 26, 2012, according to Tri-State Transportation Campaign, and another dozen or more are in the process.

The Complete Communities designation has been included in recognition of the fact that the vast majority of land in this Region consists of open space or low-density suburban and rural development without access to transit services. These places generally do not have sufficient population and job density to support public transit services and high-density, mixed-used transit-oriented development. Despite this, there are many other ways these communities can reduce carbon emissions while preserving their suburban or rural character, enhancing their livability, and providing the quality of life that their residents value.

There are over 500 incorporated villages in NYS and 81 are located in the Mid-Hudson Region. There are also hundreds of unincorporated hamlets, many of which contain traditional Main Streets or smaller centers, where basic retail and services are concentrated in walkable environments. These communities already act as magnets for tourists, as well as for families seeking to change lifestyles. The rationale behind creating more Complete Communities is to revitalize or reinforce the success and traditional character of these places by attracting more jobs, retail, schools, multifamily housing, and other activities. This allows residents to link numerous activities, such as shopping for groceries, mailing a package, and visiting the dentist, in one trip, saving gasoline and reducing GHG emissions, all while protecting the surrounding natural environment from development.

Several metrics were used to evaluate Complete Community characteristics, including:

- Balance of housing to jobs (Objective 2a),
- Salaries to home values (2b),
- Increased multi-family housing (2c), and
- Access to parkland (2d).

Challenges to infill development

Achieving this objective will entail a greater degree of new infill development – building on vacant or underutilized lots – and rehabilitation of existing buildings in the downtown or "Main Street" areas of established centers. This is easier said than done. Infill development currently faces a range of challenges that discourage implementation. Perhaps most importantly, infill is often more expensive for developers because of the higher costs for land acquisition, removing or rehabilitating existing structures, and environmental remediation. It is also constrained by the limited size and layout of existing parcels, potentially complex transportation and parking issues, among other challenges. As mentioned earlier, local zoning laws may not allow for mixed-use development or other features that are typical of smart growth.

There also may not be sufficient housing options or housing quality to accommodate families in centers, compared with suburban locations. Some center cities may lack the quality green space, schools, parks, and natural amenities that residents in the Region value or have grown accustomed to.

3.4 Indicators

Table 3.8 presents a series of sustainability indicators for the land use, livable communities, and transportation focus area. These indicators should be used by local government to track performance in achieving the objectives noted above.

3.4.1 Metrics and Targets

TABLE 3.8 INDICATOR INVENTORY – TIER 1 INDICATORS

Objective	Metric	Current Value	Target – 2020	Target – 2035	Target – 2050
TL 1. Strengthen centers supported by transit	Percent of population and jobs in centers supported by transit	Pop: 48%; Jobs: 54% (2000)	Pop: 52%; Jobs: 56%	Pop: 56%; Jobs: 58%	Pop: 60%; Jobs: 60%
1a. Stabilize land consumption.	Acres of urbanized land per capita	0.31 (2010)	0.30	0.30	0.30
TL 2. Create Complete Communities	Communities that have achieved the following targets	n/a	n/a	n/a	n/a
2a. Improve job-housing balance	Ratio of the number of jobs to the number of housing units	*Measured at the census tract level. Makes more sense when combined with the job pay-home value balance indicator.*			
2b. Improve job pay-home value balance	Ratio of average annual job pay to median home values	*Measured at the census tract level. Makes more sense when combined with the job-housing balance indicator.*			
2c. Increase share of new housing units built in multi-family buildings	Share of new housing units built in multi-family (5+ units) buildings	19.6% (2011)	22%	28%	35%
2d. Increase access to parkland	Percent of people living within one half mile of a park	61% (2010)	62	64	68
2e. Population in floodplains	Percent of population residing within a 100-year flood plain	TBD	TBD	TBD	TBD
TL 3. Reduce transportation fuel consumption and GHG emissions	Gallons of gasoline sold per registered vehicle	482 (2010)	460	382	328
3a. Shift work travel from single-occupant vehicles to carpool, transit, and non-motorized modes	Change in carpool, transit, and non-motorized minus change in single occupant vehicle work trips	7.99% (2005 to 2010)	8.5%	9.0%	9.5%
3b. Reduce vehicle travel	Annual vehicle miles traveled	23.1 billion (2009)	22 billion	19 billion	15 billion

TABLE 3.8 INDICATOR INVENTORY – TIER 1 INDICATORS

Objective	Metric	Current Value	Target – 2020	Target – 2035	Target – 2050
3c. Reduce vehicle ownership	Active vehicle registrations per 1,000 capita	742.7 (2010)	730	710	680
3d. Reduce Hudson River bridge crossings per registered vehicle	Hudson River bridge crossings per registered vehicle	60.4 (2010)	58	55	50
3e. Reduce commercial truck traffic at toll barriers	Annual commercial truck traffic at all toll barriers in the Region	7.7 million (2009)	7.5 million	7.3 million	7 million
3f. Reduce transportation fuel use	Transportation fuel use (MBtu) per capita	79	67	55	39
3g. Reduce transportation GHG emissions	Transportation GHG emissions per capita	INSERT	INSERT	INSERT	INSERT
TL4: Improve the Safety and Integrity of Regional Transportation Infrastructure		n/a	n/a	n/a	n/a
4a. Reduce vehicle accidents	All injuries due to motor vehicle accident per 10,000 registered vehicle	68.2 (2007)	60	30	0
4b. Reduce pedestrian and bicyclist injuries due to vehicle accidents	Pedestrian and bike injuries due to vehicle accidents per 10,000 registered vehicles	8 (2010)	7	4	0
4c. Improve poor bridge conditions	Percent of bridges that are classified as "structurally deficient"	12.8% (2012)	12%	10%	8%
4d. Improve poor road conditions	Average condition rating of road pavement	6.73 (2011)	7	7.5	8
4e. Passenger rail lines in storm surge hazard areas	Percentage of the passenger rail network located in areas vulnerable to hurricane surges	26.7% (2012)	22%	16%	10%
4f. Roads in storm surge hazard areas	Percentage of the road network located in areas vulnerable to hurricanes surges	???	-	-	-

TABLE 3.9 INDICATOR CALCULATIONS AND DATA

Metric	Calculation	Data Source
TL 1. Percent of population and jobs in centers supported by transit	Centers = index synthesizing multiple factors at the following thresholds: - Road connectivity = 20+ intersections per sq. mi. - Access to transit = within 5 miles of a train station, more than 1 bus stop per sq. mi. - Suitability for transit services = transit score > 1 - Walkability to transit = walk score > 0.3 - Walkability to schools = walk score > 0.3	Roads = U.S. Census TIGER; Transit = RPA, Ulster County, MTA Metro North; Schools = NYS Department of Education; Population = U.S. Census; Jobs = Census Transportation Planning Package
1a. Acres of developed land per capita	Total acreage of urban development in the Region divided by the total population	Urban development = Urban Area, U.S. Census; Population = U.S. Census
TL 2. Communities that have achieved the following targets	n/a	n/a
2a. Ratio of the number of jobs to the number of housing units	Total number of jobs divided by the total number of housing units per census tract	U.S. Census, CTPP. Can be done with 2010 CTPP when available in 2013
2b. Ratio of average annual job pay to median home values	Average salary put to a 1-10 scale divided by median home value normalized to a 1-10 scale per census tract	Salary = County Business Patterns; Home value = U.S. Census, ACS
2c. Share of housing permits issued for units in multi-family (5+ units) buildings	Total permits issued for housing units in multifamily buildings divided by total permits issued for all housing units annually	U.S. Census, ACS
2d. Percent of people living within one half mile of a park	Total number of people living within one half mile of a park divided by the total population of the Region	Parkland = Scenic Hudson. Population = U.S. Census
2e. Percent of population residing in 100-year flood plain.	TBD	
TL 3. Gallons of gasoline sold per registered vehicle	Total annual gallons of gasoline sold divided by total active vehicle registrations	NYSERDA / NYSDMV
3a. Change in carpool, transit, and non-	Change in the percentage of work trips by carpool,	U.S. Census, ACS. Can be done with 2010

TABLE 3.9 INDICATOR CALCULATIONS AND DATA

Metric	Calculation	Data Source
motorized minus change in single occupant vehicle work trips	transit, bike, and walk minus change in the percentage by single occupant vehicle	CTPP when available
3b. Annual vehicle miles traveled per capita	Total annual vehicle miles traveled divided by the total population	NYSDOT
3c. Active vehicle registrations per 1,000 capita	Total active vehicle registrations divided by the total population, then divided by 1,000	NYSDMV
3d. Hudson River bridge crossings per registered vehicle	Total annual Hudson River bridge crossings divided by total active vehicle registrations	NYSBA / NYSTA
3e. Annual commercial truck traffic at all toll barriers in the Region	Total annual commercial traffic at toll barriers	NYSBA
3f. Transportation fuel use (MBtu) per capita	Total transportation fuel consumption (in MMBtu) / regional population: ∑ Fuel Combustion for Transportation Energy (On Road, Off Road, Marine, Air, Rail)	Regional Tier 1 or 2 Greenhouse Gas Inventory: DOT, DMV, CAFÉ impact, NYMTC
3g. Transportation GHG emissions per capita	See GHG inventory	Regional Tier 1 or 2 Greenhouse Gas Inventory: DOT, DMV, CAFÉ impact, NYMTC
TL4: Improve the Safety and Integrity of Regional Transportation Infrastructure	n/a	n/a
4a. All injuries due to motor vehicle accident per 10,000 registered vehicle	Total injuries due to vehicle accidents divided by active vehicle registrations, then divided by 10,000	NYSDOH, Bureau of Injury Prevention
4b. Pedestrian and bike injuries due to vehicle accidents per 10,000 registered vehicles	Total pedestrian and bike injuries due to vehicle accidents divided by 10,000 active vehicle registrations	NYSDOH, Bureau of Injury Prevention
4c. Percent of bridges that are classified as "structurally deficient"	Total number of bridges classified as structurally deficient divided by the total number of bridges	NYSDOT

TABLE 3.9 INDICATOR CALCULATIONS AND DATA

Metric	Calculation	Data Source
4d. Average condition rating of road pavement	Average annual condition rating of road pavement by county	NYSDOT
4e. Percentage of the passenger rail network located in areas vulnerable to hurricanes surges	Number of miles of rail lines in SLOSH zones (with sea level rise) divided by total rail line miles	National Weather Service (NWS) / MTA Metro-North
4f. Percentage of the road network located in areas vulnerable to hurricanes surges	Number of miles of road in SLOSH zones (with sea level rise) divided by total road miles	National Weather Service (NWS) / NYSDOT

3.4.2 Limitations and Tier 2 Indicators

INSERT DATA QUALITY AND GAPS DISCUSSION

TABLE 3.10 TIER 2 INDICATORS

Objective	Metric	Calculation
TL 2	Bike routes and trails	Number of linear miles of bicycle lanes or routes vs. recreational trails per capita
TL 3	Vehicle fuel efficiency	Miles per gallon per vehicle by county
TL 3	Vehicle occupancy	Average vehicle occupancy by trip purpose
TL 3	Local vs. through traffic	Origin-destination data to measure the amount of vehicle miles travelled created by local vs. through traffic
TL 3	Park and ride locations and capacity	Number of parking spots available at park and rides

3.5 Priorities for Implementation

Over the last several decades, much of the Region's development has been low density, consisting of single-family homes on large, undeveloped, greenfield lots. This type of development requires substantial investment in new roads and utilities, perpetuates auto dependency, and often permanently eliminates a community's natural assets, whether common areas to mingle, or surrounding forests. Focusing investment into centers supported by transit will reduce the necessary infrastructure spending per capita, protect the Region's natural ecosystems and rural character, while ensuring that residents have more than one transportation option available to them. In areas without transit service, a focus on creating compact, Complete Communities will help preserve open space, increase quality of life, and reduce auto-dependence. Investment in infrastructure will create jobs, improve safety and reliability, and ensure that local businesses are highly-connected to the global economy. Smart investments can be used to enhance mobility and reduce environmental impacts.

Reducing single-occupancy vehicle use can be addressed by improving the jobs-housing and salary-home value balance in the Region's communities, making it easier for people to live and work in the same community. If a family member lives close enough to work to walk, bicycle, or carpool, families may be able to save money by reducing the number of cars they own.

Even with these improvements, it is unlikely in the short-term that most commuters will be able to work in the same place they reside. Comprehensive travel demand management strategies are needed to encourage more sustainable commuting patterns in the Region, such as carpooling and vanpools through employer-based incentive programs, and flexible work schedules.

Achieving a more balanced work trip mode share would not only reduce GHG emissions and energy use, it would also generate other significant societal benefits. For example, reduced vehicle traffic will improve air quality, and increasing walking and bicycling has health and potential social benefits.

A multiplicity of projects and initiatives will be needed to achieve the Plan's land use, livable communities, and transportation objectives. Below, priority project types (referred to as 'priorities for implementation') are presented. To facilitate implementation, a series of programs, policies, and other initiatives (referred to as 'enabling mechanisms') can be put in place at the local and regional level to help target investment, prioritize development in areas of interest, and promote sustainable development patterns. Wherever possible, example projects or initiatives have been given that typify the efforts needed to achieve the Plan's objectives. Note that the list of examples is not intended to be comprehensive, or reflect any degree of priority. The examples listed reflect ideas submitted during the planning process with sufficiently well-developed information to illustrate the concepts being proposed. A full list of project ideas submitted can be found in Appendix E.

3.5.1 Transit-Oriented Development (TOD)

TOD projects are aimed at directing new, dense, mixed-use, equitable development into areas around transit hubs, allowing residents to live, work, shop, and play without having to travel long distances in a vehicle, thus encouraging mode shift and more efficient use of land. Successful TOD efforts often require zoning, land use and policy changes, discussed in the Enabling Strategies section of this Chapter.

Numerous TOD projects have been proposed for the Mid-Hudson Region. The Tappan Zee Bridge/Route 287 project has been in the study phase for many years, with the goal fo promoting TOD.

Example Projects

There are several properties near the train station in New Rochelle that are underutilized, a few of which are owned by the City, presenting opportunities for new development that could support greater use of the train station. The City has retained a consultant to undertake a TOD Smart Growth Study. The project goal is to identify how to create a vibrant TOD Zone around the New Rochelle Transit Center, leveraging the city's transit assets to provide improved access to housing and jobs locally and regionally. New Rochelle's proximity to the employment centers of NYC, Stamford, and White Plains, and the surrounding region, makes it ideally positioned for TOD.

The downtown of Harrison, NY is located right next to a train station on Metro-North's New Haven Line on the Northeast Corridor and is served by the Westchester Bee-Line bus system. There are currently 3.3 acres of surface parking lot adjacent to the train station prime for TOD. The plan, developed over a number of years by the Harrison community and Metro North, involves transforming these acres into a high-density, mixed-use development with residential units, street-level retail stores and restaurants, a structured parking garage, and convenient connections to the train station.

The Metro North train station in Harriman is adjacent to an enormous site that is planned for a TOD development. In addition, the 130-acre site is adjacent to the New York Thruway and one mile south of Woodbury Commons, a shopping mall that is visited by 12 million shoppers per year. These are location advantages that give it the potential to shift the travel mode of future residents, workers, and shoppers. The existing TOD plan is the largest in the state and has been approved for up to 2 million square feet of multi-family residential, retail, office, hotel, and entertainment uses. Current zoning allows for up to 25 dwelling units per acre near the train station and building heights up to 45 feet.

3.5.2 Land Efficient Development (LED)

These projects encourage more compact, mixed-use development in centers (e.g., hamlet areas) that are not in proximity to transit. The goal is to reduce automobile dependency and create more Complete Communities. Successful LED efforts often require zoning, land use and policy changes, discussed in the Enabling Strategies section of this Chapter.

Example Projects

In Kingston, the Rural Ulster Preservation Company is pursuing the transformation of an abandoned factory into affordable housing for low-income populations. The U.S. Lace Curtain

Mill Factory, built in the 19th century and bought in 21st century for $575,000 will now undergo a multi-million dollar renovation, which will convert the building into 55 affordable live-work units for artists. Adaptive re-use projects, such as this one, consume far less land than a similar development on a greenfield site and generally require fewer resources to construct.

3.5.3 Livability Improvements

These projects are aimed at improving the safety and general quality of life of communities. These improvements can help direct new development into priority growth centers and create Complete Communities where a variety of amenities are available for residents, including designing buildings to accommodate different household composition, such as one-person senior households. Projects could include increasing the supply of affordable housing, installing more urban amenities, or improving access to parks and recreational facilities.

Example Projects

Pending Kingston and Peekskill projects.

Quassaick Creek Multi-Purpose Conservation Corridor

3.5.4 Mass Transit Expansion and Upgrades

Transit projects are aimed at encouraging transit ridership through various means, such as: improving equitable access to existing transit services, expanding transit services, optimizing transit operations, reforming management procedures and institutional structures for greater efficiency, and/or building new transit infrastructure capacity. Operational improvements typically include changes such as increased or more reliable service, fare integration amongst agencies, or extended operating hours.

Example Projects

The Central Avenue Bus Rapid Transit Project, sponsored by the Westchester County Department of Transportation, involves building a 14.4 mile express bus route along NYS Route 100, connecting major destinations in the Region including: Downtown White Plains, the Westchester County Center, Cross County Shopping Center, Yonkers Raceway, NYC Subway in the Bronx, and other Westchester Bee-Line bus routes. The project will include implementing intelligent transportation system treatments, such as traffic signal priority at most intersections and queue jump lanes at selected intersections, preferential roadway treatments, and attractive bus stations with shelters, real-time arrival information, low floor

boarding, and off-board fare collection. These features could reduce travel times of 16 to 37 minutes one way, or 25-35 percent, generating ridership increases in the corridor of up to 35 percent. The project is estimated to cost $17.1 million over several years.

The corridor has high concentrations of dense, residential and commercial development that could help attract riders, as well as many underutilized or vacant properties that could be redeveloped, attracting more riders still. The Westchester DOT is contemplating several park-and-ride locations and transit-oriented development projects to support and complement the new service.

This is a relatively inexpensive transit project (compared to light rail or commuter rail projects) in a dense corridor that could potentially attract and move millions of new riders that may have otherwise driven to work in a car. As such, it would help the Region achieve the sustainability objective of reducing fuel consumption by shifting travel out of single-occupant vehicles and on to transit.

3.5.5 Transportation Demand and Systems Management to Relieve Highway Congestion

These projects aim to decrease road congestion and encourage people to drive more efficiently to reduce gas consumption. This is frequently achieved by adjusting the price of parking or expanding parking capacity in certain areas such as train stations, improving highway conditions, or implementing traffic management systems, such as synchronizing and optimizing traffic signals.

Example Projects

NYS Route 17, which was originally a two-lane road, is in the process of being converted to an interstate (U.S. I-86) by adding additional lanes, and removing intersections and grade crossings. When the project is complete, the length of the 381-mile corridor from the border of Pennsylvania in Chautauqua County to where it meets I-87 in Orange County will be a four-lane highway that meets U.S. DOT's Interstate standards. Over half of the project is complete, mainly the western half, which has already been designated I-86, and the eastern half of Route 17 is still in various stages of project development. As this project progresses, the state should consider implementing a suite of transportation demand management (TDM) and transportation systems management (TSM) strategies to manage congestion and increase the capacity of this corridor, which is so critical to the Region.

TDM strategies on this corridor could include policies and programs to increase carpooling or adding transit infrastructure to reduce demand for single-occupant vehicles. TSM strategies for highways could include adding sufficient acceleration / deceleration lanes, reducing sharp curves, or widening shoulders for emergency vehicles.

3.5.6 Street and Sidewalk Improvements

These projects are aimed at improving the design and condition of street right-of-ways and the pedestrian realm to encourage travelers to walk for short trips rather than drive, reducing gas consumption either by repaving local or feeder streets, upgrading sidewalks, or adding pedestrian-friendly street signals.

The 2011 Complete Streets legislation aims to build streets that accommodate all users, including pedestrians, bicyclists, and public transit modes, with quality design. Such improvements may require additional public funds for sidewalks and bike lanes, for example, which are not always available.

Example Project

Now that Governor Cuomo has signed Complete Streets legislation, requiring state and local departments of transportation to consider incorporating new safety and multi-modal elements into streets and roadways, it is up to the counties and municipalities to formally adopt these principles into their design guidelines. A series of demonstration projects could help speed up this process up and encourage adoption.

The hamlet of Golden's Bridge located in the town of Lewisboro is currently pursuing a grant from the FHWA to implement pedestrian improvements at the intersection of Route 35 & 138. The Town of Lewisboro proposes to construct sidewalks, crosswalks, and pedestrian refuges in the area around the intersection to encourage people to walk between the hamlet, nearby shopping center, and Metro North train station, thereby increasing pedestrian access to many of the local businesses. The completion of this project would demonstrate to other towns the benefits of pedestrian friendly improvements to their road networks. Lewisboro has already adopted a Complete Streets policy.

3.5.7 Bicycle Improvements

These projects are aimed at making bicycling safer and more convenient to increase access to transit, reduce vehicle use and gas consumption, and improve quality of life by implementing new bike lanes, adding bike parking at train stations, and installing bike racks on buses, trains, and at job locations.

Example Project

Scenic Hudson is pursuing the phased implementation of the Hudson Fjord Hike/Bike Trail, an eight-mile path between Little Stony Point in Cold Spring and Breakneck Ridge in Beacon, joining Philipstown and the town of Fishkill in Putnam County along Route 9D. The trail would provide a connection for bicycle and foot traffic providing safe access to the nearby hiking trails in Hudson Highlands State Park, the Hudson River, and the towns and train stations along the busy road. This project would provide other towns in the Region with an excellent example of retrofitting an existing auto-orientated roadway to improve safety for all users, including pedestrians and bicyclists.

3.6 Enabling Strategies

3.6.1 Zoning, Planning & Legislation

Projects are aimed at encouraging the adoption of planning and zoning ordinances, regulations, and legislation that promotes TOD and LED, and other sustainability objectives. They could include zoning for higher densities and mixed uses; reduced parking requirement ratios, shared parking concepts, fee waivers or expedited processing for projects meeting certain criteria; modified codes to establish green building criteria for new development and permitted use of green stormwater management infrastructure.

Example Initiative

Many municipal planners lack sufficient resources and training to implement the projects that have been discussed. The Region as an entity or each county could create a program that provides technical assistance to planners in municipalities with fewer resources. This would help cities plan for sustainability and adopt the zoning ordinances and legislation that will result in more sustainable outcomes.

3.6.2 Funding Tools & Strategies

These initiatives seek to replace or expand the range of financial mechanisms for collecting revenues for transportation and use those revenues to fund projects that facilitate mode shift from driving to other modes and helping make sustainable development projects that help promote mixed-use TODs and LEDs with affordable housing easier to finance. New revenue streams could include mileage-based user fees to replace the gasoline tax, and those new revenues could be used to support existing transit agencies.

Example Initiative

Municipalities and developers need more leeway to use Tax Increment Financing (TIF) as a tool to help focus development in centers and create more Complete Communities. The State or Region should pass laws that make it easier to use future tax revenue increases to pay for redevelopment projects or infrastructure improvements that can help direct growth into centers.

3.6.3 Education & Demonstration

Projects under this category are aimed at educating local and regional planners and zoning officials on the benefits of TOD, LED, and other sustainable land use and development patterns, which would help facilitate implementation of the strategies to direct growth into centers and maintain Complete Communities throughout the region.

Such programs can also help educate the public about how their transportation choices impact the environment and the quality of their lives, and encourage them to change their behavior. They also can inform travelers about options for transit that they may not be aware of, thus encouraging a modal shift to transit or carpool. These programs can also demonstrate to employers that they can save money and attract workers by locating near transit services or offering guaranteed ride home programs.

Example Initiative

The counties and municipalities should work together to build the Mid-Hudson Center for Sustainable Learning, which would provide curriculum for planners and elected officials who would like to learn how to use the tools that have been discussed in this chapter to make their communities more sustainable. The Center could also provide other education programs that teach the public live in more sustainable ways. For example, the Center could provide classes that teach urban, suburban, and rural youth and adults how to grow healthy foods for good nutrition, how to start and sustain natural resource, home-based businesses, or how to ride and maintain a bicycle. The Center could also administer or operate as a clearinghouse for other programs that encourage sustainable transportation or land use patterns, such as carpooling programs that help commuters link up with one another to share rides, etc.

3.6.4 Vehicle Fuel Efficiency Programs

Vehicle fuel efficiency programs are aimed at encouraging turnover in vehicle fleet to high efficiency or renewable fuel vehicles to reduce gas consumption through programs such as the

expired Cash for Clunkers or tax rebate programs that encourage users to sell their gas guzzlers and buy the most fuel efficient vehicles available.

Example Initiative

The fleet of school buses in the Region is largely powered by diesel fuel and make up a significant portion of the greenhouse gas emissions. The state should consider a program that encourages private bus companies to purchase new, zero-emission buses and retrofit existing school buses with engines powered by cleaner fuels, which could include renewable biofuel produced from vegetable oils, animal fats or grease, or harvested from landfills, wastewater digesters or livestock operations; electricity generated by renewable fuels, or natural gas.

3.6.5 Freight Efficiency

Freight efficiency initiatives are aimed at improving the freight delivery system, including infrastructure and operations to reduce gas consumption either through incentive programs to encourage fleet turnover to high efficiency or renewable fuel vehicles, regional freight system planning to establish more efficient truck routes, or policies that mandate the use of location efficient metrics when siting and constructing intermodal freight facilities.

Example Initiative

Responding to current trends and the needs of the freight industry in the Region presents many complex challenges, which are not well understood. The TLULC WG suggests that the state and the Region's MPOs work with the private freight companies that operate in the area to undertake a comprehensive regional freight systems planning study to create a long-term framework for development and investment in the Region's freight network.

3.6.6 Commuter Incentives

Commuter incentives aim to induce either a modal shift from vehicles to transit or encourage commuters to use their vehicles more efficiently, either through the use of carpools or vanpools. These policies can be sponsored by a government, as with commuter tax benefits, or by an employer, as with guaranteed ride home or parking cash out programs.

Example Initiative

GAP

4 Energy

This Chapter includes:

1. A review of the baseline conditions for the energy sector
2. A discussion of GHG emissions from the sector, as well as potential climate change impacts
3. A presentation of energy objectives and indicators
4. A review of priority projects, which include:
    a. Energy Efficiency
    b. Demand Response
    c. Microgrid Development
    d. Distributed generation
    e. Energy Storage
5. A discussion of enabling strategies, including:
    a. Energy Improvement Districts
    b. Facilitating Demand Response for Small and Medium Consumers
    c. Community Choice Aggregation
    d. Energy Efficiency Certificates

The Mid-Hudson Region must make significant improvements in how it generates, delivers, and uses energy for NYS to meet its commitment to reduce GHG emissions by 80% below 1990 levels by 2050. The Mid-Hudson Region's geography – connecting Long Island and NYC with the rest of the state – limits the development of traditional thermal power plants, refineries, and other facilities. High local demand for electricity is compounded by the Region's role as a conduit for electricity to downstate NY. The Region's ability to attract and retain business and jobs is at risk due to the physical constraints of siting new energy infrastructure.

Recent damage from storms, sea level rise, and other climate effects underscores the vulnerability of the Region's energy infrastructure. If the Region is to meet the vision set by the REDC's recent Economic Development Strategy, it must take action to reduce real and perceived risk to the Region's energy infrastructure. Mitigating this risk – by updating the

Region's buildings, industrial facilities, and electrical grid – will create thousands of jobs, strengthen the local economy, and reduce the Region's dependence on imported energy.

The future energy economy is already thriving in the Region. It includes solar installers and mechanical insulators, engineers and electricians, Energy Service Companies (ESCOs) and multinational IT firms. It includes union and non-union labor. A sustainable energy system is about reducing risk, controlling costs, and investing in the local/regional economy. The Mid-Hudson Region can be a leader in this new economy.

Already, residents of the Mid-Hudson Region seek access to reliable, affordable, and renewable energy – this has driven growth as businesses and residents have capitalized on the Region's existing energy brain trust. Residents are also seeking to radically increase energy efficiency. These changes will reduce energy impacts. Following from this, the Region's energy strategy seeks to:

- Delineate specific policy and regulatory concepts that will help achieve ubiquitous energy efficiency, control, storage and distributed generation, enabling deep penetration of renewable energy
- Enhance grid reliability and energy security using competition and local community aggregation/empowerment
- Motivate the private sector to finance demand side opportunities and engage energy consumers to achieve efficiency and savings

4.1 Baseline Conditions

Among US states and territories, NYS is a relatively low per capita energy consumer, representing just 3.8% of the nation's total energy consumption in 2010[50], despite bing home to 6.3% (19.4 million) of the nation's population[51]. This relative efficiency derives chiefly from low per capita energy consumption in the NYC metropolitan area, where 40% of NYS' residents live. Without NYC, NYS' per capita energy use comes closer to the US average.

[50] US Energy Information Agency, State Energy Data System (SEDS): http://www.eia.gov/state/seds/
[51] http://www.census.gov

The Mid-Hudson Region is relatively efficient in energy use compared to the NYS average, containing 12% of NYS' population, but accounting for only 10% (377 trillion Btu) of NYS' annual energy consumption of 3,728 trillion Btu (2010).[52]

4.1.1 Net Energy Consumption

The Mid-Hudson Region is served by four electric utilities and four natural gas utilities. There are numerous vendors of other fossil-fuel derived products such as home heating oil. After electricity conversion and delivery losses of about 30%[53], annual net energy consumption for the Mid-Hudson Region is 377 trillion Btus (2010 – see Table 4.1). The corresponding annual expense associated with this energy use is $7.12 billion (2010).

TABLE 4.1 NET ENERGY CONSUMPTION (MMBTU) BY COUNTY AND SECTOR (2010)

County	Residential Fuel	Commercial Fuel	Industrial Fuel	Transportation	Total	MMBtu per Capita
Dutchess	11,431,954	12,026,304	7,633,522	22,751,023	53,842,803	183.41
Orange	14,982,928	12,810,076	3,212,530	33,434,790	64,440,325	168.02
Putnam	3,525,949	2,902,006	1,920,606	14,670,049	23,018,609	231.89
Rockland	13,498,330	4,129,511	6,638,019	21,330,399	45,596,259	151.90
Sullivan	3,482,764	5,986,623	215,906	6,772,171	16,457,465	217.04
Ulster	8,325,853	10,496,025	1,710,134	16,248,683	36,780,695	202.72
Westchester	35,443,876	29,874,424	7,668,445	64,801,349	137,788,094	144.14
Total	90,691,653	78,224,970	28,999,163	180,008,463	377,924,250	165.05

Source: Source: MHR GHG inventory (10-2012): worksheet "GHG_Summaries of Energy Use"

[Electricity and Natural Gas consumption included within each sector.]

TABLE 4.2 NET ENERGY USE BY SECTOR AND FUEL TYPE (MMBTU) 2010

[52]US Energy Information Agency, NY State profile http://www.eia.gov/beta/state/print.cfm?sid=NY

[53] The process of creating and distributing electricity is inefficient. See sidebar below on the NYS Energy Flow.

By sector	%	million Btu
Transportation	48.0%	90,691,653
Residential	24.0%	78,224,970
Commercial	21.0%	28,999,163
Industrial	8.0%	180,008,463
Total	**100.0%**	**377,924,250**
By fuel type	**%**	**million Btu**
Petroleum	47.0%	177,624,398
Natural gas	30.0%	113,377,275
Electricity	18.0%	68,026,365
Other[1]	4.5%	17,006,591
Coal	0.5%	1,889,621
Total	**100%**	**377,924,250**

Notes[1] Ethanol (46.8 TBtu) is included in "Other" totals and also in the petroleum category as a component of motor gasoline. Total consumption and percentages are based on ethanol only as "Other."

Source: adapted from USEIA Annual Energy Outlook 2012 (www.eia.gov/oiaf/aeo/)

Transportation (including on road, off road, rail, air, marine sectors) is the single largest user of energy in the Region (See Figure 4.1).

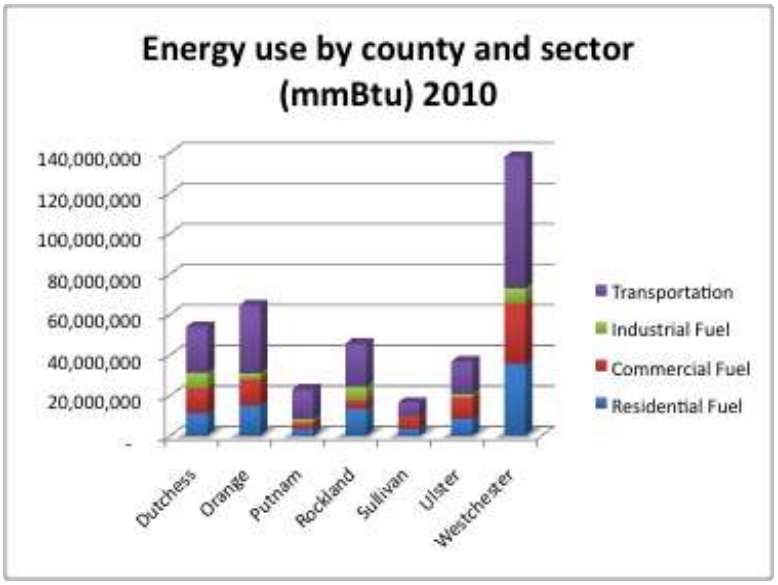


Figure 4.1 Energy use by county and sector (mmBtu) 2010

The counties with the higher population densities consume less energy per capita across all the major consumption sectors (residential, commercial, industrial transportation) – see Figure 4.2.

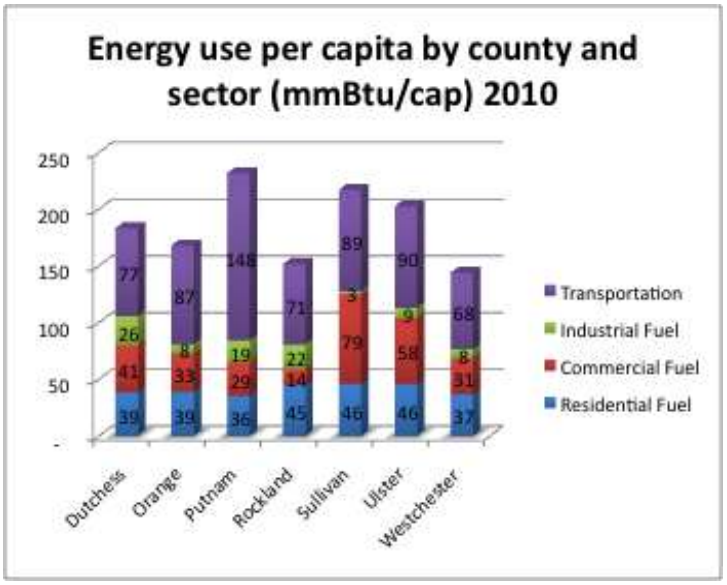


Figure 4.2 Energy use per capita by county and sector (mmBtu/cap) 2010

4.1.2 Energy Prices and Expenditure in the Mid-Hudson Region

On a cost basis (unit of energy acquired per dollar expended), electricity is by far the most expensive fuel type in the Mid-Hudson Region. The Region is not unique in this regard – in 2011, NYS had the fourth highest average electricity prices in the United States.

Petroleum is 1.8 times more expensive than natural gas, due to low present-day costs for natural gas. Natural gas prices have dropped to approximately $17 per thousand cubic feet (MCF) from a high of nearly $23/MCF in 2008[54].

TABLE 4.3 ENERGY USE AND EXPENDITURE BY SECTOR AND FUEL TYPE (2010)

Sector		mmBtu (2010)		Expenditure ($ millions 2010)	Expenditure rate ($million/billion Btu)
Residential Fuel	24%	90,691,653	31%	$2,220	$0.024

[54] http://www.nyserda.ny.gov/Page-Sections/Energy-Prices-Supplies-and-Weather-Data/Natural-Gas/Monthly-Average-Price-of-Natural-Gas-Residential.aspx

TABLE 4.3 ENERGY USE AND EXPENDITURE BY SECTOR AND FUEL TYPE (2010)					
Sector		**mmBtu (2010)**		**Expenditure ($ millions 2010)**	**Expenditure rate ($million/billion Btu)**
Commercial					
Fuel	21%	78,224,970	29%	$2,136	$0.027
Industrial Fuel	8%	28,999,163	4%	$288	$0.010
Transportation	48%	180,008,463	36%	$2,616	$0.015
	100%	377,924,250	100%	$7,260	$0.019
Fuel Type					
Petroleum	47%	177,624,397	45.0%	$3,267	$0.018
Natural gas	30%	113,377,275	15.0%	$1,089	$0.010
Electricity	18%	68,026,365	39.0%	$2,831	$0.042
Other [2]	5%	17,006,591	0.4%	$29	$0.002
Coal	1%	1,889,621	0.6%	$44	$0.023
	100%	377,924,250	100.0%	$7,260	

[1] % for Fuel type use and $ derive from the NYSERDA ENERGY FAST FACTS state-wide % with MH as 12% (rprate-rate by population.

[2] Ethanol (46.8 TBtu) is included in "Other" totals and also in the petroleum category as a component of motor gasoline. Total consumption and percentages are based on ethanol only as "Other".

Despite the recent drop in natural gas prices, fossil fuel prices have on average risen from 2000 to the present. Since 2010, both heating oil prices and gasoline prices have risen sharply, as tracked by NYSERDA's average weekly price history. After hovering around $3 per gallon for most of 2010, #2 fuel oil jumped 30% entering the late fall of 2012 at around $4 per gallon. The price of gasoline has risen similarly, as gasoline is derived from the same fuel stock oil.

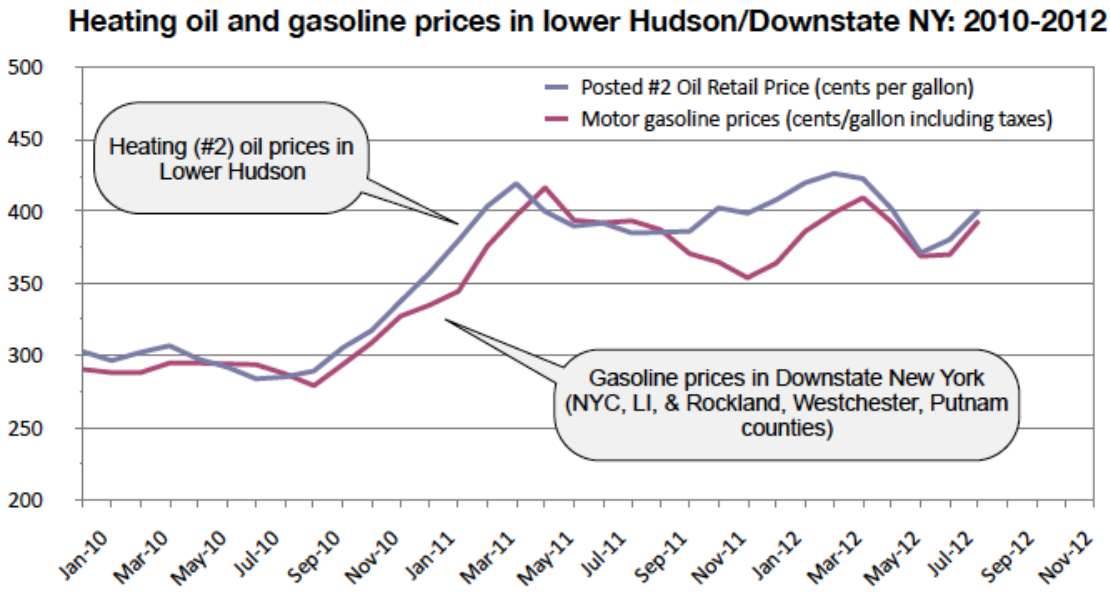


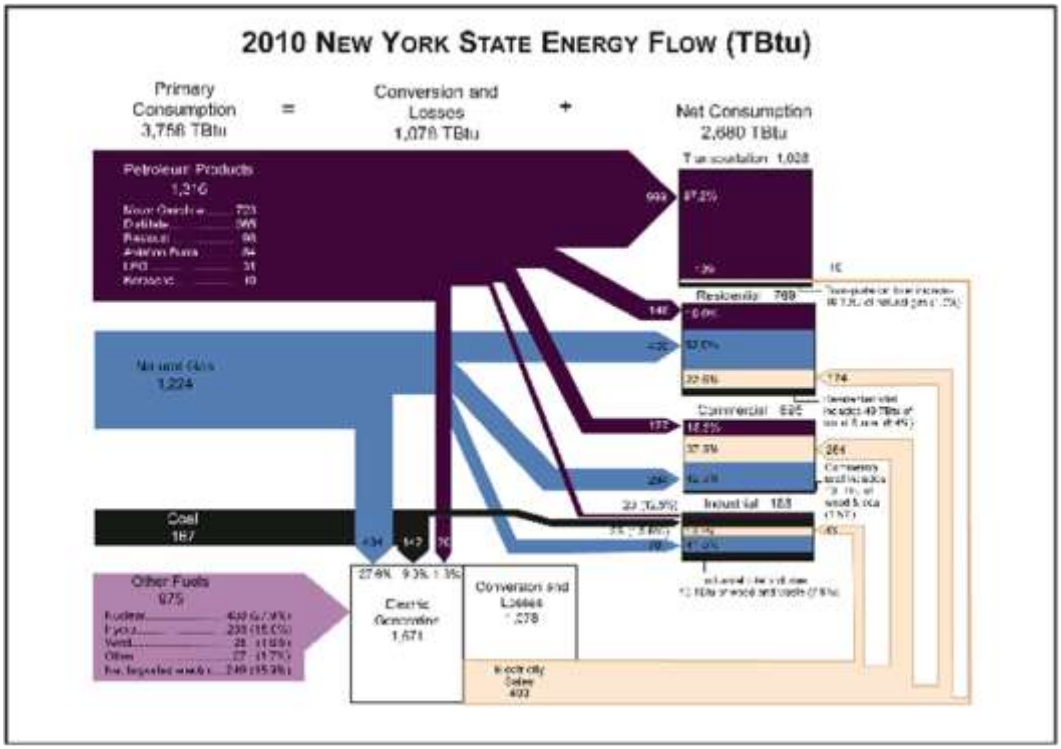
Figure 4.3 Recent price history for gasoline and heating oil in the Hudson Valley: 2010-2012[55]

Figure 4.4 NYS Energy Flow 2010 (TBtu)[56]

[55] http://www.nyserda.ny.gov/en/Programs/Energy-Prices-Supplies-and-Weather-Data/Annual-Prices.aspx

[56] NYSERDA Patterns and Trends: NYS Energy Profiles: 1995-2009 (January 2011) and USEIA Annual Energy Review (2012)

Figure 4.4 NYS Energy Flow – Approximately 30% of the energy used in NYS for electricity generation is consumed by energy conversion itself or lost during transmission and distribution. This conversion loss is endemic, large, and in many ways unavoidable in a system of large centralized generation facilities. But we can reduce the need for these losses by expanding distributed generation.



4.1.3 Energy Dollar Exports

There is virtually no petroleum extraction in the Mid-Hudson Region. For all practical purposes, 100% of the fuel oil (including gasoline and kerosene) used for transportation and for space heating is imported. As a whole, NYS is a net energy importer.

For example, NYS consumers buy hydroelectric power from Quebec. Nearly all petroleum-based fuels come from suppliers outside NYS. Of NYS' annual estimated energy expenditure ($60.50 billion in 2010), about half those dollars ($30 billion) left the state. Trying to retain even 3% of that annual exported expense will leave an extra $1 billion in the NYS economy. For the Mid-Hudson Region, this export expense is about $3.36 billion for 2010. Reducing the amount

of energy the Mid-Hudson Region imports by just 3% would leave an additional $100 million per year in the Region's economy.

4.1.4 Household Fuel Use

About 85% of the Region's households use either fuel oil or utility supplied natural gas for space heating. Yet, the breakdown in fuel source varies widely across the Region's counties. For example, natural gas predominates in Rockland County, serving 89% of Rockland residents. In Westchester and Orange County, fuel oil and natural gas use is roughly equal.

Fuel oil predominates in four of the Region's counties, with at least six out of ten households in Dutchess, Putnam, and Ulster using oil for space heating. For these homes in particular, energy efficiency is a big money saver, in light of rising fuel oil prices.

TABLE 4.4 ENERGY USE FOR MID-HUDSON REGION BY HOUSEHOLD, 2011

	Total occupied households	Fuel Oil or Kerosene	Utility gas	Electricity	Bottled tank or LP Gas	Wood, other*
Dutchess	103,204	60,334	24,655	12,225	3,336	2,654
Orange	122,233	45,222	55,391	12,650	4,582	4,388
Putnam	34,334	22,785	1,879	6,781	1,876	1,013
Rockland	94,687	2,993	84,184	5,899	1,093	518
Sullivan	29,750	16,810	469	3,919	5,416	3,136
Ulster	67,499	42,362	10,510	6,613	5,071	2,943
Westchester	340,377	159,070	149,527	24,196	4,310	3,274
Totals	792,084	349,576	326,615	72,283	25,684	17,926
	100%	44%	41%	9%	3%	2%

*Wood other includes household that use wood (10,478) other (4,184), no fuel (1,671), coal or coke (1,362) or solar energy (231).
Source: adapted from NYSERDA NYS Energy Profiles: 1995-2009 (January 2011)

4.1.5 Electric Generation in the Mid-Hudson

The seven counties of the Mid-Hudson Region are host to nearly 50 licensed electric generation facilities that feed the grid. These facilities vary tremendously in fuel type and name-plate capacity, ranging from 1,299 MW of nuclear (Entergy's Indian Point 2) to 0.2 MW of hydropower (Central Hudson's Montgomery West dam). Just two facilities, Entergy's Indian Point 2 and 3, represent collectively 41% (2.31 MW) of the Region's nameplate capacity. Electric generation is powered by a variety of fuel sources, presented by NYISO zone below:

- Zone G: 78% of the electricity generated within Zone G (most of the Region except Westchester) relies on fossil fuel (steam turbines using oil or gas) which total 2424 MW name plate capacity.
- Zone H: 97.5% of the electricity generated within Zone H (northern and central Westchester) relies on nuclear (2 steam turbines at Indian Point with 2,062 MW name plate capacity)
- Zone I: Nearly 100% of the electricity generated within Zone I (southern Westchester) relies on low head hydro dam from New York City water supply (at only 1.8 MW name plate capacity)

Electric generation infrastructure in the Mid-Hudson Region is aging. No new generation facilities have been licensed since 1993. Among the oldest facilities are hydropower sites dating from the 1920s, a number of which underwent renovation in recent years, e.g. Central Hudson's Dashville, High Falls and Sturgeon facilities.

The Renewable Portfolio Standard, established by the PSC in 2004, requires that 30 percent of electricity come from renewable energy resources in New York State by 2015; in 2011, 24 percent of electricity came from renewable energy resources.

Power demand is not constant – it varies over the course of the day and the year. Utilities must manage their power generation and distribution to meet the changing demand. During peak periods, utilities may even be required to cycle on "peaking plants" to generate supplementary power. The variability of demand has impacts on fuel use, GHG emissions, and cost for consumers.

On a typical weekday with low heating or cooling load, the peak load occurs in early evening, resulting from residential dinnertime load. This "supper bump" is typical. Therefore, increasing efficiency of residential loads is important in managing the base load. If every dishwasher that runs at 8 pm starts at 3 am instead, the savings will add up for the over 800,000 households in the Region. Shifting electricity usage from peak to off-peak helps create more balanced load profiles, thereby lowering costs.

The NYISO has two demand response programs that provide load control and peak shaving to support reliability of the bulk-power grid by providing incentives for retail loads (i.e. electricity consumers, either individual, aggregated, or load serving entities, such as utilities) to participate in the wholesale market.

In the most recent Reliability Needs Assessment (RNA), the NYISO indicates that unless certain measures are taken, the current electric system will violate resource adequacy criteria (the ability of the system to reliably meet electricity demand) beginning in 2020[57]. Deficiencies will exist in the Mid-Hudson Region and other downstate regions. The needs could be satisfied with the addition of generation and transmission capacity in these geographic areas.

4.1.6 Energy Efficiency Participation Rates

NYS has set a goal of achieving a 15% reduction in energy use through energy efficiency improvements by 2015. In the Mid-Hudson Region, current participation in existing NYSERDA programs for both the residential and commercial/industrial sectors is modest, with some signs of recent increases.

For example, homeowner participation in residential energy efficiency programs has begun to climb, in part due to the Green Jobs, Green New York (GJGNY) program, which provides free or low cost energy assessments (see Figure 4.5). Communities that have launched the Energize New York program, in which outreach to homeowners is coupled with the state's GJGNY assessment incentives and low interest finance options, have experienced a significant increase in the number of homes upgraded.

For the commercial, institutional and industrial sector, NYSERDA reports relatively steady participation in the Existing Facilities Program, New Construction Program, and Industrial & Process Efficiency Program. Under these NYSERDA programs, in 2010 and 2011 about 300 different projects were completed annually in the Mid-Hudson Region, for a total of 75 million kilowatt-hour savings (see Table 4.5).

[57] www.nyiso.com/public/about_nyiso/fundamentals_of_planning/reliability_planning/index.jsp

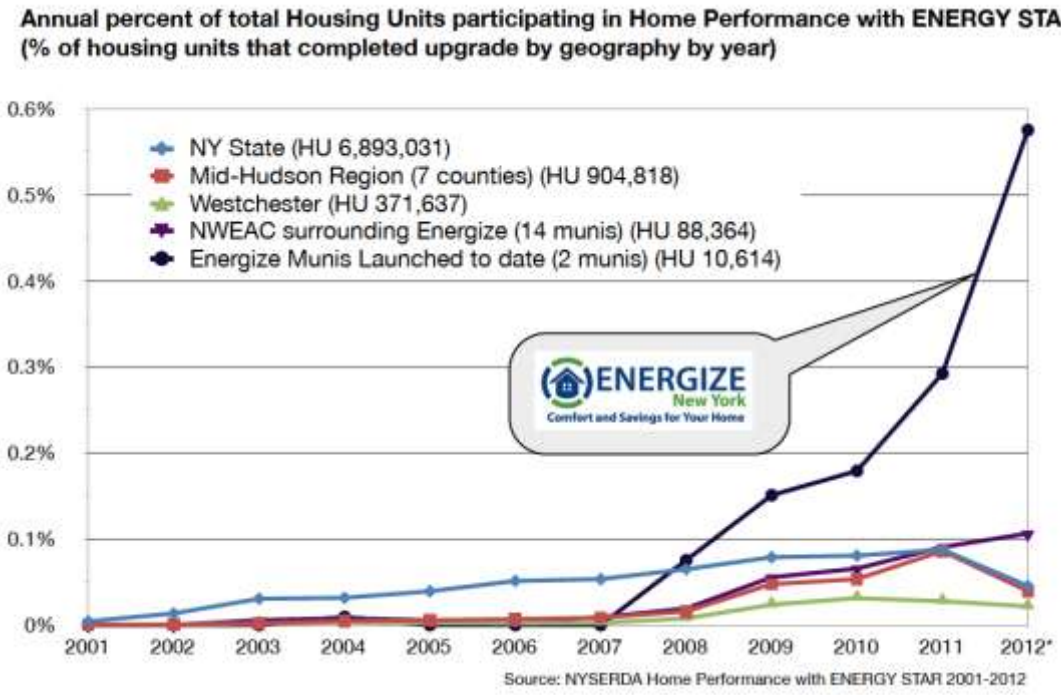


Figure 4.5 Annual percent of home energy upgrades by geography: 2001-2012

TABLE 4.5 MID-HUDSON PARTICIPATION IN NYSERDA'S COMMERCIAL SECTOR ENERGY EFFICIENCY PROGRAMS

Installation Year	2010		2011	
NYSERDA PROGRAM	Number of Projects	Sum of kWh savings	Count of Project Number	Sum of kWh savings
EFP	266	26,898,913	273	14,946,592
IPE	14	10,049,602	14	17,632,185
NCP	20	4,177,393	24	2,144,041
Total	300	41,125,908	311	34,722,817

Source: NYSERDA, 2012; EFP = Existing Facilities Program, NCP= New Construction Program, IPE = Industrial & Process Efficiency Program

INSERT IN CALLOUT

Energy Efficiency and Job Creation: The EnergizeNY program began in earnest in October 2010. In two full years since its launch, homeowners in the northern Westchester municipalities targeted by the program have invested $2,846,329 in home energy efficiency

upgrade improvements. This investment has generated 22.77 job years in that time period, representing 8 job years per $1 million of home upgrades.

In EnergizeNY's first 12 months, 67 home upgrades were completed, creating 6.66 job years of contractor work. In the second 12 months through October 2012, participation shot up with 162 home upgrades being completed, creating 16.11 job years of contractor work.

The average upgrade undertaken yielded an investment of $12,429 per home. In short, every ten homes upgraded at that average investment created one full year of employment for one person.

Expanding the EnergizeNY program to all seven MHR counties for the period 2013 through 2016 could realistically yield an economic impact of $82,728,424 invested in home energy upgrades. This projection is based on the actual participation increases seen to date in northern Westchester County, extrapolated to the housing stock of the rest of the region.

This region-wide investment permanently reduces homeowner's expenses, by lowering the export of energy dollars, and keeping those dollars in the local economy. This $82 million creates 661 direct jobs over the three years, or gainful employment for 220 persons per year.

TABLE 4.6 ENERGIZE NY IMPACT ON JOB CREATION

Installation Year	Year 1	Year 2	Year 3
Homes upgraded	67	162	229
EE $ dollars invested	$832,769	$2,013,560	$2,846,329
EE job years created	6.66	16.11	22.77
Jobs / EE $1MM invested	8.00		
Average $EE invested / home	$12,429		
Home upgrades needed to reach $1MM invested	80.45		

Source: NYSERDA, and Energize NY – November 2012

4.2 Climate Change and Energy

4.2.1 GHG Emissions

Energy-related GHG emissions are typically divided into stationary (i.e. emissions from sources that are immobile such as power plants and boilers), and mobile (i.e. emissions from combustion of fuel to power vehicles). In the Plan, mobile source emissions are included in Chapter 3 on Land Use, Livable Communities, and Transportation.

Stationary energy consumption includes direct emissions from the combustion of natural gas, coal, kerosene, distillate, motor gasoline and other fuels, as well as indirect emissions from electricity consumption. Direct emissions from residential, commercial, industrial, and electricity generating activities in the Region are considered Scope 1. Indirect emissions from the consumption of electricity are considered Scope 2.

Because the electricity generated in the Region does not uniquely serve the Region's consumers – the electrical grid crosses regional borders – Scope 1 emissions from electricity generation are not included in the regional totals. Instead, Table 4.7 below includes Scope 2 emissions which are estimated based on the amount of electricity used by consumers in the Region regardless of where the electricity was generated. This helps avoid double-counting, and better reflects the realities of the electrical grid. Table 4.8 presents the breakdown of GHG emissions by fuel source and sector.

TABLE 4.7 2010 STATIONARY FUEL CONSUMPTION GHG EMISSIONS BY COUNTY (MTCO2E)

		Emissions ($MTCO_2e$)			
County	Scope	Residential	Commercial	Industrial	Total
Dutchess	1	449,020	253,415	393,986	1,096,422
	2	257,645	303,417	108,052	669,114
Orange	1	635,399	735,340	152,935	1,523,674
	2	302,896	357,461	50,882	711,240
Putnam	1	154,389	23,568	97,183	275,141
	2	86,772	212,349	13,754	312,875
Rockland	1	576,330	577,818	329,493	1,483,642
	2	209,792	204,482	70,083	484,357
Sullivan	1	127,210	13,196	9,924	150,330

Table 4.7 2010 Stationary Fuel Consumption GHG Emissions by County (MTCO2e)					
		Emissions ($MTCO_2e$)			
County	Scope	Residential	Commercial	Industrial	Total
	2	66,170	126,435	4,445	197,050
Ulster	1	307,718	103,961	99,325	511,005
	2	171,692	161,821	25,407	358,920
Westchester	1	1,621,317	1,012,451	375,880	3,009,648
	2	735,333	1,039,622	100,511	1,875,467
Mid-Hudson Region Total	**1**	**3,871,385**	**2,719,749**	**1,458,727**	**8,049,861**
	2	**1,830,301**	**2,405,587**	**373,135**	**4,609,023**
	Total	**5,701,686**	**5,125,336**	**1,831,862**	**12,658,884**

Table 4.8 2010 Stationary Fuel Combustion GHG Emissions by Fuel (MTCO2e)					
Fuel	Residential	Commercial	Industrial	Total	Percent of total
Electricity	1,830,301	2,405,587	373,135	4,609,023	36%
Natural Gas	1,968,089	1,800,014	753,733	4,521,837	36%
Fuel Oil	1,727,143	870,614	198,434	2,796,192	22%
Propane	158,986	46,411	7,160	212,557	2%
Coal or Coke	9,419	714	198,614	208,747	2%
Other Petroleum	0	0	298,820	298,820	2%
Other/Not specified	7,747	1,996	1,965	11,708	0%
Total	**5,701,686**	**5,125,336**	**1,831,862**	**12,658,884**	**100%**

Emissions also result from energy supply processes include electricity transmission and distribution (T & D) losses, natural gas T & D losses, and the use of sulfur hexafluoride (SF_6) in the utility industry. These are presented in Table 4.9 below.

TABLE 4.9 2010 EMISSIONS FROM ENERGY SUPPLY ACTIVITIES (MTCO2E)					
County	Electricity T & D Emissions ($MTCO_2e$)	Natural Gas T & D Emissions ($MTCO_2e$)	Utility SF_6 Emissions ($MTCO_2e$)	Total	Percent of total
Dutchess	35,329	28,265	7,839	**71,433**	**11%**
Orange	37,553	81,153	8,332	**127,039**	**20%**
Putnam	16,520	8,011	3,665	**28,196**	**4%**
Rockland	25,574	84,470	5,674	**115,718**	**18%**
Sullivan	10,404	840	2,308	**13,553**	**2%**
Ulster	18,951	10,487	4,205	**33,643**	**5%**
Westchester	99,025	126,858	21,971	**247,854**	**39%**
Mid-Hudson Region Total	**243,357**	**340,085**	**53,995**	**637,437**	**100%**

4.2.2 Climate Change Vulnerability

The Mid-Hudson Region has a reliable electricity and gas supply and distribution system; however weather-related stressors can damage equipment, disrupt fuel supply chains, reduce power plant output levels, and increase demand beyond the system's operational capacity. Table 4.10 summarizes the potential effects of climate change on energy infrastructure and demand in the Mid-Hudson Region.

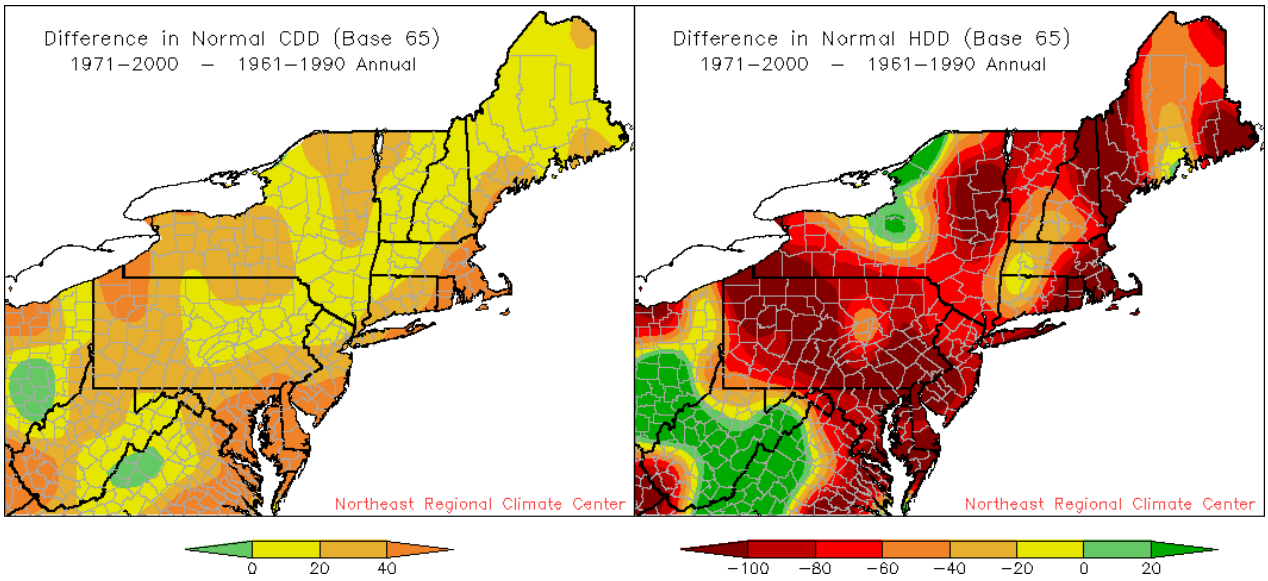
TABLE 4.10 SUMMARY OF ENERGY RELATED CLIMATE EFFECTS IN THE MID-HUDSON REGION			
Asset	Climate Impact	Climate Effect	Description
Generation, Transmission & Distribution	Severe storms; Extreme heat	Reduced grid reliability	Power outages from severe storms; Brownouts and blackouts from spikes in demand during extreme heat events
	Drought; Warmer winters	Reduced production capacity	Lower stream flows in the late summer may reduce hydropower production (an important energy source in the Region); Less water availability for cooling
Demand	Extreme heat; Warmer winters	Increased demand in the summer; Reduced demand in the winter	Increased demand in the summer for cooling is projected to outpace the decrease in demand in the winter for heating

The Mid-Hudson Region is home to many major electric power plants including Roseton Generating Station, Danskammer Generating Station, Lovett Generating Station (closed in 2008), Indian Point Energy Center and Bowline Generating Station. These facilities are located along the Hudson River, making them particularly vulnerable to the effects of climate change.

The Region's generation, transmission and distribution system may be impacted by climate change due to increased prevalence of extreme weather (wind, storms, heat and flooding), which could damage energy supply, transmission and distribution. Flooding, sea level rise, and coastal storms may threaten generation facilities along the Hudson River as well as fuel storage facilities. Nor'easters bringing more ice versus snow in the winter could result in widespread power outages. Sagging transmission lines from extreme heat can also result in downed wires. Extreme heat may cause transformers to fail if they are not rated for the increase in temperatures. Natural gas supply could be vulnerable due to increased frost heave risk.

Energy demand is also likely to rise due to climate change. Demand due to cooling in the summer will increase and demand for heat in the winter will decrease; however the increase demand in the summer is projected to outpace the decrease in demand in the winter.

Figure 4.6 Heating and Cooling Degree Days in the Region: Historic Trends



Heating and cooling degree days are a standardized means of measuring the day's temperature relating to the energy demands of air condition and heating. These maps above show the difference in Heating Degree Days (HDD) and cooling degree days (CDD) between two 30 year time periods (1971 to 2000 and 1961 to 1990) (Northeast Regional Climate Center 2009). CDD have increased during this time period while HDD have declined. Further supporting this claim, NYSERDA reports that between 1970 and 2007, the number of HDD declined by 46.3 days per decade.

Source: NYSERDA. "Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation in New York State." Technical Report, 2011.

4.3 Objectives

EN1 – Become radically less energy intensive while strengthening the regional economy

- Energy intensity is measured as the amount of energy needed to produce each dollar of regional economic product. The less energy needed, the lower the operating costs for local businesses. Each dollar diverted from energy expenses becomes available for business development and innovation.

EN2 – Expand renewable generation as an energy source across the Region

- The Region benefits from a diverse array of well-established renewable energy sources, including wind, solar, geothermal, hydro, and biomass, with potential for tidal. These diverse energy sources will improve energy security, energy resilience, and continuity

for the local energy delivery infrastructure, reducing the large amount of energy dollars exported outside the Region and NYS.

EN3 – Lower fossil fuel intensity of the built environment

- In the Mid-Hudson Region, 85% of households heat with fossil fuels (44% with fuel oil and 41% with natural gas). Reduction of fossil fuel use is a key component to achieving EN1 above, lowering overall energy intensity. Existing programs, such as EnergizeNY, have a proven track record in dramatically increasing the participation rates of building owners in energy efficiency programs.

EN4 – Improve the continuity of the energy delivery system throughout the Region

- The Region must reduce risks from interruption in energy delivery. Tis can include simple steps, such as burying utility lines in denser communities to limit debris-related damage. Community energy districts are a perfect framework for the implementation of energy supply diversity, demand response expansion, and energy storage, which are all areas attractive for private sector investment. The Region can expand its role as a clean energy leader in the deployment of high technology and service business models. Agility and intelligence will increase local resilience and reduce risk of energy interruption. Offering a reliable, affordable source of energy will help attract business investment.

4.4 Indicators

Table 4.11 presents a series of sustainability indicators for the energy focus area. These indicators should be used by local government to track performance in achieving the objectives noted above.

4.4.1 Metrics and Targets

TABLE 4.11 INDICATOR INVENTORY – TIER 1 INDICATORS

Objective	Metric	Current Value (2010)	units	Target – 2020	Target – 2035	Target – 2050
EN 1. Become markedly less energy intensive while strengthening the regional economy	1. Energy intensity: Regional energy consumption per capita[58]	164.8	million Btu/capita	140.1 (-15%)[59]	115.4 (-30%)	82.4 (-50%)
EN 2. Grow renewables dramatically as energy source across the region	2. Renewable intensity: Installed generation capacity per capita[60]	0.382	million Btu/capita	1.15 (+200%)	8.02 (+2000%)	76.91[61] (+20000%)
EN 3. Lower fossil fuel intensity of the built environment significantly	3. Stationary fossil fuel intensity: Existing building stock use of fossil fuel per capita[62]	81.8	million Btu/capita	69.51 (-15%)	57.25 (-30%)	40.89 (-50%)

[58] From MHR GHG inventory (2012): Energy Use totals from worksheets: Residential Fuel, Commercial Fuel, Industrial Fuel, Electricity Consumption, Natural Gas Consumption, On Road, Off Road, Marine, and Rail fuel totals. Population base for MHR's 7 counties for each value in this table is assumed to be 2,290,851 (census.gov 2012).

[59] Electric demand growth (from NYISO) alone increases this by 5% through 2020 (an average of one-half percent per year for ten years). Population growth is the biggest unknown. And the MH region is home to all 5 of the fastest growing municipalities in the entire state since 2000.The targets for energy intensity assume 5% population growth per decade and 5% drop in energy use per capita per decade as a starting point.

[60] From: The renewable generation capacity (2011 NYISO Gold Book) at current value includes HYDRO (actual) and PV (estimated) as follows: [HY+ PV installed = 875,214 MMBtu from HYDRO (actual)= 832,903.66 MMBtu + PV (estimated)= 42,310.55 MMBtu] for 2010. Since HYDRO is dominant and mature, the targets here reflect non-hydro renewables only (PV, solar thermal, wind, biomass, geothermal etc).

[61] Given the target of reducing energy intensity to roughly 80 mmBtu/capita by 2050 in indicator 1, the target value for growing renewables in indicator 2 is calibrated to reach roughly the same 80 mmBtu/capita by 2050, matching the energy intensity with renewable generation capacity.

[62] From: MHR GHG inventory (2012): Energy Use totals for Residential Fuel, Commercial Fuel, Industrial Fuel, Natural Gas Consumption and Electric Consumption.

TABLE 4.11 INDICATOR INVENTORY – TIER 1 INDICATORS						
Objective	Metric	Current Value (2010)	units	Target – 2020	Target – 2035	Target – 2050
EN 4. Improve continuity of the energy delivery system	4. Track resource adequacy criteria (NYISO - NERC) [63]	TBD	TBD	TBD	TBD	TBD

TABLE 4.12 INDICATOR CALCULATIONS AND DATA		
Metric	**Calculation**	**Data Source**
EN 1. Energy intensity: Regional energy consumption per capita	∑ annual energy uses by sector / population: where ∑ (regional energy consumption) =Residential Energy Consumption + Commercial Energy Consumption + Industrial Energy Consumption + Transportation Energy Consumption	Energy uses from Regional Tier 2 Greenhouse Gas Inventory, NYSERDA and US EIA; subcomponents include annual energy use for residential, commercial, industrial, and transportation;[64]
EN 2. Renewable intensity: Installed generation capacity per capita	∑ renewable installed generation capacity / regional population (MW per capita): where ∑ (capacity of all on-site renewable energy sources) =On-Site Solar PV Capacity+On-Site Solar Thermal Capacity+On-Site Wind Turbine Capacity+On-Site Geothermal Capacity+Capacity of Other On-Site Renewable Sources	NYSERDA and Regional Tier 2 Greenhouse Gas Inventory: subcomponents include cumulative generation capacity from installations of PV, solar thermal, wind, biomass, geothermal, etc.

[63] We would like access to category 1-2-3-4-5 reliability information from NERC-NYISO. Alternatively, we could employ information from "resource adequacy capacity" (17%) or use the actual prior year summer peak demand for our region (which does not quite match the geogrpaphy of the NYISO control area zones for which prior year peak data is published.

[64] Energy use intensity: A further refinement would be Energy intensity per dollar of Gross Regional Product.

TABLE 4.12 INDICATOR CALCULATIONS AND DATA		
Metric	**Calculation**	**Data Source**
EN 3. Stationary fossil fuel intensity: Existing building stock use of fossil fuel per capita:	Regional fossil fuel combustion in stationary sources per capita = ∑ (fuel combustion for space heating and cooling) / regional population[65]	Energy uses from Regional Tier 2 Greenhouse Gas Inventory, NYSERDA and US EIA; subcomponents include annual energy use for residential, commercial, industrial, and transportation

[65] Stationary fossil fuel use intensity: A further refinement would be weather-normalizing this use annually: ∑ Fuel Combustion for each fuel type=[(Btu/Household/HDDfor space heating) X HDD X (# of households)]+[(Btu/Household/CDD for space cooling) X CDD X (# of households)] + [(Btu/Household for dhw) X (# of households)]+[(#of Employees in region / # of employees in state) * Statewide commercial consumption]+[(#of Employees in region / # of employees in state) * Statewide Industrial consumption] - [Industrial fuel consumption * % consumed in non-energy uses]

4.4.2 Metric Limitations and Tier 2 Indicators

INSERT DISCUSSION OF DATA LIMITATIONS

TABLE 4.13 TIER 2 INDICATORS

Objective	Metric
	Public-private investment ratio
	Frequency and severity of transmission and delivery disruption
	Regional employment in clean energy and energy efficiency
	Public literacy about energy (or sustainability) related topics

4.5 Priorities for Implementation

4.5.1 Energy Efficiency

Energy efficiency is a strong driver of economic development for two reasons: (1) efficiency measures often pay for themselves while reducing future operating costs and (2) implementation is a proven jobs-creator with immediate results.

Residential energy use can be reduce by 20-30% for the average consumer, by correcting inefficient building envelopes, heating, cooling and ventilation systems, old appliances, and poor energy management equipment and practices. Much greater efficiencies are achievable in new construction or major renovation projects.

On the commercial side, effective energy efficiency measures are easy to sell for two reasons, (1) operating costs are a significant factor in a firm's decision-making, and (2) for many commercial establishments, energy bills run into the hundreds of thousands of dollars annually.

The Mid-Hudson Region's households spend $2.18 billion on utilities per year for non-transportation related energy ($2,750 for space heating and appliances per household per year) - see Table 3.7. If the residential sector installed common energy upgrades (e.g. air sealing and insulation) on a wide scale sufficient to achieve just 5% regional savings, that action alone save $109 million annually. Energy savings like this are especially important to those with limited disposable income, who may spend upwards of 10% of their income on residential energy.

TABLE 4.14 MID-HUDSON UTILITY COSTS & SAVINGS PROJECTION (HOUSEHOLDS)		
	Estimated Household utility costs/year	**Annual savings with modest energy upgrades**
	$2,750	5.0%
County	**Total utility costs all households**	**Total potential savings all households**
Dutchess	$309,612,000	$15,480,600
Orange	$366,699,000	$18,334,950
Putnam	$103,002,000	$5,150,100
Rockland	$284,061,000	$14,203,050
Sullivan	$89,250,000	$4,462,500
Ulster	$202,497,000	$10,124,850
Westchester	$1,021,131,000	$51,056,550
Totals	**$2,376,252,000**	**$118,812,600**

Source: Household counts from Census.gov, American Community Survey 2010

The Mid-Hudson Region's businesses spend $2.37 billion on utilities per year. A modest 5% energy savings through common efficiency measures (building envelope, lighting, etc.) would yield $118 million per annum in easily achievable savings to reinvest. Energy efficiency alone in both the residential and commercial sectors could easily make available $230 million per year or more in private capital for job retention and creation in the Region.

Additionally, strict energy codes are needed to ensure new buildings and major renovations are energy efficient. The 2010 Energy Conservation Construction Code of NYS has been revised under the 2009 ARRA DOE guidelines. This comprehensive code establishes minimum requirements for buildings using prescriptive and performance-related provisions, and helps make possible the use of new materials and innovative techniques that conserve energy.

To the extent that the state energy code sets minimums, local jurisdictions may adopt standards that exceed the state 'floor.' The state standards are based on the ASHRAE standards, but often run a cycle behind. Therefore, municipalities or counties that wanted to use a reliable standard before it has been adopted state-wide may refer to the most recent ASHRAE national standard recommendations[66].

In addition, local jurisdictions should review their building codes to ensure that ultra-high performance construction is not prohibited or discouraged by current code requirements (e.g. through prohibitions against building shading devices, or requirements for building heating systems).

The Town of Greenburgh in Westchester County amended its local code to add new energy conservation requirements, which were more restrictive than the adopted statewide mandatory energy construction code. Greenburgh's local law requires that all new homes constructed in the town comply with the NYS "Energy Star-Labeled Homes" requirement. The NYS Energy Star Program provides several methods of making a home at least 15 percent more energy efficient than required by the state energy code. These include more effective insulation, higher performance windows, more efficient heating and cooling equipment, tightening the building envelope to reduce air infiltration, and the use of various energy efficiency products. The Greenburgh approach is a strategic one since it applies only to one and two-family dwellings and multi-family buildings of three stories or less - the same buildings covered by the residential provisions of the state code.

Example Projects

Expand Energize New York

Expanding the Energize NY (ENY) program from Northern Westchester to all seven counties of the Mid-Hudson Region will help accelerate residential and commercial energy efficiency programs. The ENY model of community based outreach, messaging, direct property owner support, useful tools and leveraged local leadership has proven successful since its launch in 2010. An expanded ENY will have positive regional impacts in the areas of job creation, community development, economic growth, energy independence, GHG reductions and more. These effects will be felt far beyond the energy sector while using private sources of capital to facilitate the scaled up demand for energy improvements.

Notably, the EnergizeNY program is financially self-sufficient by 2016 from the fees and other ancillary revenues derived from the financings initiated and processed by the program. The EnergizeNY program will leverage any public program funds for the bridge period 2013-2016 with private program funding. In addition, PACE funds will source private capital for

[66] www.ashrae.org

financing energy upgrades, facilitating energy efficiency and renewable energy installations for property owners who find opt-in property assessments preferable to more traditional finance methods.

Resource Centers for Sustainable Communities

As recommended by Sustainable Hudson Valley, historic buildings should be targeted for deep energy retrofits. This project would seek to renovate many of the Region's historic buildings, as part of a wider Community Energy District (CED) program, turning them into shining beacons of energy efficiency. These renovations would work to combine the old and the new by maintaining the historic look and feel of these buildings while still increasing their energy efficiency. Prime targets of renovation could include the Hudson River Psychiatric Facility and the Newburgh Armory, depending on the level of interest and location of the proposed districts.

This project would show the potential for the Region to maintain its historical identity while remaining on the cutting edge of energy efficiency.

4.5.2 Community Energy Districts

There are many energy-related projects which can be undertaken by individual site or building owners, regardless of whether a neighbor does the same or not. This "every-man-for-himself" approach has predominated and produced only the modest participation levels seen in most state-wide energy efficiency and other energy programs.

It is time for a different approach. A CED aggregates supply and demand opportunities within a specific neighborhood. Energy districts have proven highly effective at both raising participation rates and lowering costs by delivering economies of scale to each neighboring building owner.

While quite flexible, energy improvement districts, by definition, pool the interests of a diverse set of co-located property owners and operators.

- Each district could incorporate one or more of the following resources and strategies: energy generation, energy efficiency, demand response, energy storage, electric vehicle charging, or collective energy purchase.

- Each district would tailor the mix of resources and strategies in a manner that creates synergistic values for all of these technologies and capabilities for the particular mix of energy consumers within the district.

Microgrid development is, in some cases, a logical result of the combination of these resources within the CED. A microgrid is a localized grouping of electricity generation, energy storage, and consumers that typically operate connected to a traditional centralized grid, but can also operate independently, if necessary. Microgrids are a critical tool to enable local business districts to collaborate in curbing electricity costs and capture value from the electricity markets that are inaccessible to most without the shared investment in a microgrid. Microgrids, with their ability to operate in sync with the power system, yet with a duplication of the supply infrastructure, offer a critical opportunity to ensure reliability through diversity, and to attract business to the Region that requires an absolutely reliable supply of power.

Benefits from CEDs include:

- Economic (both local and system-wide): economies of scale; sale of excess power to grid; earnings from ancillary services, energy and capacity for storage and demand response (DR); better ROIs for renewables when coupled with storage or DR; better ROIs for storage or control systems when coupled with renewables, reduced transmission losses/charges; deferred or avoided capital investments for T&D system; reduced fuel costs and energy price volatility (if coupled with fuel-free renewables); enhanced price elasticity (end users can reduce load when cost is high); and more options for co-gen facilities.
- Environmental: reduced CO2, NO2, SOX emissions and particulate matter.
- Demonstration/Education Opportunities: CEDs can be replicable demonstration sites and centers of local education about benefits of smart grid, DG, renewables, control systems, storage technologies, energy efficiency and clean energy technologies.
- Grid Reliability (both local and system-wide): System-wide reliability as a balancing resource; ability to contain disruptions and limit cascading outages; reduced power interruptions (possibility of CED operating when the rest of grid is down); "safe-havens" for essential services when rest of grid is down; less grid congestion.
- Power Quality: reduced variability of voltage and frequency levels; potential to provide voltage support by injecting reactive power into local distribution system; avoids damages or failure to equipment.

These districts are leveraging initiatives that have already been designed and are ready to be implemented. Replication is critical, and so the demonstration will seek to create processes to work with utilities and the NYISO to enhance energy storage and demand response revenues, as well as energy and energy efficiency savings, beyond what has been achieved by other efforts across the nation. A key feature to achieving replicable outcomes will be to develop contract templates that anyone in the Region can access, for each relationship between counterparties, consistent with state regulatory frameworks, such as HEFPA, utility data access, net metering and tariff structures/formulation and NYISO registration procedures. Each improvement district will have one central location to track its activities, offering a demonstration site for local residents and businesses to learn of and access best practices from the project.

Example Initiative

MHRP CED Project
This project proposal will facilitate the development of a robust, reliable, less expensive and more efficient sustainable energy infrastructure.

The project proposes to develop a minimum of four districts, in diverse locations in the Region. Each will incorporate an education center, showing generation and consumption of energy in real-time, and assembling an working archive with step-by-step process documents, contractual and marketing templates, peer-to-peer sharing opportunities, and more. District outreach to the public will include events, a potential kiosk hosted by a local institution (such as a school, library, city hall, or chamber of commerce) and an online portal that will link districts and encourage replication.

Each district will include some or all of the following components, tailored to each site's local interest and business communities: metered distribution loops, distributed renewable generation, distributed storage, electric vehicle charging stations, distributed co- generation, often enriched by co-location (e.g. the returns for renewable generation are enriched by storage and/or demand response).

4.5.3 Demand Response

Demand Response programs pay customers to temporarily reduce electricity consumption in response to supply conditions. Developing local DR resources will (a) create jobs and strengthen businesses throughout the Region, (b) encourage the development of upstate wind energy, (c) reduce regional and state-wide environmental impact, (d) reduce the need for

imported fossil fuel, (e) ensure that the Region and NYS are in the vanguard for clean technology, and (f) prove an ultimately more reliable infrastructure than the current, more centralized infrastructure. At present, participation in DR program is low, especially for small- and medium-sized enterprises.

Example Project

NWEAC DR Program

The Northern Westchester Energy Action Consortium has entered into a process with Con Edison in Mount Kisco, New York, to install meters on the low and medium voltage distribution system. These meters are cost-effective, because three high-quality meters will capture the real-time consumption of an entire 10 MW distribution loop. When installed, these meters will allow all consumers inside the loop to participate in DR programs for which they are currently ineligible because individually, they are too small. The Mount Kisco location has planned the installation of four separate multi-vehicle charging stations, each of which will be able to charge vehicles dynamically, earning money through demand response provided.

At the same time, Distribution loop customers have installed roughly 100kW of rooftop solar, and will match this installation with battery back-up. This particular site has newly installed rooftop area that can accommodate as much as 5 MW of solar; the demonstration project has the clear potential to scale with private sector funding, in the wake of this pilot.

4.5.4 Distributed Generation

NYS and the Region must continue to ensure a reliable electricity system infrastructure, supported by adequate supply. The continuity of grid reliability can be achieved in two essential ways:

- Centralize sources of generation, and build out a more robust transmission and distribution system
- Develop more local resources closer to the end users

Distributed generation includes renewable energy systems, cogeneration and small power production, which can include the following components: combined heat and power, waste heat recovery and district energy. These systems are logical for independent development or for inclusion in CEDs.

The benefits of distributed generation include:

In 2009, the NYISO became the first grid operator in the nation to implement federally-approved market rules that enabled storage systems to participate in the markets as frequency regulation providers, delivering reserve capacity that helps grid operators maintain the balance between generation and load.

Energy storage capacity makes the variable hourly output of renewables more valuable, while also offering the capability of "load leveling" during otherwise expensive peak demand spikes for all non-load following power generators (including nuclear, solar, and wind).

- Increased electric system reliability
- Reduction of peak power requirements
- Provision of ancillary services, including reactive power
- Improvements in power quality
- Reductions in land-use effects and rights-of-way acquisition costs
- Reduction in vulnerability to terrorism and improvements in infrastructure resilience

In addition, increased heat and power generation efficiency results in reduced carbon emissions, better air quality, and lower operating costs.

Decentralizing energy generation capacity is essential for at least two key reasons:

- A build out relying on local innovation and adaptation can outpace any centralized generation capacity, given the four to six year siting and permitting hurdles for major traditional power generation sites
- Grid and pipeline constraints in the Mid-Hudson Region require well-coordinated, decentralized solutions that put power generation close to sites of power demand

Example Project

SUNY New Paltz Bio-Mass and Photovoltaic Systems

The SUNY New Paltz Bio-Mass and Photovoltaic Systems project is attempting to create a bio-mass boiler system and expand the existing photovoltaic system already in place. This project will significantly decrease the energy consumed by the institution and its overall GHG emissions.

This project should also provide a useful model for other large businesses or intuitions to follow if they wish to limit their own greenhouse gas emissions and decrease their energy bills. Assuming the project is successful; SUNY New Paltz will show that large power consumers can utilize alternative energy generation effectively.

4.5.5 Energy Storage

Energy storage amplifies the value of both traditional generation and newer, distributed, renewal generation, with enhancing grid reliability as well. Energy storage includes a diverse set of technologies divided into those that store energy for use as electricity or for thermal capacity.

Electric energy storage technologies include pumped hydro, compressed air, flywheels and batteries, and can be applied to both stationary sources and to the transportation sectors, e.g. plug-in electric vehicles (PEVs) for vehicle-to-grid deployment. Thermal storage technologies can be very effective when integrated into combined heat and power or waste heat reduction installations to heat or cool buildings, or industrial or agricultural processes.

The Region could capitalize on the existing commitment by NYS to the New York Battery and Energy Storage Technology collaborative.

The Mid-Hudson Region has abundant locations that will serve as demonstration and deployment sites for all kinds of energy storage applications from batteries to fly wheels, and thermal storage to capacitor banks.

Example Project

Net Zero Energy District Education Center
As proposed by the Sullivan Alliance for Sustainable Development, the Net Zero Energy District Education Center project would set up a net zero energy district in the Human Services Complex in Liberty, NY. This district would utilize a net of zero energy, meaning that it would produce all the energy it consumed, and thereby be able to work off the grid – this will require the rollout of energy storage technology, and would help to demonstrate the viability of many alternative energy sources in the Region.

The Human Services Complex in Liberty exemplifies many of the same issues and challenges faced by others, making it the perfect pilot. Any potential issues will surface prior to the project being replicated elsewhere. As the Complex is currently known for its inefficiencies, this project will also allow it to reinvent itself in a more sustainable light.

4.6 Enabling Strategies

4.6.1 Energy Improvement Districts

See above.

4.6.2 Facilitating Demand Response for Small and Medium Consumers

State-wide rules makes demand response enrollment challenging for tens of thousands of medium to small commercial consumers. Even with rule changes under review, the participation of small consumers in most demand response markets is not cost effective, unless those smaller consumers band their collective demand response together.

Small and medium consumers currently provide circa 200 megawatts of demand response resources statewide, far below their potential. They could provide as much as 1,870 megawatts of demand response, if the rules would be rewritten to allow cost effective ways to enable their participation. Revising demand response rules would allow for broader participation by more customers:

- Banks would finance upgrades in NYS homes and small businesses, in exchange for a slice of electric grid earnings; and
- Consumers would buy "smart meters" and "smart appliances" because they will have shorter "pay backs" and become investments pay dividends.

As seen in other states and provinces, implementing three policy changes could greatly increase participation in DR programs statewide: (1) allow aggregation, (2) lower eligibility thresholds, and (3) establish floor prices for demand side resources.

- NYISO rules and PSC rulings could allow customers (and even communities) to aggregate their efficiency resources together to reach size thresholds dictated by the NYISO for all electricity market products. (See Community Choice Aggregation discussion above.)
- The NYISO could lower size thresholds for all electricity market products to expand the pool of eligible participants[67].

[67] Participation in demand response is limited to customers who meet or exceed a minimum size of facility requirement, size of shed commitment requirement, or total shed load aggregated together in order to be

- NYS (e.g. the NYISO or the legislature) could establish floor prices for demand side resources to attract private investment in building out energy control and storage capabilities.

4.6.3 Community Choice Aggregation

Community Choice Aggregation (CCA) is a market-based energy solution that is revenue supported, not reliant on taxpayer subsidies, and provides a procurement framework that allows municipalities to procure and produce electricity to meet the collective load of their local residents and businesses.

- Six states—California, Illinois, Massachusetts, New Jersey, Ohio, and Rhode Island—have CCA legislation enabling local governments to aggregate the electricity loads of residents, businesses, and municipal facilities.
- Best practice enabling legislation is available from the states listed above.

4.6.4 Energy Efficiency Certificates

Energy Efficiency Certificate (EEC) is a private-sector incentive structure that requires all private-sector energy sales entities to buy efficiency certificates–in proportion to the amount of energy they sell.

- EEC programs currently operate in Italy, the United Kingdom, Connecticut, Pennsylvania, and Nevada, and are expected soon in India and other nations in Europe.
- Typical steps in establishing an EEC program include the following:
    - Create compliance buyers of efficiency certificates by establishing a state-wide EEC program, refined by lessons learned from the existing EEC programs[68].

---

eligible for DR. If the first and second minimums are eliminated, and the third is reduced to, say, 100kW for every DR product, a very large number of medium to smaller electricity customers could participate in DR programs.

[68] Beyond electric reduction, efficiency certificates could be a powerful tool, if applied to heating oil consumption. We strongly recommend an EEPS be established for heating oil to enable efficiency certificates for reductions in heating oil consumption.

- Create peak demand reduction certificates, akin in structure to Peak Demand Reduction markets in New England and in the Mid-Atlantic and Midwest (PJM Interconnect) states[69].

- The above steps create an asset–the Energy Efficiency Certificate–as well as common metrics to assess and verify the efficiency achieved. A good EEC program will overcome tenant/owner misalignments and split incentives by creating a fungible, transparent, valuable asset that survives the transfer of a property or tenancy.

4.6.5 Feed-In Tariff

A Feed-in Tariff (FIT) is a government policy that supports the development of new, renewable power generation. Unlike incentives, tax credits or grant programs, a Feed-in Tariff pays only for power produced and relies entirely on non-government funds.

A Feed-in Tariff enables contractual guarantees that utilities will purchase power from new generators at stated rates for a guaranteed time period (typically 15 years). New generators must demonstrate they have verifiable and reliable new sources of electricity. Feed-in Tariffs spur investment of private sector funds into renewable energy generation capacity because investors use the guaranteed payments to secure stable long term financing.

A well-designed Feed-in Tariff will offer different tariff rates based on system size and location, offering true and verifiable value to ratepayers and utility stockholders.

Around the world, and in several locations in North America, Feed-in Tariffs have worked well as the quickest, lowest cost method of creating sustainable markets for both distributed and large scale deployments of renewable power systems. Seven states currently have Feed-in Tariffs in place or being piloted.

TABLE 4.14 FEED-IN TARIFFS IN THE U.S

California
The California Public Utilities Commission (CPUC) approved a feed-in tariff on 31 January 2008. In 2010, Marin Energy Authority launched the first Community Choice Aggregate Feed-in Tariff program. The program was updated in November of 2012, and now offers 20-year fixed-price contracts, with prices varying by energy

[69] In our view, design nuance would address a. underpayment in each of these markets and b. over and under-estimates of demand relief provided in future years.

source (peak, base-load, intermittent) and progress towards the current program cap of 10-MW. In addition, municipal utility companies have enacted feed in tariff pilot programs in Palo Alto and Los Angeles
Florida
In 2009, Gainesville, Florida, adopted the nation's first solar feed-in tariff. Open to small, medium and large projects, the program is capped at 4 MW per year. As of 2011, Gainesville had increased solar generated electricity 2300% (from 328 kW to 7,391 kW), and it now comprises approximately 1.2% of city's peak load energy (610 MW)
Hawaii
In 2009, the Hawaii Public Utilities Commission required Hawaiian Electric Company to pay above-market prices for renewable energy fed into the electric grid. The policy offers projects a set price and standard 20-year contract. The PUC plans to review the initial feed-in tariff two years after the program starts and every three years thereafter.
Maine
In 2009, Maine initiated a Feed-In Tariff pilot program, which is available for projects up to 10MW in size.
New York
In 2012 in New York, the Long Island Power Authority (LIPA) adopted a feed-in tariff for systems from 50 kW (AC) to 20 MW (AC), and is limited to a total of 50 MW (AC). The LIPA Feed-in Tariff bars customers from using their own electricity, in effect, offering a 20 year fixed rate power purchase agreement instead.
Oregon
In 2009, Oregon established a pilot solar volumetric incentive rate and payment program with legislation. Under this incentive program, systems are paid for the kilowatt-hours (kWh) generated over a 15-year period, at a rate set at the time a system is initially enrolled in the program. The rates for the performance-based incentive program range from $0.25/kWh to $0.411/kWh.
Vermont
Vermont adopted feed-in tariffs as part of the Vermont Energy Act of 2009. Generators must possess a capacity of no more than 2.2 MW, and participation is limited to 50 MW in 2012, a limit that increases by 5 to 10 MW/year to a total of 127.5 MW in 2022. Payments were 24¢/kWh for solar, which was increased to 27.1¢/kWh in March 2012, and are 11.8¢/kWh for wind over 100 kW and 25.3¢/kWh for wind turbines up to 100 kW. Other qualifying technologies include methane, hydro, and biomass.
Source: www.dsireusa.org (Search for "performance based incentives").

5 Materials Management

This Chapter includes:

- A review of the baseline conditions for materials management
- A discussion of GHG emissions from the sector, as well as potential climate change impacts
- A presentation of materials management objectives and indicators
- A review of priority projects, which include:
    - Product Stewardship
    - Material Reuse
    - Organics Recycling
    - Transportation
- A discussion of enabling strategies, including:
    - Inter-County Cooperation
    - Policy
    - Funding

How a society uses materials has a fundamental effect on the economy and the environment. Inefficient and wasteful use of materials not only challenges the capacity of the earth – air, water, land, minerals, etc. – but also the accessibility and affordability of the materials that society relies on to function. Materials management seeks to understand how society uses materials in an effort to change behavior, create smart policy, and implement programs to fulfill needs and ensure prosperity while using less material, reducing toxic waste and exposure to hazardous substances, and recovering and reusing or recycling as much of the material consumed as possible. The materials management focus area centers on developing regional solutions to maximize the value of materials and extend their useful lifecycle, by:

- Reducing waste generation
- Decreasing the impact of materials transportation for disposal/recovery
- Increasing reuse, recycling, composting
- Enhancing local market creation for improved materials recovery outcomes

The approach is intended to be consistent with the vision set by the NYSDEC's sustainable materials management strategy, *Beyond Waste*. The goal is to shift the focus on materials management techniques from "end of pipe" waste disposal to a more comprehensive perspective that addresses upstream issues. For the Mid-Hudson Region, the goal is to shift from the status quo, where much of the material used in the Region is shipped to other parts of NYS or the US for disposal, to a future where the Region is largely self-sufficient in materials management. This requires a significant reduction in the quantity of waste generated as well as the introduction of new management solutions.

5.1 Baseline Conditions

5.1.1 Materials Management Roles and Responsibilities

Responsibility for materials management is shared by multiple parties. The role of NYS is to provide oversight and assistance to local municipalities so that they may adhere to their solid waste management obligations as directed under NYS law. New York State itself operates under a framework of federal guidance[70]. This is accomplished through the NYS Solid Waste Management Plan, funding, and permitting and approval of local plans and facility applications.

In the Mid-Hudson Region, each county serves as a formal Solid Waste Management Planning Unit, providing oversight, guidance, and in some cases running facilities and other infrastructure and services.

Local municipalities are traditionally responsible for implementation of materials management programs. Activities are typically run directly by local government or via contract with third-parties. In some cases a public authority is established to implement materials and solid waste management within a political or geographic area. Efforts to address materials management on a regional level are ongoing as exemplified by the Hudson Valley Regional Council (HVRC). The HVRC has a Solid Waste Committee consisting of solid waste professionals from

[70] US EPA Wastes – Laws and Regulations (http://www.epa.gov/epawaste/laws-regs/index.htm)

all seven counties. Information about the Committee and its activities can be found on the HVRC website[71].

The management landscape is complex due to the mix of both public and private-sector actors, as well as inter-county and inter-regional export and import of materials, making it difficult to speak in general terms about the state of materials management in the Region. Data and trends collected from state and local actors are presented below. A county-by-county summary is presented in Appendix A.

5.1.2 Material Definitions and Flows

As defined by the NYSDEC in *Beyond Waste*, and for the purposes of this Plan, municipal solid waste (MSW) MSW includes "materials generated by the residential, commercial and institutional sectors." Other types of material streams such as industrial (by-products of factories, mills, mines, etc.), construction and demolition (C & D – debris generated during the construction and demolition of buildings and infrastructure), and biosolids (residual, semi-solid material left from industrial wastewater or sewage treatment processes) are not considered MSW in this Plan. Regional solid waste types discussed in this Plan are described in greater detail in Table 5.1; please note that this is not a comprehensive list of all solid waste categories.

TABLE 5.1 REGIONAL SOLID WASTE TYPES

Waste Types	Description	Typical Method of Collection	Destination
Asbestos	Any, material, object, product or debris that contains asbestos	• Private	• Landfill – Out of Region
Biosolids	Stabilized organic solids derived from wastewater treatment processes	• Municipal • Private	• Landfill – Out of Region • Incineration • Reuse Application
Construction and Demolition (C&D)	The solid inert component of the waste stream arising from the construction, demolition or refurbishment of buildings or infrastructure	• Private	• Landfill – Out of Region • Materials Recovery Facility
Green & Yard Waste	Subset of MSW; biodegradable waste including grass clippings, hedge	• Municipal • Private	• Materials Recovery & Composting Facility

[71] www.hudsonvalleyregionalcouncil.org

TABLE 5.1 REGIONAL SOLID WASTE TYPES

Waste Types	Description	Typical Method of Collection	Destination
	trimmings, woody debris, as well as domestic and commercial food waste.		• Left in place or composted on site • Landfill – Out of Region
Hazardous	Any unwanted or discarded material (excluding radioactive material), which because of its physical, chemical or infectious characteristics can cause significant hazard to human health or the environment when improperly treated, stored, transported, disposed of or otherwise managed	• Private	• Landfill – Out of Region
Industrial	Waste stream arising from commercial, industrial, government, public or domestic premises (not collected as Municipal Solid Waste), but does not contain Listed Waste, Hazardous Waste or Radioactive Waste	• Municipal • Private	• Landfill – Out of Region • Incineration • Materials Recovery Facility
Municipal Solid Waste (MSW)	Waste and recyclable materials stream arising from domestic premises including items such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, batteries.	• Municipal • Private	• Landfill – Out of Region • Incineration • Materials Recovery Facility
Pharmaceutical Waste	Subset of MSW; includes expired, unused, spilt, and contaminated pharmaceutical products, drugs, vaccines, and sera that are no longer required and need to be disposed of appropriately. The category also includes discarded items used in the handling of pharmaceuticals, such as bottles or boxes with residues, gloves, masks, connecting tubing, and drug vials.	• Municipal • Private	• Landfill – Out of Region • Incineration
Universal / Household Hazardous Waste (HHW)	Subset of MSW and hazardous waste; which includes widely generated materials such as paints, batteries, pesticides, mercury-containing equipment, and bulbs (lamps)	• Municipal • Private	• Landfill – Out of Region • Materials Recovery Facility

Obtaining county level information on materials streams other than MSW is difficult due to the multiplicity of private actors and limited monitoring and regulation at the county, NYS,

and federal level. For those reasons statewide estimates from the NYSDEC are used for benchmarking and comparative purposes. Table 5.2 presents NYS' 2008 solid waste stream quantities broken down by method of disposal. As shown in Table 5.2, the largest material stream in NYS is MSW, which makes up 50% of the total and of which 20% is recycled. The second largest stream is C & D waste, at 36% of the total, 55% of which is recycled. It is assumed that the Mid-Hudson Region has a similar profile; however, data availability is limited, particularly for non-MSW materials.

It should be noted that combustion rates are likely higher for the Mid-Hudson Region due to the fact that two of the seven counties (Westchester and Dutchess, accounting for 54% of the population) combust a large proportion of their MSW.

TABLE 5.2 MATERIALS AND WASTE MANAGEMENT IN NYS, 2008

	MSW		Industrial		C & D		Biosolids		Total	
	Million Tons	%	Million Tons	%	Million Tons	%	Million Tons	%	Million Tons	%
Recycle/Compost	3.7	20	1.4	39	7.2	55	0.9	47	13.1	36
Landfill	6.0	33	2.1	60	4.1	32	0.3	17	12.5	34
Combustion	2.5	14	<0.1	1	<0.1	0	0.4	24	3.0	8
Export for Disposal	6.1	33	<0.1	0	1.7	13	0.2	12	8.0	22
Total	18.3	100	3.5	100	13.0	100	1.8	100	36.6	100

Source: NYS DEC 2010, Beyond Waste: A Sustainable Materials Management Strategy for New York State.

As shown in Table 5.3 below, estimates based on 2009 Planning Unit Annual Recycling Reports show that the Region overall is generating less waste per capita and recycling a greater percentage of its materials compared to the NYS average. With moderate effort, the Region can likely perform far better than the NYS average. However, to meet the NYSDEC's *Beyond Waste* goals of 1.7 pounds/person/day by 2020, and this Plan's MSW recycling rate goal of 50%, the Region will require a 46% reduction in per capita disposal and a 13% increase in the recycling rate. This will require significant collaboration among the Mid-Hudson counties.

Please note that large variations between reported county values shown in Table 5.3 may in part be due to discrepancies in how the counties define and measure MSW generation and recycling rate. Furthermore, materials that are generated outside of the Region but brought to

a Mid-Hudson facility may cause inflated values – such as in Rockland County which has a service area that extends into New Jersey and other New York Counties.

TABLE 5.3 REGIONAL STATISTICS

County	Population[1]	Per Capita MSW Disposal Rate[2] (lb/person/day)	Recycling Rate[3] (%)
Dutchess[4]	297,488	2.8	29%
Orange[5]	372,813	3.8	38%
Putnam[6]	99,710	3.3	11%
Rockland[7]	311,687	5.6	34%
Sullivan[8]	77,547	3.1	3%
Ulster[9]	182,493	4.8	41%
Westchester[10]	949,113	3.2	52%
Mid-Hudson Region	2,290,851	3.7[11]	37%[11]
New York State	19,378,102	4.1[12]	35%[12]

1. Source: NYS Data Center, 2010 Census
2. Note/Source: Per Capita MSW Disposal Rate excluded recycled and C & D materials. All values, with exception of Putnam county (see note 6) are from 2009 Planning Unit Recycling Reports submitted to NYSDEC.
3. Note: Recycling Rate includes MSW recycled/composted and C & D materials recycled, but does not include combusted materials.
4. Source: Recycling Rate - Dutchess County Draft LSWMP 2012
5. Source: Recycling Rate - Orange County LSWMP 2010,
6. Note/Source: Disposal Rate - Materials collected in Putnam County are hauled to transfer stations outside of the county by private haulers; therefore there is currently no reliable disposal and recycling data. Putnam disposal rate value presented in this table is an estimate generated using the average disposal rates of the surrounding Mid-Hudson counties. Recycling Rate - Putnam County Materials Generation and Recovery 2010 Data provided by Planning Unit
7. Source: Recycling Rate - Rockland County 2011 LSWMP,
8. Source: Recycling Rate - Sullivan County 1992 LSWMP
9. Source: Recycling Rate - Ulster County 2009 report data (http://www.ucrra.org/recycling/graphstats.htm 2009 Data)
10. Source: Recycling Rate - Westchester County 2011 Annual Report
12. Note: Weighted average based on county populations.
13. Source: NYS DEC 2010, *Beyond Waste Plan*. Pg. 93

5.1.3 Common Sustainability Challenges in the Region

Each of the seven Mid-Hudson counties has identified challenges to meeting statewide goals for sustainable materials management. Each county's challenges have been categorized into the six themes described below:

- **Organic Materials Management –** The southern more urbanized counties have disproportionately large organic components in their solid waste streams due to disposal of yard waste. Organics management can be improved by first reducing the amount of organic material that is sent to the curb for collection and disposal. This can be accomplished by composting or reusing yard debris and other organic material on-site. After collection, organics management can be improved through recycling or composting of the material at a central or larger-scale facility. Removing organics from the waste stream (either at the source or after collection) has multiple benefits such as reducing the volume of waste to be landfilled and reducing GHG emissions from transport of waste and anaerobic decomposition at landfills. Other organics, such as food scraps and biosolids from wastewater treatment plants also make up a large proportion of the regional waste stream. Often organics are sent to landfills or incinerated; however, there are several existing municipal organics composting programs in the Region such as those operated by the Rockland County Solid Waste Management Authority and the Ulster County Resource Recovery Agency, which can be used as model programs that can be expanded or replicated to improve organics recovery regionally.

- **Transport and Disposal (T & D) Costs –** With no operating landfills in the Region, all landfill-destined waste is exported as either solid waste or as incinerated residual ash. Every ton of MSW and C & D material that is reduced, reused, recycled, repaired or composted locally will represent a reduction in the environmental and fiscal impact of T & D. The cost of export represents a large portion of community operating budgets and continues to rise. The cost of export represents a large portion of community operating budgets and continues to rise. For example, in Ulster County, T & D costs have increased by 12% in from 2009 through 2011 (from $51/ton to $57/ton). According to the UCRRA, the increase in T & D costs was primarily attributed to rising fuel costs which varied between $8 and $13 per ton during that time period, whereas all other major cost factors such as hauler fees and landfill disposal fees stayed roughly the same.

FLOW CONTROL CALL OUT BOX PENDING FURTHER INFORMATION

- **Regulatory Enforcement** – There are multiple municipal and state laws mandating the separation of materials and prohibiting the disposal of recyclables in MSW and C & D waste streams; however, many municipalities lack an effective system of enforcement of these laws.

- **Post-Consumer Product Market** – Many materials can be reused or reprocessed into useful products; however, the development of a viable, large-scale market for these materials continues to remain a challenge at all levels.

- **Programmatic Funding** – Many counties lack the necessary funding to support staff or make the capital investment to initiate more effective materials management programs.

- **Data Collection and Management** - Inconsistent definitions, tracking mechanisms, reporting, and data management render materials accounting very difficult.

A listing of the greatest challenges faced in each county can be found in Table 5.3.

TABLE 5.4 REGIONAL CHALLENGES

	Organic Materials Management (3)	T & D Cost (4)	Flow Control (3)	Regulatory Enforcement (4)	Post - Consumer Product Market (2)	Programmatic Funding (2)	Data Collection and Management
Dutchess		•	•	•			•
Orange				•			•
Putnam	•		•	•			•
Rockland	•	•			•		•
Sullivan				•		•	•
Ulster		•	•			♦	•
Westchester	•	♦					•

● Directly Identified as a challenge by County staff
♦ Identified as a challenge by County stakeholders

Table 5.4 helps identify which challenges, if addressed, could bring the greatest benefit to the Region as a whole. The two most commonly cited challenges were regulatory enforcement

and T & D cost, which are directly reflected in the regional materials management objectives noted below.

The issue of regulatory enforcement is perhaps best summarized in *Beyond Waste*: "Although most municipalities did adopt the requisite local source separation laws or ordinances before the statutory deadline of September 1992, in some cases, local laws still lack fundamental and important provisions such as requiring source separation in all generating sectors and providing for enforcement. In many cases where the laws include enforcement provisions, municipalities have not effectively used them, particularly for commercial and institutional generators."

Westchester County, which has the highest recycling rate in the Region (52%), attributes much of its success to its recycling enforcement program which was instituted in 2008, the first enforcement program of its kind in NYS. This exemplifies the opportunity to take successful locally-implemented programs and replicate them throughout the Region to meet materials management objectives.

5.1.4 Regional and County Infrastructure

The Mid-Hudson Region has no active public landfill. However, there are numerous private and public facilities used to manage materials in the Region, including recyclables handling and recovery facilities (RHRFs), materials recovery facilities (MRFs), and transfer stations. Closed landfills are also important as the maintenance, monitoring, and in some cases remediation, continues to be a cost and environmental burden for many counties. A complete list of facilities and a county-by-county profile is provided in Appendix A.

5.1.5 Universal Waste, Household Hazardous Waste, and Pharmaceutical Waste Management

Universal waste, household hazardous waste (HHW) and pharmaceutical waste pose significant environmental and public health threats when improperly managed.

State law[72] provides standards and regulations for the handling, transport and disposal of universal waste generated by institutions and commercial facilities. Generators themselves are required to ensure the proper handling, transportation and disposal of universal waste. In

[72] NYSDEC, Environmental Conservation Law Section 27-0900, Subpart 274-3: Standards for Universal Wastes

many cases, institutions will contract with an independent commercial hauler for universal waste collection and disposal.

To address the potential hazards posed by HHW, communities in the Region have organized programs to collect, package and transport HHW to hazardous waste treatment, storage, recycling or disposal facilities. HHW programs reduce environmental threats by providing a collection and management system, informing residents about how to properly manage HHW and, most important, how to avoid using hazardous products at home. As a regional best practice example, Rockland County operates a HHW collection facility available to the public five days a week and alternately on Saturdays and Sundays. This level of service is uncommon in NYS, and is exemplary for the Region.

For pharmaceutical waste, some communities and pharmacies in the Mid-Hudson Region and across NYS have voluntarily established take back programs for unused and unwanted pharmaceuticals. Some communities and counties, such as Rockland County have included pharmaceuticals in their HHW collection events, while pharmacies and certain other communities have established stand-alone pharmaceutical take back events. A county-by-county summary of HHW and pharmaceutical programs offered by Mid-Hudson planning units is presented in Appendix A.

As pointed out in the *Beyond Waste Plan*, these HHW and pharmaceutical programs have been very successful and popular with New Yorkers; however they are also expensive – thus limiting their public reach and frequency. For these reasons, pharmaceuticals and the products that become HHW become key targets for product stewardship as discussed in Section 5.5.1 below.

5.2 Climate Change and Materials Management

5.2.1 GHG Emissions

According to the NYSDEC, there are no active MSW landfills in the Mid-Hudson Region as of December 30, 2011[73]. However, landfills may still emit GHGs for several decades after closure because as organic matter decays it produces methane (CH_4). Closed landfill facilities in the

[73] NYS DEC Active Municipal Solid Waste Landfills. 12/30/2011. http://www.dec.ny.gov/docs/materials_minerals_pdf/mswlist.pdf

Region include Al Turi Landfill & Landfill Gas to Energy Facility and Sullivan County Landfill. Closed landfills in the Region emitted 39,648 $MTCO_2E$ in 2010[74].

In addition to emissions from closed landfills within the Region, waste exported from the Region for landfill disposal also generates GHG emissions. These emissions were calculated based on the volume of waste produced. See Table 5.5 for a breakdown of emissions by county.

Note that emissions from composting are not included. Emissions from the collection and transportation of waste are included in overall transportation emissions (see Chapter 3). Note that these emissions are significant – as noted earlier in the Chapter, a major part of T & D cost is related to fuel expenditures, which directly correlate with GHG emissions.

TABLE 5.5 GHG EMISSIONS BY COUNTY

County	MSW CH_4 emissions ($MTCO_2e$)	C & D CH_4 emissions ($MTCO_2e$)	Total CH_4 emissions ($MTCO_2e$)	Percent of total
Dutchess	69,756	227	69,983	6%
Orange	125,167	1,728	126,895	11%
Putnam	293	N/A	293	0%
Rockland	495,997	8,066	504,063	45%
Sullivan	58,976	932	59,909	5%
Ulster	194,791	3,835	198,625	18%
Westchester	156,393	11,044	167,436	15%
Mid-Hudson Region Total	**1,101,373**	**25,832**	**1,127,204**	**100%**

The GHG emissions noted in Table 5.5 should be reviewed with caution. For example, Westchester and Dutchess County incinerate much of their solid waste – these emissions are not included in the figures above, but rather in electrical generation emissions noted in Chapter 4. Additionally, Rockland County manages significant volumes of waste for neighboring counties in New Jersey, making their emissions appear significantly greater than those directly attributable to Rockland County residents. Furthermore, the emissions calculated above used NYSDEC-provided data, which differ from county-provided MSW data

[74] See Attachment B: GHG Inventory

by up to 30%. These factors all underscore the need for an organized, systematic method of accounting based on consistent regional definitions.

5.2.2 Climate Vulnerability

Materials management infrastructure and processing, disposal, and storage facilities may be subject to various impacts due to climate change. Table 5.6 summarizes some of the impacts and effects on the Mid-Hudson Region's materials management systems and facilities.

TABLE 5.6 MATERIALS MANAGEMENT-RELATED CLIMATE EFFECTS IN THE MID-HUDSON REGION

Asset	Climate Impact	Climate Effect	Description
Collection Infrastructure	Flooding and Storm events	Increased debris	The volume of solid waste substantially increases after natural disasters, which stresses existing solid waste facilities. Debris resulting from flooding and storm events can also be hazardous, complicating the disposal of post-storm/ flooding debris. Vegetative debris can accumulate in streams and catch basins thereby exacerbating localized flooding.
	Flooding; Sea level rise; Storm events	Disruption to transportation/ collection	Transportation infrastructure damage caused by climate change effects can impede solid waste collection procedures.
Processing/ Disposal/Storage Facilities	Flooding; Sea level rise; Storm events	Damage to solid waste storage facilities and waste-to-energy plants	Some solid waste storage facilities including landfills and industrial storage areas are located along rivers and in other low-lying areas that may be vulnerable to flooding, sea level rise, and storm surge. If damaged, these types of facilities have the potential to release contamination thereby affecting nearby ecosystems, residents, and businesses.
	Increasing average temperature; decreasing snowfall	Improved anaerobic processes	Certain management options such as composting and biodigestors may experience an increase in waste processing efficiency as a result of increased ambient temperatures and reduced snowfall.

Debris Management

Natural hazards that occur in the Northeast have the potential to produce large amounts of debris. Past disasters in the US have generated debris volumes equivalent to 5 to 15 times the

annual waste generation of the affected communities[75, 76]. Existing materials management facilities often become overwhelmed with debris proposed for recycling, incineration, composting, or disposal. While individual counties have debris management plans in place, there is an opportunity to increase regional-scale coordination (see Section 5.XXX). Table 5.7 details the types of debris and challenges presented by various natural disasters.

Additionally, natural disasters can impact hazardous material storage facilities, releasing oil and other hazardous materials into the natural environment. The hazardous materials can contaminate debris, complicating disposal efforts.

TABLE 5.7 SUMMARY OF DEBRIS TYPES AND CHALLENGES OF NATURAL DISASTERS

Natural Disaster	Example of Debris	Challenges Faced
Hurricanes	Construction and Demolition (C & D) materials, damaged automobiles and boats, furniture, fallen trees, sediments, and other debris	Hurricanes can result in large amounts of vegetative debris, which is usually the most voluminous debris stream. Hurricanes also leave behind large amounts of displaced sediments.
Tornadoes	C & D materials, automobiles, vegetative debris, furniture, and other materials	Tornadoes inflict damage on structures and infrastructure resulting in projectile materials.
Floods	Personal property, C & D debris, damaged automobiles, trees, sediments, and sandbags	Floods can destroy roads and bridges, impacting a community's ability to clean up debris. People must dispose of large amounts of food-damaged household items.
Wildfires	Ash, charred wood waste, mixed metals, C & D materials, and damaged personal property	Wildfires typically leave less debris than other types of disasters, but the remaining debris is often mixed together. Loss of groundcover can lead to mud slides.
Winter Storms	Vegetative debris, C & D debris	Heavy snow and ice can cause many broken trees and branches, and the collapse of roof structures. Icy roads can impede debris removal.

Source: EPA. *Planning for Natural Disaster Debris.* EPA, 2008.

[75] Brown, C., M. Milke, and E. Seville. "Disaster Waste Management: A Review Article." *Waste Management* 31 (2011): 1085-1098.

[76] EPA. *Planning for Natural Disaster Debris.* EPA, 2008.

A large portion of disaster debris consists of vegetative matter. Fallen trees have the potential to disrupt transportation and leave residents without power. For example, the total number of tree crews required to clear tree debris in Orange and Rockland counties following Hurricane Irene and Tropical Storm Lee ranged between 25 and 70 per day over an eight day period[77]. This is likely to be exceeded by Hurricane Sandy. The quantity of tree crews deployed in all of NYS by electric utilities following Hurricane Irene and Tropical Storm Lee in 2011 is shown in Figure 5.1[78].

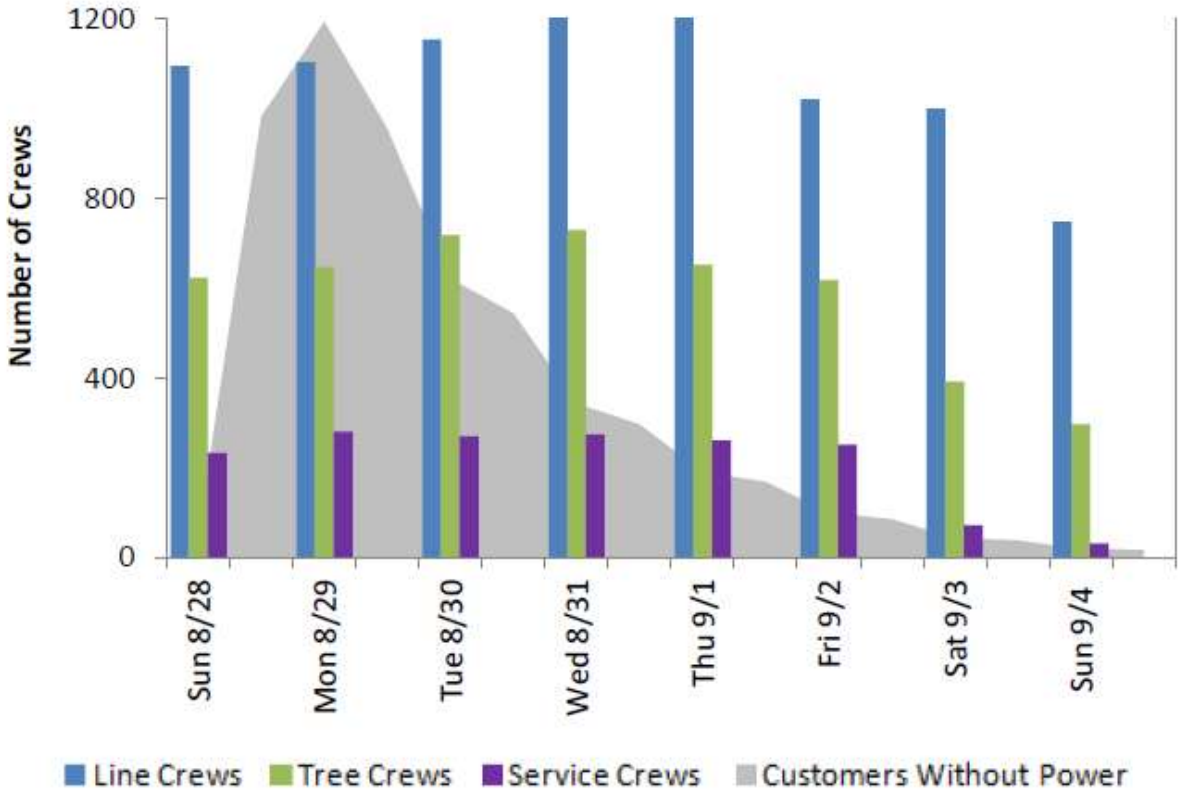


Figure 5.1 Number of Crews Deployed in NYS Following Hurricane Irene and Tropical Storm Lee

Materials Management Facilities

Flooding can cause damage to infrastructure such as landfills, industrial storage areas, and agricultural waste retention ponds. The resulting damaged facilities have "significant

[77] Orange and Rockland Utilities, Inc. *Report of on Preparation and System Restoration Performance. Hurrican Irene August 28, 2011 through September 3, 2011 and Tropical Storm Lee September 5, 2011 through September 8, 2011.* Orange and Rockland Utilities, Inc., 2011.

[78] NYS Department of Public Service. *Utility Performance Report Following Hurricane Irene and Tropical Storm Lee.* NYS Department of Public Service, 2012.

potential to contaminate floodwaters with petroleum and other noxious substances, causing odors and pathways for disease and affecting nearby ecosystems, residents and businesses"[79].

Per a regional GIS analysis, there are five inactive landfills located in the existing 100-year floodplain and one additional landfill in the projected 2080 floodplain. With sea level rise and increase frequency of extreme weather, these landfills may be vulnerable to further flooding and storm surge impacts.

5.3 Objectives

MM1 Reduce the volume of solid waste generated

- Focus efforts on creating policies and programs that will reduce the overall amount of waste generated, with the long-term objective of achieving zero waste. Incentivize policies and programs that will work regionally to achieve reduction goals so that counties work together to solve materials management problems, sharing resources and expertise.

MM2 Increase the proportion of material diverted from landfills via reuse, recycling, composting and other organic recycling methods

- Focus efforts on maximizing the useful lifespan of materials and increasing recycling rates. This will help reduce the environmental impacts associated with producing new goods and materials. This will also reduce GHG emissions from landfills.

MM3 Reduce T & D Cost

- Focus on projects and policies that create local management and disposal options. By keeping material local, transportation costs and associated energy use and GHG emissions can be reduced.

[79] Sea Level Rise Task Force. "New York State Sea Level Rise Task Force Report to the Legislature." 2010.

Zero Waste

The heart of sustainable materials and waste management lies in the concept of Zero Waste. As defined by the Zero Waste International Alliance : "Zero Waste is a goal that is ethical, economical, efficient and visionary, to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use."

To promote the concept of Zero Waste within the Mid-Hudson Region, organizations like the Rockland County Solid Waste Management Authority (RCWMA), and the NYS Office of Parks, Recreation & Historic Preservation have been working with public event planners to make their events Zero Waste. A prime example of this was the 2012 Knickerbocker Ice Festival – complete with compostable products bins, recyclables bins, waste bins and easy to read signs directing people where to deposit their materials. All compostables and recyclables were repurposed at the RCSWMA facilities.

The next step is to work with urban planners to incorporate the Zero Waste concept into the urban streetscape by making recycling and composting available in the Region's urban centers.

5.4 Indicators

Table 5.8 presents a series of sustainability indicators for the materials management focus area. These indicators should be used by planning units, municipalities, and private operators to track performance in achieving the Region's materials management objectives.

5.4.1 Metrics and Targets

TABLE 5.8 INDICATOR INVENTORY – TIER 1 INDICATORS

Objective	Metric	Current Value	Target – 2020	Target – 2035	Target – 2050
MM1 – Reduce the volume of solid waste disposed	Per capita MSW disposal rate (lbs/person/day)	3.7 (2009)	1.7	0.5	0.3
MM2 – Increase the proportion of materials diverted from landfills via reuse, recycling, composting and other organic recycling methods	Recycling Rate (%)	36% (2011)	50%	75%	95%
	GHG emissions ($MTCO_2E$)	1,127,204	20%	50%	80%
MM3 – Reduce T & D cost	n/a	n/a	n/a	n/a	n/a

TABLE 5.9 INDICATOR CALCULATIONS AND DATA

Metric	Calculation	Data Source
Per capita MSW disposal rate (lbs/person/day)	Weighted population average of [(Annual lbs MSW / County population) / (365 days/year)]	County Planning Unit, Solid Waste Management Plans
Recycling Rate (%)	Weighted population average of [Total materials recycled (MSW +C & D) per county / Total materials generated per year per county]	County Planning Unit, Solid Waste Management Plans
GHG Emissions (Million $MTCO_2E$)	See Regional GHG Inventory	See Regional GHG Inventory

5.4.2 Limitations and Tier 2 Indicators

As discussed in *Beyond Waste*, data collection and subsequent reporting on materials and waste volumes has been a constant challenge in NYS and nationally. Data for the Tier 1 indicators were provided primarily by the individual county planning units or NYS DEC. The level of accuracy of MSW generation and disposal volumes varies per county due to disparities in flow control legislation, management structure and monitoring methods. For the most part, the strongest and most consistent data has been from municipally collected residential materials; the weakest is from regions or planning units dominated by private collection. Known limitations of MM1 and MM2 metrics are provided below:

MM1: Per capita MSW disposal rate (lbs/person/day)

- MSW is only a proportion of the total waste stream. Collecting reliable data is difficult for commercially- and institutionally-generated materials and streams such as C & D, biosolids, and industrial waste. This indicator can only be construed as a limited proxy indicator.
- This indicator is a (poor) proxy for T & D costs, in the sense that less waste disposal results in lower T & D costs.
- MSW generation rates, and therefore disposal rates, are susceptible to outside factors such as the state of the economy and regional population trends.
- GHG emissions data have significant limitations, as noted earlier in the Chapter.

MM2: Recycling Rate (%)

- As noted by participants in the planning process, variation likely exists in how planning units define which materials streams are included in the recycling rate; such as C & D materials, compost etc.
- The recycling rate does not account for materials that are reused or recycled via informal methods such as thrift stores, internet exchange sites, and building material reuse centers. Nevertheless such informal methods are significant and critical to the sustainability of the materials management sector.

To enhance the monitoring and evaluation of the goals and indicators set forth by this plan, local planners could benefit from county-level data such as those listed in Table 5.10. Particular themes/topics that require additional data to evaluate performance include T & D costs and educational outreach.

TABLE 5.10 TIER 2 INDICATORS	
Objective	**Metric**
MM3	Total Annual T & D Cost
MM3	Total energy consumption associated with T & D
MM1, MM2	Total annual solid waste (MSW + Biosolids + Industrial + Commercial + C & D) generation per capita. Proportion of total MSW salvaged/reused
MM3	Proportion of MSW exported from the Region
MM1	Total C & D waste generation
MM2	Ash generation

5.5 Priorities for Implementation

Meeting the Region's materials management objectives will require a lifecycle perspective that seeks to reduce waste before it is created, use materials with minimal environmental and health impacts, maximize the effective life of products through careful maintenance and reuse, recycle waste into new materials and products, and ensure the environmentally responsible disposal of any waste streams created.

5.5.1 Product Stewardship and Environmentally Preferable Purchasing

Product stewardship projects address waste minimization through the development or selection of pre-consumer products that have the least possible impact on the environment, health and safety. Product stewardship initiatives are particularly critical for minimizing the generation and impacts of Universal Waste, HHW and pharmaceutical waste. The components of successful product stewardship are essentially three fold: responsible manufacturing, informed consumer purchasing, and effective legislation.

For manufacturers, this includes the development of products with low toxicity, minimizing the use of disposable packaging, and implementing take-back programs for proper reuse, recycling, or disposal of the product.

For retailers and consumers, product stewardship entails making informed purchasing decisions, based in part by the supplier or product's environmental performance, and ensuring the product is sent to the proper disposal facility. To assist in guiding their decisions, retailers

and consumers can use resources like the EPA's Environmentally Preferable Purchasing (EPP)[80].

The third component of product stewardship comes in the form of legislative policies which limit the production of certain products such as mercury filled thermometers, and mandate take back and proper disposal of material such as electronic waste (e-waste). Efforts in NYS to expand and develop product stewardship legislation are ongoing. The New York Product Stewardship Council (NYPSC) supports efforts to implement product stewardship legislation. More information about NYPSC's activities and initiatives, including relevant legislative actions in NYS, can be found on their website[81].

Example Project

Shopping Center/Retail Procurement Initiative

Targeting the numerous large shopping centers within the Mid-Hudson Region, this project seeks to maximize the use of EPP and packaging reduction approaches. The project would include the following phases:

- Phase 1 – Conduct a feasibility study to identify economic and logistical barriers to EPP and recycling/packaging reduction; evaluate and propose techniques and methods that reduce the use of packaging and increase the use of recyclable material.
- Phase 2 – Develop an association/task force/entity to engage shopping centers in a commitment to EPP.
- Phase 3 – Conduct reporting to assess use of EPP methods among participating centers.

The rapid spread of invasive species, particularly Emerald Ash Borer, may impact the way organic waste (in particular woody waste) is managed in the Mid-Hudson Region. Currently, Orange and Ulster counties are in the NYSDEC Emerald Ash Borer quarantine zone. This restricts "the movement of ash logs or wood (such as tree trimmings), ash nursery stock and all firewood out of the respective counties, unless done under a Compliance Agreement from NYS Department of Agriculture and Markets." This demonstrates the need to develop local markets and disposal/reuse facilities for woody biomass and other organic waste within the Region.

5.5.2 Organics Recycling

Organics recycling projects seek to prevent or remove organics from the waste stream and reprocess (compost)

[80] http://www.epa.gov/epp/
[81] http://www.nypsc.org/

the material for beneficial reuse. Projects can include efforts to encourage small-scale composting or waste minimization to larger-scale county or regional composting schemes.

Example Projects

Onsite Organics Recycling

A program developed in Westchester County called Love 'Em and Leave 'Em (LELE) has the potential to significantly reduce costs, energy use, and GHG emissions due to grass and leaf removal. LELE promotes mulch mowing of leaves and grass which eliminates the need to collect and dispose of these materials. It also allows for in situ decomposition, which provides multiple benefits including reducing the need for fertilization.

LELE has existing public outreach material, growing "brand" recognition, an established landscaper training program, "How To" videos on its website and on YouTube, and a well-developed toolkit of resources that can be adapted by other groups and municipalities. To implement this project, an additional "train the trainers" component would be developed. This more extensive training program, to be conducted in key locations throughout the Mid-Hudson Region, would train key persons in the concepts and methodologies of onsite mulching, enabling them to provide a local program of trainings and demonstrations, promoting the LELE initiative.

Organics Recovery Facility

Ulster County Resource Recovery Agency is currently piloting an organics recovery facility (ORF) to remove food and yard material from the waste stream and convert it into compost to be sold for use as an agricultural soil amendment. This project will evaluate the feasibility of expanding the operations of the ORF to serve the entire Mid-Hudson Region.

Regional Composting Opportunities at NYS Correctional Facilities

The NYS Department of Corrections operates organics composting programs at prisons in the Mid-Hudson Region. Previously, farms were also operated at prisons. These farms produced milk, meat, and agricultural products either for direct consumption by inmates or for community groups in support of sustainable agriculture. Composting at prisons save resources by managing materials on site using low-cost inmate labor on abundant open space away from people. This project proposes expanding existing on-site prison composting operations to accept community-generated organic waste.

Alternative Fuel Generation Project

This initiative would begin with a feasibility study to investigate siting a pilot co-generation facility for anaerobic bio-digestion to process food and yard waste into compost, while producing renewable natural gas. The study will also examine best sites and carbon reduction value of compressed natural gas (CNG) fueling stations. The study would examine the cost-benefits, infrastructure availability, delivery systems, market, economic values, and environmental values and help determine a plan for replicating the bio-digestion facilities and CNG fueling system throughout the region.

5.5.3 Material Reuse

Material reuse projects seek to reduce the volume of waste sent to landfills by facilitating the valued reuse of materials. These can include commercial or non-profit initiatives to reuse building materials and other products. Existing initiatives include the New Paltz Reuse Center, PC Renew in Rockland County, and more.

Example Project

Building Material Reuse Facility

A Building Material Reuse Facility (B-MRF) is proposed to promote reuse of building materials and reduce MSW exported to landfills. The facility would receive materials primarily from contractors that are rehabilitating structures, but any entity or property owner could contribute materials. The B-MRF facility would capitalize on the emerging trend of 'deconstruction', which is a process of dismantling buildings in a manner that conserves the function/use of the existing materials, furniture, appliances, etc., thus allowing for their reuse. The B-MRF would be somewhat different than a thrift or consignment store because its primary market would be for contractors. Based on the quality of materials, these could be marketed for rehabilitation of structures or for new construction. The B-MRF would target materials that may be re-used and would not focus on materials processed at C & D debris facilities.

5.5.4 Transportation Improvements

Transportation improvements address the process of collecting and delivering solid waste. Waste collection requires significant quantities of energy and generates air pollutants including GHGs. Efforts may include optimization of routes and vehicle sizing, modifications to collection frequency, and development of new infrastructure to enable more efficient transportation.

Example Project

Intermodal/Rail Transfer Station

The project would develop an intermodal transfer station to facilitate the distribution of MSW, recyclables, biosolids, ash, and/or other materials by rail. Currently, most materials are distributed by motor vehicles, sometimes at distances of several hundred miles per trip. This mode of transport has environmental impacts, with fiscal impacts increasing as petroleum costs escalate.

5.6 Enabling Strategies

5.6.1 Inter-County Cooperation

Inter-county cooperation includes projects that are related to the sharing of resources and information, as well as the development of programs and processes that extend beyond county boundaries. To a degree, inter-county cooperation is already occurring as exemplified by HVRC's Solid Waste Committee, and Orange County and Rockland County Solid Waste Management Authority's service areas extending beyond their county and state borders. Many of these existing efforts can be built upon and learned from. One critical step for inter-county cooperation is the adoption of consistent methodologies and definitions, such as those provided in Appendix A of *Beyond Waste*. One way to increase recycling and waste diversion efforts is to adopt a set of consistent and uniform labels to be used in marking different waste receptacles. Counties could collaborate to develop a standard and then implement this standard throughout the Region.

Additionally, the Mid-Hudson Region's Counties' Emergency Management Departments should coordinate and conduct regional debris management planning in preparation for future large scale natural disasters.

Example Initiative

Integrated Solid Waste System Feasibility

To address integrated solid waste management through the Region, this initiative would begin with a feasibility study to examine the present status of solid waste management, including private and public actors, and the regional feasibility of implementing various management solutions. An informed consent engagement exercise would bring all stakeholders together to come up with a system whereby the solid waste generated in the Region is handled locally.

The study should evaluate private and public waste transfer and combustion facilities; MRFs; C & D reuse and recycling; local recycling end markets; public and private yard waste, food waste and sewage sludge composting facilities; household hazardous and universal waste facilities and programs; and public reuse facilities and private reuse businesses. Infrastructure and legislation examined by the study should include but is not limited to:

- Construction of one or more landfills for residuals disposal
- Rail and water transportation solutions
- Material bans, deposits fees, and producer responsibility mandates

5.6.2 Policy

Policy can address areas where the social and political environment is critical to the development of projects, either by permitting or incentivizing activities or removing barriers to implementation. For example; the social environment may include public perception and behavior; the political environment may include the adoption, enforcement or repeal of regulation.

Example Initiatives

Flow Control Legislation - Regional, Local

Flow control is viewed by some as a significant tool for local governments to successfully establish integrated solid waste management systems. Amendment(s) to the NYS Environmental Conservation Law or General Municipal Law could help clarify and delineate the authority for local governments to enact flow control statutes. For example, the potential for more than one local governments/county governments to establish flow control within their combined jurisdictions could be defined in an amendment. By establishing flow control in, say two or three counties, the larger geographic boundary may enhance the financial viability of an integrated solid waste management program. While regional flow control may already be permissible under present case law, an enactment by the NYS Legislature would clarify the establishment of these arrangements.

C & D Debris Legislation

The initiative proposes the development of a model ordinance or local law on required demolition debris reuse, for subsequent consideration by planning units or municipalities. Cook County, Illinois, recently enacted such an ordinance which required contractors to reuse 70% of commercial C & D debris. Residential C & D is treated separately under the law, requiring 5% reuse. The environmental and economic benefits of diverting C & D debris from

landfills to reuse are readily apparent. Increasing amounts of C & D reuse can create new jobs in reuse/processing as well as marketing of materials.

Transitioning from Not In My Back Yard (NIMBY) to Yes In My Back Yard (YIMBY)
The Hudson Valley Regional Council is an existing consortium of the Mid-Hudson Region counties that examines administrative benefits and regional solutions to challenging issues in government. The Region requires new MSW infrastructure if it is to transition toward self-sufficiency. A possible solution to the NIMBY position of MSW facility siting may be to conduct regional online opt-in contests that discover who may actually want to proactively host MSW facilities in their communities, in exchange for a host community benefit.

5.6.3 Funding

Funding initiatives include developing finance mechanisms to reduce or eliminate financial dependency on out-of-Region disposal options. Such mechanisms include the development of pre/post-consumer materials markets and the adjustment of taxes and fees paid by users.

Example Initiative

Pay-as-you-throw

As described in Beyond Waste, "more than 400 communities in NYS employ some form of volume-based pricing. These programs charge residents for waste collection and recycling services based on the volume of waste generated. When properly structured, the full system costs (including recycling, composting and waste prevention programs) are included in waste disposal fees, while recycling and composting collections are provided for free. This gives residents an incentive to reduce their waste and recycle more." These properly structured volume-based pricing programs are known as Pay-As-You-Throw (PAYT) programs. PAYT is currently instituted by many communities in the Mid-Hudson Region; however there is room to expand as illustrated by Ulster County which estimates that only 20% of the population utilizes town transfer stations with the PAYT Program. The benefits of PAYT have been well documented[82].

5.6.4 Education

INSERT TEXT AND GOOD PRACTICE EXAMPLES

Example Initiative

[82] http://www.epa.gov/osw/conserve/tools/payt/

Increasing Regional Household Composting Rates through Training, Education, and Outreach

The regional network of Cornell Cooperative Extension (CCE) associations is proposing to implement a household composting assessment and outreach project for the Mid-Hudson Region. CCE will first assess the level of knowledge about composting methods and habits of Mid-Hudson Valley residents, and identify barriers to composting through a social science survey. Working with the Cornell Waste Management Institute and county waste coordinators, CCE will then recommend various policy options to increase composting rates, and develop targeted training for residents. CCE will also provide training through its Master Gardener Program, and develop a new master Composter Program. This project will improve composting rates and reduce the use of energy to haul or incinerate biodegradable waste. This project can be replicated throughout NYS through close collaboration with Cornell University and regional Extension networks.

6 Agriculture and Open Space

This Chapter includes:

1. A review of the baseline conditions for agriculture and open space
2. A discussion of GHG emissions from the sector, as well as potential climate change impacts
3. A presentation of agriculture and open space objectives and indicators
4. A review of priority projects, which include:
    a. Food infrastructure networks
    b. Energy efficiency and renewable energy in agriculture
    c. Priority conservation areas
5. A discussion of enabling strategies, including:
    a. Sustainable agriculture education and training
    b. Branding Mid-Hudson Agricultural Products

The agriculture and open space focus area centers on developing regional solutions to maximize the value of the agricultural economy, sustain working landscapes, and ensure the sustainable management of the Region's natural resources. Furthermore, it aims to maintain open space and forests and ensure that parts of the Region retain a rural character. For the purposes of the Plan, open space is defined as "as land which is not intensively developed for residential, commercial, industrial or institutional use. Open space can be publicly or privately owned. It includes agricultural and forest land, undeveloped coastal and estuarine lands, undeveloped scenic lands, public parks and preserves. It also includes water bodies such as

lakes and bays83." It is important to note that this Plan distinguishes agricultural lands as a distinct subset of open space in that is it an intensive use of land and is an infrastructure asset to the business owner (i.e., farmer) much like an industrial building is an asset to a manufacturer. This chapter will discuss agriculture in terms of land use, the agricultural industry, and then will separately address open space and its other components.

The preservation of open space, including farmland and forestland, contributes to sustainability by protecting the environment, supplying valuable ecosystem services, and providing opportunities for food production, employment and recreation. Preserving working farms provides a fresh food source for the NYC metro region and the Mid-Hudson Region and reduces the need for rural residents to travel long distances to buy fresh food.

For the purposes of the Plan, the definition of a farm is based on that of the USDA Agriculture Census, which considers farms to be agricultural businesses with gross annual receipts of one thousand dollars or more. The USDA Agriculture Census definition has been used for the purpose of data collection and analysis. However, it is important to recognize that not all farm activity is included in this definition, such as farms whose owner's sole occupation is not farming and where gross receipts are at or below the $1,000 mark. Similarly this figure may also exclude urban farms and gardens which contribute to regional food production and supply, but do not have income levels above the defined threshold. Anecdotal information suggests these farms are an important part of the agricultural fabric of the Region, but data are sparse and incomplete.

Directing rural and suburban growth into village centers also protects open space from development. This helps maintain ecosystem services such as water filtration, carbon sequestration, flood mitigation, and biodiversity.

6.1 Baseline Conditions

6.1.1 Agriculture

The Mid-Hudson Region's agricultural activity includes the following:

- Dairy
- Fruits
- Vegetables
- Nursery
- Greenhouse crops
- Animal agriculture

[83] New York State Open Space Plan. 2009. http://www.dec.ny.gov/docs/lands_forests_pdf/osp09complete.pdf

- Silviculture[84]

The Mid-Hudson Region's agricultural economy has a number of distinct advantages:

- **Access to markets** – The Region serves as an important source of fresh, high quality, local food for the NYC metro area.
- **Direct marketing** –The Region sells a large part of its farm production through direct sales, exceeding the NYS average; direct sales can increase profit margins for farmers.
- **Local food movement** – A strong local food movement drives increased demand for the Region's products.
- **Value-added products** – A strong market for regional farm products provides the opportunity for higher receipts at the farm as well as increased employment and a greater economic impact.
- **The Region's soils and climate** – Local geography is well-suited to agricultural production.
- **The NYC watershed** – NYC's Department of Environmental Protection has determined that agriculture is a preferred land use in its watersheds, helping promote and preserve agricultural activity.

As shown in Figure 6.1 and presented in Table 6.1, in 2007 the seven counties of the Mid-Hudson Region contained 2,321 farms operating on 323,154 acres of farmland[85]. These farms account for 4.5 percent of total farmland in NYS and 6 percent of total land in the Mid-Hudson Region.

[84] Silviculture is the art and science of controlling the establishment, growth, composition, health and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis http://www.fs.fed.us/forestmanagement/silviculture/index.shtml

[85] Data for farm numbers and acres are from Census of Agriculture, 2007. For the purposes of the Census of Agriculture, a farm is counted if it has $1,000 or more in annual sales. This Census is voluntary and may not reflect the true number of all types and sizes of farms. The Census is, however, the best available information and has a consistent methodology over time which facilitates analysis of trends.

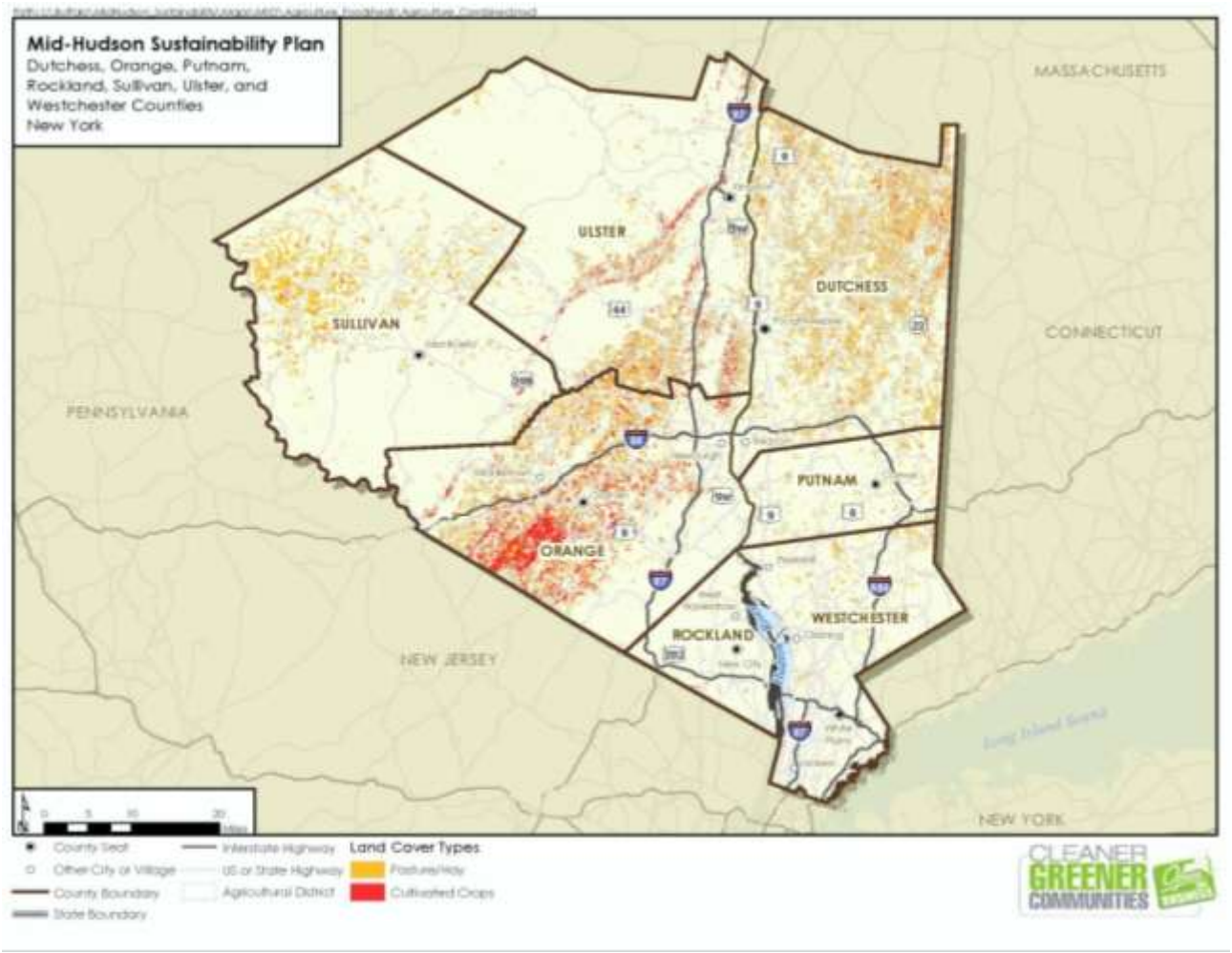


Figure 6.1 Agricultural Land Cover

TABLE 6.1 AGRICULTURAL LAND USE				
County	Land In farms (Acres)	% of total land	**Harvested Cropland (Acres)**	Agricultural Districts (Acres)
Dutchess	102,360	19.9	37,961	179,454
Orange	80,990	15	38,677	166,365
Putnam	5,635	3.6	870	4,501
Rockland	(D)*	(D)*	(D)*	(D)*

Sullivan	50,443	7.9	21,198	161,765
Ulster	75,205	10.1	26,776	65,668
Westchester	8,521	2.6	1,763	6,517
Region	323,154	11.1	127,245	584,271

*(D) = withheld to avoid disclosing results for a single farm

Farmland in the Region is under pressure from competing land uses. Approximately 27 percent of the prime farmland soils in the Region (including prime farmland if drained) and 18 percent of the soils of statewide importance have been developed for non-agricultural purposes and are no longer usable for farming (see Figure 6.2).

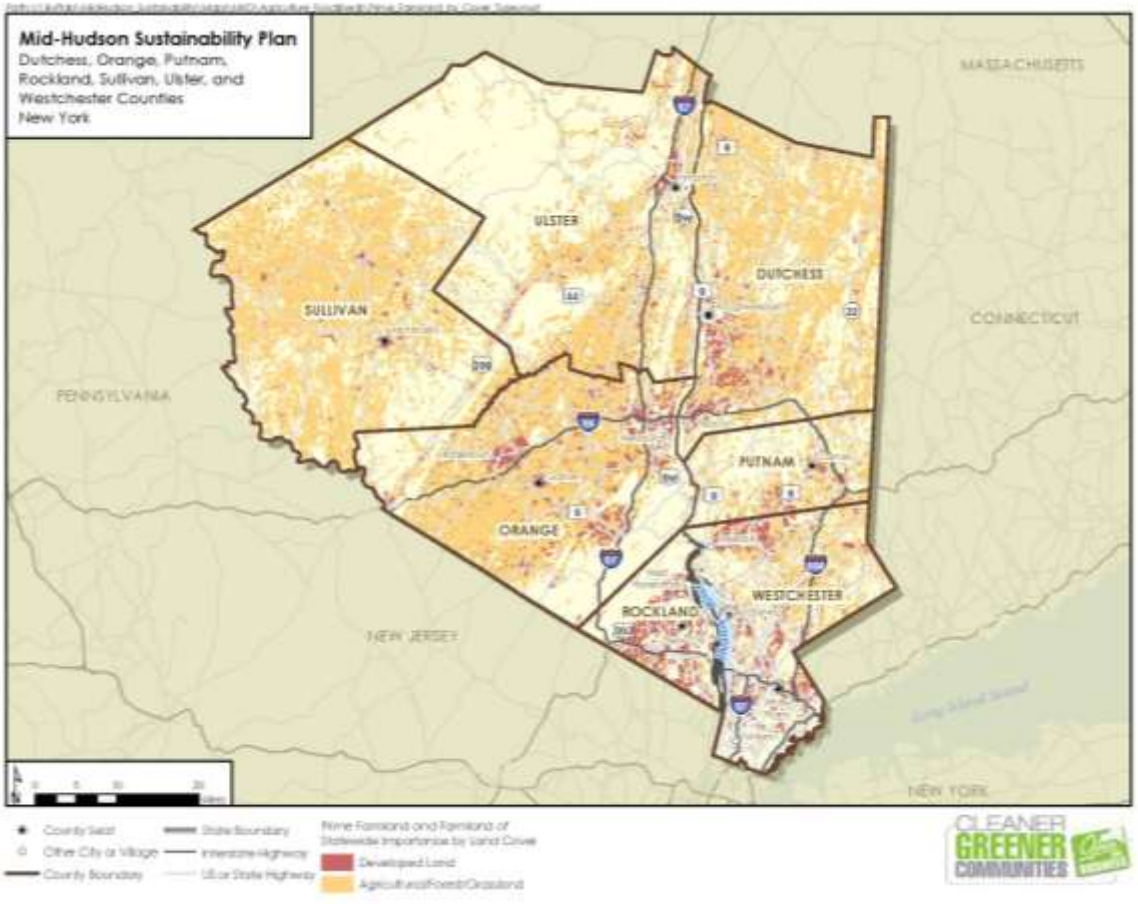


Figure 6.2 Prime and Statewide Important Farmland Soils by Land Cover

Despite efforts to maintain agriculture through the creation of agriculture districts, Census of Agriculture statistics show an approximate 16 percent loss of farmland between 2002 and 2007.

Agricultural Districts are designated as part of a statewide program intended to curb the conversion of agricultural land to non-farm use by providing a series of benefits to the properties they contain thereby reducing pressure to sell the land for non-farm development. Per the NYS Department of Taxation and Finance, these districts also:

- Limit unreasonable local regulation on farm practices
- Modify public agencies' ability to acquire farmland through eminent domain
- Modify the right to advance public funds to construct facilities that encourage development
- Require state agencies to modify administrative regulations and procedures to encourage continuing far businesses
- Provide *Right to Farm* provisions for protection from private nuisance suits for land in agricultural districts and parcels receiving agriculture assessments outside districts[86]

Agricultural lands within and outside of designated agriculture districts are eligible to receive a tax preferential agricultural assessment; however, the encumbrance period is eight years for those properties not located within an agriculture district. Under either scenario, eligibility for the agriculture assessment is based on a combination of criteria involving both land quantity and gross revenue and must be applied for and met separately from the agriculture district qualification. For lands under agricultural production of greater than seven acres gross receipts must be greater than $10,000. Land under seven acres are eligible for the preferential tax treatment; however, gross receipts must be greater than $50,000 for the property to qualify.

These protections require that agricultural properties within the district be encumbered for a period of five years or be subject to a payment for conversion to non-agriculture use.

Agricultural Economy

The number of farms and total land area occupied by farming in the Region continues to decline, while the total market value of products sold in the Region increases (see Table 6.2). Incomes varied widely among counties, with some counties averaging net losses (see Table 6.3). While overall net income did not increase significantly from 2002 to 2007, average net income per farm operator did. Harvested cropland decreased over that period. The total

[86] New York State Department of Finance, Agricultural Assessment Program Overview: http://www.tax.ny.gov/research/property/assess/valuation/ag_overview.htm; (accessed 9/20/2012).

number of farms decreased across all sectors (see Table 6.4). This means that while the number of farmers and acres of farmland dropped, the value of agricultural goods increased.

TABLE 6.2 AGRICULTURAL ECONOMY – CROPS AND DIARY, 2007

County	Crop Sales	Dairy Sales	Total Value of Land, Buildings and Equipment
Dutchess	23,408,000	9,004,000	631,563,472
Orange	51,180,000	14,800,000	483,076,020
Putnam	1,299,000	(D)*	83,320,288
Rockland	(D)*	0	15,408,723
Sullivan	2,088,000	7,468,000	202,352,323
Ulster	58,859,000	2,642,000	346,210,409
Westchester	5,517,000	(D)*	282,252,760
Region	142,351,000	33,914,000	2,044,183,995

Source: 2007 Census of Agriculture
D* Withheld by USDA to avoid disclosing data for individual operations.

TABLE 6.3 AGRICULTURAL ECONOMY – NET CASH INCOME, 2007

County	Net Cash Income - County Totals	Net Cash Income Per Operator – Average Per Farm
Dutchess	-5,825,000	-8,879
Orange	4,669,000	7,273
Putnam	-1,588,000	-22,051
Rockland	1,083,000	51,549
Sullivan	2,414,000	7,474
Ulster	14,316,000	28,575
Westchester	297,000	2,803
Region	15,366,000	66,744

Source: 2007 Census of Agriculture

The breakdown of agricultural receipts by activity type is presented in Table 6.3.

TABLE 6.4 MID-HUDSON AGRICULTURAL ECONOMY – ALL FARM TYPES, 2007[87]

NAICS Category	Farms (2002)	Farms (2007)	Sales (2007)
Oilseed and grain farming	96	22	$7,671,000
Vegetable and melon farming	429	216	$38,308,000
Fruit and tree nut farming	334	170	$46,945,000
Greenhouse, nursery, and floriculture	468	206	$85,271,677
Other crop farming	1031	529	$5,570,000
Sugarcane farming, hay farming, and all other	1030	529	N/A
Beef cattle ranching and farming	350	176	$5,677,000
Cattle feedlots	59	20	N/A
Dairy cattle and milk production	307	125	$33,914,000
Hog and pig farming	32	12	$213,000
Poultry and egg production	170	122	$29,831,000
Sheep and goat farming	189	88	N/A
Animal aquaculture and other animal	1246	635	N/A
Total	**4711**	**2321**	

In general, sales figures vary widely year-to-year due to variations in production and prices, making it difficult to characterize. Despite this, farms contribute significantly to the local economy as they tend to spend within their community and utilize $.29 in services for every

[87] Source: 2007 Census of Agriculture

$1.00 earned in taxes. Based on research by Cornell University; the total gross economic impact of farming in the greater Hudson Valley in 2007 was $810 million (CITE).

The impact of agriculture on the Region's economy is greater than may appear because agriculture includes activities far beyond farming. The broader agricultural infrastructure consists of:

- Support services – veterinarians, fuel and feed suppliers, equipment repair services
- Processing – cleaning, freezing, packaging, and more
- Aggregation – bulk buyers that need large quantities of product, in many cases more than any individual farm can provide
- Storage – to keep perishable fruits, vegetables, and meats fresh
- Slaughter facilities
- Distribution

Sustaining agriculture in the Mid-Hudson Region will have a multiplier effect amplifying its economic contribution far beyond farm receipts alone.

The Local Food Movement in the Mid-Hudson Region

Nationwide, the local food movement has led to an increase in the demand for locally grown agriculture. The Mid-Hudson Region has taken advantage of this increase in demand by expanding direct marketing and other local sales efforts in the Region and to the NYC metro area. Demand is strong – in 2007, the New York Industrial Retention Network conducted a survey of food manufacturers that found that there was an interest in increasing the amount of locally grown ingredients in their products[88].

While demand is strong, small and medium sized farms have a difficult time getting their products to the distributors and processors needed in order to sell their goods locally[89]. This limits the ability of small and medium sized farms to break into lucrative markets like that of NYC. According to the USDA 2007 Census of Agriculture, small and medium sized farms make up the majority of farm operations in the Region[90]. This then greatly impacts the economic viability and sustainability of agriculture in the Region.

[88] http://www.agriculture.ny.gov/ap/ftf/fsmipnyfarm-to-factory-final-report.pdf
[89] http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5097957
[90] http://www.newpaltz.edu/crreo/crreo_brief_5_summer_2011.pdf

One of the more widely supported methods for helping bridge the gap between distributors, processors, and small and medium farms is through the use of Food Hubs. Food Hubs are businesses or organizations that actively manage the aggregation, distribution, and marketing of source-identified food products from local producers to strengthen their ability to satisfy wholesale, retail, and institutional demand[91]. In the Mid-Hudson Region, there are two such food hubs and in NYC there are three[92].

Challenges Facing Agriculture in the Region

Agriculture continues to thrive in the Mid-Hudson Region, despite considerable challenges. Action is needed to sustain the industry, for example:

- Counties and municipalities need to continue to implement planning policies that help curb infringement on agricultural landscapes on a regional level
- New methods are needed so that landowners, land trusts, and agencies work together to protect land from development and help farmers access needed resources
- Investment in infrastructure needs to be sustained to expand value-added processing and facilitate market access
- Farm businesses need support through policies and programs that enhance their economic viability
- Increased integration is needed between agriculture and processors and retailers of food products
- Facilitating access to land for new farmers

Additionally, while proximity to NYC brings opportunities for marketing farm products, it is accompanied by factors that do not favor agricultural businesses:

- The high costs of business – supplies, labor, land, taxes
- Competition for labor
- Pressure from land development for non-agricultural uses

Finally, intergenerational transfers are a challenge. The average age of farmers in the Region has been increasing. This reflects a trend of children of farmers seeking employment outside of agriculture due to:

---

91 http://www.ngfn.org/resources/food-hubs
92 http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5091437 (POSSIBLY USABLE GRAPHIC)

- Disparate earning potential
- Difficult working conditions
- The high level of capital investment required to start or continue a farm business
- The inherent risks to agriculture from weather
- Fluctuations in demand and prices for farm products

6.1.2 Open Space

Much of the Region's preserved land and large, natural open spaces are located in a greenbelt through the Hudson Highlands in southeast Orange and northwest Putnam counties, in the Catskill Forest Preserve of northwest Ulster and Sullivan counties, and along the Shawangunk Ridge in Ulster, Sullivan and Orange counties[93]. These lands, combined with the agricultural land discussed above, contribute to the Region's rural character and natural beauty.

According to Scenic Hudson, the Region has 618,100 acres of preserved land, representing 21 percent of total land area. This land is protected from development either through public ownership of its development rights or through land conservation easements, which restrict certain uses on the land[94].

According to US Forest Service data, total forest land in the Region is approximately 1.8 million acres, or 62% of total land area (see Table 6.5). As noted in Chapter 3, estimating regional forest cover can be challenging due to inherent data and methodological limitations, which give widely divergent results. Forests in the Region are primarily mixed deciduous – the canopy species composition is presented in Figure 6.3 below.

TABLE 6.5 MID-HUDSON REGION FORESTED AREA BY COUNTY, 2005-2010[95]

County	Acres of Forest
Dutchess	292,392.09
Orange	270,847.85
Putnam	83,633.90
Rockland	33,604.18
Sullivan	395,867.26
Ulster	551,936.90

[93] Scenic Hudson. 2012. Protected Land.
[94] Ibid.
[95] http://fia.fs.fed.us/tools-data/default.asp

Westchester	130,782.72
Total	1,759,064.92

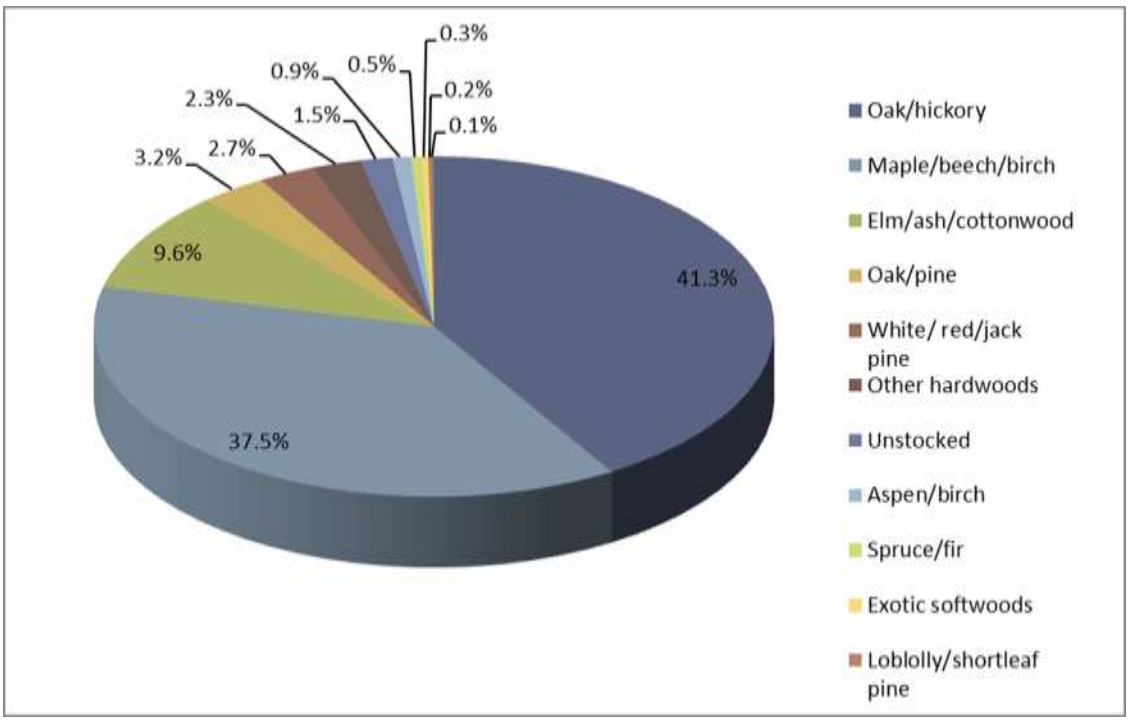


Figure 6.3 Mid-Hudson Region Forestland by Forest Type, 2005[96]

As shown in Figure 6.4, the Region's forests range from large, contiguous patches in the Catskill Mountain Preserve and the Hudson Highlands greenbelt, to small, disconnected patches in the south and east. The average size of a contiguous patch of forest in the Region is only 33.6 acres, largely due to fragmentation in the more developed areas. In Ulster County, where there are proactive measures to conserve forest in the Catskill and Shawangunk areas, the average patch size is 79.6 acres[97].

Large patches of connected forests provide essential habitat, helping conserve biodiversity while also providing multiple ecosystem services (stormwater retention, pollutant mitigation, etc.). Larger forests are also better able to handle the impacts of fires, floods, and wind damage. Forest fragmentation, particularly in the south and east parts of the Region, presents

[96] Source: U.S. Forest Service Forest Inventory Analysis National Program, Forest Inventory Data Online (FIDO) accessible at: http://fia.fs.fed.us/tools-data/default.asp
[97] New York State Department of Environmental Conservation. 2012. Forest Fragmentation

challenges for biodiversity and ecosystem resilience, as does the increasing encroachment of roads and utilities into forests throughout the Region.

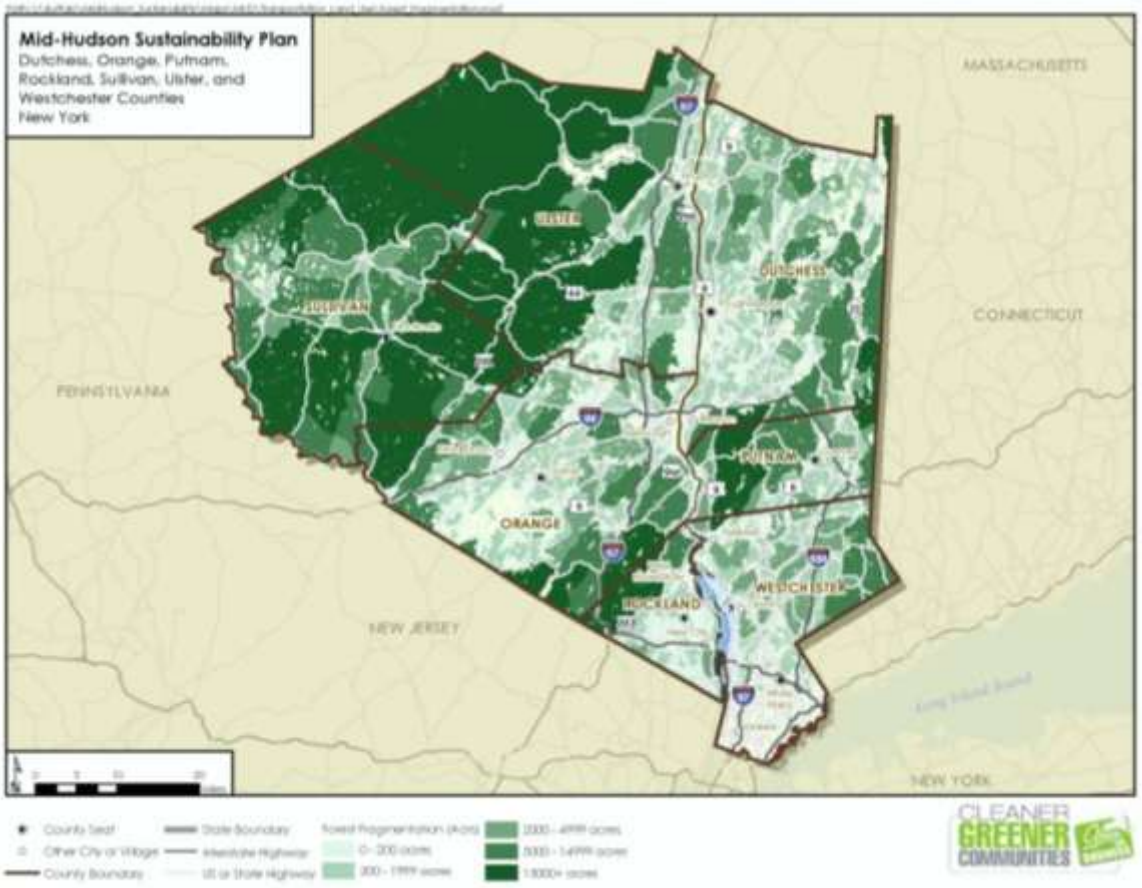


Figure 6.4 Forest Fragmentation

In addition to providing valuable habitat, forests also have a number of economic and recreational benefits. For example, forest-based manufacturing and forest-related recreation and tourism produced over 8.8 billion dollars for the NYS economy in 2005[98]. Hunting is a popular pastime in the Region, generating economic benefits and a source of game. Maple

[98] North East State Foresters Association. "The Economic Importance and Wood Flows from New York's Forests, 2007." 2007.

syrup production is another example of an economic benefit of forests. In 2012, NYS produced more maple syrup than any state in the US except Vermont[99].

6.2 Climate Change, Agriculture, and Open Space

6.2.1 GHG Emissions

Agriculture

The agriculture sector in the Mid-Hudson Region generates non-carbon dioxide GHG emissions from enteric fermentation in livestock, livestock manure management, and agricultural soil management (including fertilizer application). Among these, the largest single source is from enteric fermentation.

Livestock emit GHGs as a by-product of digestion. Enteric methane (CH_4) is generated during digestion by grazing animals, especially by ruminants such as dairy and beef cattle. Methane is also generated by manure. The amount of methane produced is a function of the type of animal, the type of feed the animals eat, and how the manure is stored and handled. Since methane from manure and digestion is an inevitable result of livestock, methane production is unavoidable without eliminating the livestock industry altogether.

Agriculture emissions are approximately 136,934 $MTCO_2e$ (see Table 6.6). Orange County, with the highest population of dairy and beef cows, generates the most emissions in the Region, accounting for 30 percent of agriculture emissions. Note that although the agricultural sector is a source of GHG emissions, emissions per acre are significantly less than those associated with other land uses such as residential, commercial, and industrial development.

TABLE 6.6 AGRICULTURE GHG EMISSIONS BY SOURCE ($MTCO_2E$), 2010

County	Enteric Fermentation	Manure Management	Agricultural Soils	Total	Percent of total
Dutchess	16,432	2,690	13,192	32,315	24%
Orange	21,003	4,673	15,111	40,787	30%
Putnam	8,176	882	3,785	12,844	9%
Rockland	8,176	882	6,163	15,222	11%

[99] US Department of Agriculture. "National Agricultural Statistics Service ." *County Profile*. 2007. www.agcensus.usda.gov

TABLE 6.6 AGRICULTURE GHG EMISSIONS BY SOURCE ($MTCO_2E$), 2010					
County	Enteric Fermentation	Manure Management	Agricultural Soils	Total	Percent of total
Sullivan	12,221	2,315	5,347	19,883	15%
Ulster	-	14	3,234	3,248	2%
Westchester	-	1	12,635	12,636	9%
Total	66,008	11,458	59,202	136,934	100%

Note: Totals may not sum due to independent rounding.

Please note that the figures in Table 6.6 do not include GHG emissions associated with energy use on farms, nor do they include emissions generated during processing or transportation of agricultural goods. These emissions are included in the energy and transportation sector GHG emissions. By increasing consumption of local agricultural goods within the Region, transportation emissions can be reduced.

Open Space

Changing land use patterns unavoidably affect GHG emissions. The harvest of trees affects GHGs through the reduction of the carbon storage capacity of the ecosystem. Forests and many wetland systems act as carbon sinks, removing carbon from the atmosphere and sequestering it for a long time. Emissions due to land use change are discussed in Chapter 3.

6.2.2 Climate Change Vulnerability

Agricultural Vulnerabilities

Climate change has the potential to alter local and global food systems. NYSERDA[100] notes that "*farmers will be on the front lines of coping with climate change, but the direct impacts on crops, livestock, and pests, and the costs of farmer adaptation, will have cascading effects beyond the farm gate and throughout the state's economy*". Table 6.7 summarizes the climate impacts and effects related to food systems and agriculture expected in the Mid-Hudson Region.

TABLE 6.7 SUMMARY OF CLIMATE IMPACTS RELATED TO FOOD SYSTEMS AND AGRICULTURE			
Asset	Climate Impacts	Climate Effect	Description
Farmland	Sea level rise; Flooding	Crop loss from flooding	More farmland in the Region may suffer increasing damage

[100] NYSERDA. "Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation in New York State." Technical Report, 2011.

TABLE 6.7 SUMMARY OF CLIMATE IMPACTS RELATED TO FOOD SYSTEMS AND AGRICULTURE

Asset			Climate Impacts	Climate Effect	Description
					from flooding
			Increase annual average temperature	Pests / Invasive species	Warmer temperatures could allow invasive species and destructive pests to expand their range and have longer breeding seasons.
				Increased irrigation demand	A warmer climate will lead to higher evaporation rates and a longer growing season—two factors that may increase the need for irrigation.
Animal Agriculture			Extreme heat	Heat Stress and Reduced Productivity	More extreme heat events will increase heat stress in cows, lowering their productivity.
			Increase annual average temperature; Extreme heat; Drought; Flooding	Changes in feed availability and price	Longer growing seasons could increase feed production and drive down prices. However, heat stress, late summer drought, and heavy precipitation could decrease yields and drive up prices.
Produce			Extreme heat; Increase annual average temperature	Changes in fruit and vegetable yield; Longer growing season	Many of the high-value crops that currently dominate the Region's agricultural economy such as apples, cabbage and potatoes, could experience a decline in yield and quality as a result of climate change.
Farmers	Variability in the system	Crop and monetary losses	Variation in the climate system will cause growing seasons to fluctuate year to year and production will be difficult to predict. This will make an already high risk endeavor in Agriculture business and make it much that much more difficult to have success with		

Food prices

Despite the emphasis on local food production, the vast majority of food consumed in the Mid-Hudson Region comes from other parts of the US and the world. While NYS could experience improved agricultural conditions because of climate change, much of the US' food production

may suffer. In a global economy this may lead to a sharp increase in food prices worldwide. Figure 6.5 shows how prices have already risen in the last decade.

A higher cost of food can place a financial burden on low-income families and individuals. Based on data from the 2008 –2010 American Community Survey, approximately 7% of households in the Region receive Food Stamp/Supplemental Nutrition Assistance Program (SNAP) benefits.

While prices may increase, a warmer climate may provide benefits to local food production. A warmer climate will lengthen the growing season, increase production and may even expand the variety of crops that can be grown. Types of food produced will need to adjust as the climate shifts. Agriculture may be impacted due to increased frequency and severity of extreme weather – this is especially true of farms lying in floodplains.

Open Space Vulnerabilities

Table 6.8 summarizes potential climate impacts to open space in the Mid-Hudson Region.

Land on either side of the Hudson River is often preserved as open space for both recreational opportunities and ecosystem and habitat preservation. As sea level rise and flooding encroaches on these areas, they will be squeezed between the rising river and development on the other side. This could limit waterfront access and impact important natural areas.

Figure 6.5 Food Prices (2001 -2010) from International Monetary Fund 2011

TABLE 6.8 SUMMARY OF OPEN SPACE RELATED CLIMATE EFFECTS

Asset	Climate Impact	Climate Effect	Description
Natural Habitat & Biodiversity	Increased temperature; Altered precipitation patterns	Shifts in species habitat and range; Change in forest composition; Spread of invasive species; Reduced water quality	Species composition will likely change as species migrate north; this includes an increase in invasive species. Species unable to migrate may become extinct. Forest composition is likely to change with implications for economically vital species such as sugar and red maple. Warmer water temperatures result in decreased water quality and diminished habitat for cold water species.
	Extreme heat and weather	Damage to habitat	Additional stress on habitats could impact the ability of species, communities, or habitat to recover. Species already vulnerable from non-climate stressors would be especially impacted.
	Reduced Snow Cover	Damage to habitat; Trophic cascades; Altered food web structure	Small mammals depend on snow cover for insulation and protection from predators. A decline in small mammals impacts predator populations but benefits large herbivores by reducing competition for vegetation.
	Flooding; Sea level rise	Damage to wetlands, shoreline, riparian areas	Inundation, changes to in salinity, and more frequent flooding can alter habitat suitability of wetlands. Inundation and more frequent flooding will cause land owners to harden shorelines, eliminating valuable shoreline habitat.

Changes in temperature and precipitation can impact the suitability a particular area for certain ecological communities. Due to a warming climate, extirpation (local extinction) of species may occur, changing the species composition of forests and other ecosystems. As species migrate northward, the Mid-Hudson Region could see an increase in species more typical of southern climates. Warmer temperatures will increase the primary productivity (the amount of energy converted into biomass that supports the food chain) in some natural systems, while causing heat stress for plants and animals in others. Warmer temperatures could also have negative effects on aquatic systems by lowering dissolved oxygen levels, creating water temperatures too warm for cold water species of fish, and by increasing harmful algal blooms. Lower stream flows during periods of drought could also have harmful effects on aquatic habitat (see Chapter 7).

Reduced snow cover in winter has negative implications for small mammals that depend on the insulation and protection provided by the snow. These small mammals are an important part of the food chain; if their population declines, so will their predators'. Vegetation typically consumed by these small mammals will flourish. Reduced snow cover will also expose more plants for grazing in the winter, benefiting the deer population.

Rising sea levels and flooding could also inundate or damage critical wetland areas. Other potential climate risks to natural areas and biodiversity include more extreme weather events and climate variability. However, it is difficult to predict the exact effects of these climate hazards on ecosystems and individual species given the complex relationships among species and their environment.

It is likely that the Region will experience a change in composition of the forests stands and the species they support. Among the trees expected to decrease are sugar maple and coniferous trees. The loss of the sugar maple could impact maple syrup production. Because maple syrup production depends on alternating freeze/thaw days to induce sap flow, warm years can cause this process to begin earlier and last for a shorter period of time[101]. In 2012, maple syrup production in NYS decreased by 36 percent from 2011 due to warmer temperatures[102].

Forests and agricultural landscapes in the Mid-Hudson Region are also likely to face invasive species, pests, and pathogens whose ranges are currently constrained by colder winter temperatures. One example of such a species is the hemlock wooly adelgid (native to parts of Asia). As of 2012, the hemlock woolly adelgid was found throughout the Region except for a few pockets in Sullivan County. This particular pest thrives in a warmer climate and can decimate hemlocks.

6.3 Objectives

AO1: Increase agriculture/silviculture activities in the Region

[101] NYSERDA. "Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation in New York State." Technical Report, 2011.

[102] US Department of Agricultural. "National Agricultural Statistics Service ." *County Profile.* 2007. www.agcensus.usda.gov

- Through a combination of land use policies, programs, and investments, agriculture and silviculture activities in the Mid-Hudson Region can be maintained and expanded. Agriculture and silviculture activities provide multiple economic and environmental benefits, including jobs and access to local food for the Region and nearby NYC. Land that remains in agriculture or managed forest provides scenic, recreational, and/or tourism benefits. Numerous studies, including those by Glynwood[103] and the American Farmland Trust[104], have documented the importance of agriculture to the Region.

AO2: Improve access to sustainable agriculture[105]/silviculture training and technologies

- Increased adoption of sustainable agricultural and silvicultural practices is necessary to improve water quality, conserve soil resources, and reduce exposure to potentially harmful chemical compounds. Farmers need access to affordable teaching programs and training facilities. Some sustainable practices will require a shift in techniques that farmers have spent generations perfecting while others may require the use of new technology. Sustainable farming practices may include:
    - Residue management including mulch tillage and no-tillage
    - Comprehensive nutrient management plan implementation
    - Agricultural energy management programs
    - Use of new technology such as GPS-guided variable rate irrigation systems
    - Crop rotation and use of cover crops

---

[103] "The State of Agriculture in the Hudson Valley," prepared for Glynwood, a non-profit based in the Mid-Hudson Region

[104]At a Crossroads: Agricultural Economic Development in the Hudson Valley," prepared for the American Farmland Trust in 2003

[105] "The term sustainable agriculture means an integrated system of plant and animal production practices having a site-specific application that will, over the long term:

- satisfy human food and fiber needs;
- enhance environmental quality and the natural resource base upon which the agricultural economy depends;
- make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls;
- sustain the economic viability of farm operations; and
- enhance the quality of life for farmers and society as a whole."

Source: http://www.nal.usda.gov/afsic/pubs/terms/srb9902.shtml

AO3: Increase intra-regional consumption of food/fiber

- Increasing access to local foods will increase consumption of local food. Local food consumption not only supports the Region's economy, it can also lower farm transportation costs and associated GHG emissions, thus enhancing the viability of farm activity and reducing environmental impacts.

AO4: Reduce GHG emissions from farm and farm-related activities

- This can be accomplished by:
  - Increasing feed conversion efficiency
  - Improving manure management
  - Enhancing local market penetration (see AO3)
  - Energy efficiency retrofits
  - Energy production using agricultural waste products, solar, and other renewables

AO5: Maintain the economic viability of agriculture/silviculture in the Region

- The economic viability of farms has been threatened by the encroachment of populated areas and corresponding increases in property taxes, rising energy costs and needs, as well as limited access to value-added facilities and distribution. To reverse this trend, multiple coordinated efforts are needed including a mixture of policy initiatives, targeted investments and incentives, as well as educational outreach. Investment is needed to create food hubs to serve the small and mid-sized farms of the Region, fostering economic development.

AO6: Decrease forest fragmentation and increase open space

- Reducing forest fragmentation can help maintain biodiversity and preserve valuable ecosystem services such as stormwater mitigation. Large, contiguous open space also provides valuable recreational opportunities such as hiking, hunting, and cross-country skiing. Efforts to increase open space in the Region should seek to connect existing parcels and create larger patches or corridors of protected land.

6.4 Indicators

Table 6.9 presents a series of sustainability indicators for the agriculture and open space focus area. These indicators should be used by counties and municipalities to track performance in achieving the Region's sustainability objectives.

6.4.1 Metrics and Targets

TABLE 6.9 INDICATOR INVENTORY – TIER 1 INDICATORS

Objective	Metric	Current Value	Target – 2020	Target – 2035	Target – 2050
AO 1. Increase agricultural/silvicultural activities	Acres of farm land	323,154 ac (2007) 2321 farms (2007)	332,700 2369	342,700 2440	352,000 2520
AO 2. Improve access to sustainable agriculture/ silviculture training and technologies	Vocational and secondary training programs related to agricultural science and technology	n/a	n/a	n/a	n/a
AO 3. Increase intra-regional consumption of food/fiber	Number of farmer markets	138	Same	Increase by 10%	Increase by 20%
	Number of municipal markets	76	Same	Increase by 10%	Increase by 20%
AO 4. Decrease greenhouse gas emissions from farm activities	GHG emissions from farm activities ($MTCO_2e$)	136,934	Reduce by 10%	Reduce by 30%	Reduce by 50%
AO 5. Maintain the economic viability of agriculture/ silviculture in the region	Net cash farm income in the Region	$27,320,000	$46,000,000	$71,000,000	$97,000,000
	Net cash farm income per farmer	$11,770	$20,000	$30,000	$40,000
AO 6. Decrease forest fragmentation and increase open space	Average acreage of contiguous forest	33.6 (2010)	34	38	45
	Square miles of land preserved from development per capita	966 (2012)	1,000	1,050	1,100

TABLE 6.10 INDICATOR CALCULATIONS AND DATA		
Metric	**Calculation**	**Data Source**
Amount of farm land	Acres	County Government, LULC Dataset, American Farmland Trust, USDA Ag. Census, Farm Service Agency
Vocational and secondary training programs related to agricultural science and technology	n/a	
Number of farmer and municipal markets[3]	Number of markets	County Tourism Offices of Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster and Westchester Counties
GHG emissions from farm activities ($MTCO_2e$)	See Appendix C	Mid-Hudson Regional Sustainability GHG Inventory
Farm proprietor income	Total receipts for all farms in the region and net cash farm income per farm	USDA Census of Agriculture
Average acreage of contiguous forests	Average acreage of contiguous forests	NYSDEC
Square miles of land protected from development per capita	Total square miles of protected land divided by the total population	Scenic Hudson

6.4.2 Limitations and Tier 2 Indicators

The primary source for much of the data presented in this Chapter is the USDA Census of Agriculture. The Census is published every five years – data presented in the Plan come from 2007, as 2012 data are not yet available.

For AO2 and AO3, there are limited available data that would allow for effective tracking of performance. For example, no information is available at the regional scale regarding enrollment or participation in sustainable agricultural education and training programs. For AO3, information is available regarding the number of farmer and municipal markets in the Region; however, little is known about the myriad other ways in which local consumers access locally-produced food products (e.g., through retailers, Community Supported Agriculture (CSA) programs, and more). The number of markets is, at best, a proxy measure for objective AO3.

Finally, as noted above, the GHG emissions data does not include many farm-related sources of emissions, such as on-farm energy use, transportation emissions, and more. These emissions are calculated as part of total energy and transportation-related GHG emissions, making it impossible to distinguish the contribution of the agricultural sector.

Additional metrics that, if available, would facilitate planning and investment decisions are noted in Table 6.11.

TABLE 6.11 TIER 2 INDICATORS

Objective	Metric (units)
AO 1	Deed restricted farmland (acres)
AO 1	Loss of prime agricultural soils
AO 1	Timber lost to disease
AO 1	Farm employment
AO 2	Precision agriculture
AO 2	Education and training
AO 2	Sustainable forestry
AO 1, AO 2	Value added production facilities
AO 4	Fuel consumption
AO 4	Farm energy usage
AO 4	Agriculture and forest bi-products used for energy

AO 4	Manure storage with covers and capture/flare of methane
AO 4	Implementation of energy audit recommendations

6.5 Priorities for Implementation

6.5.1 Food Infrastructure Networks

The Region's agricultural economy depends on production and distribution networks to process and deliver food from farm to table. The Region's production and distribution networks are currently inadequate to meet the supply of local agriculture[106]. This especially hurts small and medium sized farms that do not have the capacity to set themselves up as distributors for their goods. One such method for dealing with this is through the creation of food hubs. Food hubs provide an efficient means for small and medium sized farms to get their goods to market. For example, the Farm-to-table co-packers in Kingston repurposed an existing facility (through adaptive reuse) to create a full service contract packaging facility that produces everything from frozen vegetables and soups to jarred pickles and sauces. Their facility has been very successful in working with local farmers to get their product to tables around the Region.

Example Project

Value Added Processing for Regionally Grown Produce

The objective of the Hudson Valley Food Hub – Phase II project is to expand the infrastructure of two successful food processing and distribution firms in order to meet the growing demand for local healthy food grown by New York State Farms and HV farms in particular.

This food hub is responsible for aggregating, processing, and distributing multiple products across multiple markets from farms as small as 4 acres to farm cooperatives of thousands of acres. Currently the Farm to Table facility serves over 60 regional farms and over 40 private label customers.

The project proposes to:

[106] http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5062654

1) Expand freezer/cooler capacity and upgrade processing capabilities at Farm to Table CoPackers
2) Purchase warehousing and office equipment to improve product handling and logistical efficiency
3) In addition, Hudson Valley Harvest will purchase trucks and distribution equipment to increase distribution capacity.
4) Hudson Valley Harvest is also investing in its New York City sales depot as part of this project.

Food Hub and Training Facility

As promoted by the Friends of Hilltop Hanover Farm & Environmental Center, this training center would help to build and sustain the local food system through the expansion of the existing Westchester Community College Agricultural Certificate Program. The program would turn the Hilltop Hanover Farm into a local food hub that would aid in distribution while also providing on-the-job training regarding equipment, resources, and markets to help teach farmers about sustainable agriculture.

This two-year program would aim to train 5-7 farmers per year and provide graduates with the opportunity to work at new satellite farms throughout the Region both as part of their training and post-graduation.

6.5.2 Energy Efficiency and Renewable Energy in Agriculture

Agriculture in the Region represents a large energy consumer. Projects need to increase the efficiency of farm processes as well as develop alternative energy sources that may be used to reduce the reliance of farm operations on the grid. Projects may include energy audits that culminate in recommendations for upgrades in equipment or practices that may lead to higher efficiency. Additionally, projects may focus on production or use of alternative fuel sources like pelletized fuel that may be burned to provide heat or electrical energy. Facilitating the integration of solar technology into farms is of great importance, as farmland represents a significant quantity of open space. The creation of regional centers for alternative fuel processing may help increase the scale of fuel production. Outreach to help farmers sort through NYS' numerous energy efficiency programs would help increase the use of existing programs throughout the Region.

Example Project

Energy Efficiency and Renewables Training Center for Farmers

As championed by the Cornell Cooperative Extension (CCE), the Energy Efficiency and Renewables Training Center for Farmers would work with farmers through existing networks to increase the rates of energy efficiency and alternative fuel use by farmers in the Region. The Center would work with farmers to help them determine which renewable energy programs would benefit them the most.

6.5.3 Priority Conservation Areas

Priority conservation areas are those sites that have been identified as having particular strategic value in terms of meeting this Plan's objectives, be it as habitat, flood buffer, natural or cultural heritage, or other use, and thus merit protection from development into an alternative use. The properties are thus high priority for conservation, under the numerous mechanisms available to protect open space (purchase of development rights, permanent easement, zoning restrictions, etc. – see p. 5 of the NYS Open Space Conservation Plan[107] for a more comprehensive listing). An example could be a series of properties that connect large tracts of already protected forest area; through conservation, these properties could serve as a habitat corridor, helping protect biodiversity.

Periodically, NYS updates its Open Space Conservation Plan – the last version was published in 2009. In addition to this plan, each County in the Mid-Hudson Region has its own open space plan, along with corresponding land acquisition programs. Many municipalities within the Region also have open space plans establishing their priority conservation areas.

Example Projects

Black Creek Corridor Climate Change Mitigation and Recreational Access Project

As promoted by Scenic Hudson, safeguarding the lands along this prominent creek and floodplain area will mitigate ecological and property damage from severe flooding.

The Black Creek corridor – located in the Towns of Lloyd and Esopus in Ulster County – contains seven ecologically valuable properties that are currently available for purchase, comprising over 1,300 acres identified in the NYS Open Space Plan.

The Black Creek Corridor consists of approximately 6.5 miles of wetlands, vernal pools, hardwood swamps, waterfalls, dense woods, meadows and rock ledges that are critical

[107] http://www.dec.ny.gov/docs/lands_forests_pdf/osp09complete.pdf

breeding ground for migratory waterfowl and potential habitat for several endangered species. The properties are also within the state-recognized Grand Pond/Chodikee Lake Biologically Important Area (BIA). The A rating assigned the BIA by NYSDEC means these wildlife habitats are of the highest importance. Other properties are part of the highly-valued Plutarch/Black Creek Wetlands Complex.

Permanent protection of these lands helps to ensure clean drinking water, recreational opportunities for paddlers on the creek and hikers. Conservation of these lands would complement and build upon the State's acquisition and establishment of the Black Creek State Forest in 2011.

Quassaick Creek Multi-Purpose Conservation Corridor

As suggested by the Newburgh Community Land Bank, the Quassaick Creek Multi-Purpose Conservation Corridor is a multi-phase plan that involves developing a 3.1 mile multi-purpose conservation corridor. The plan calls for smart growth strategies to be combined with green infrastructure so as to create numerous demonstrations of sustainability in action, including urban gardening, micro hydropower, and land conservation.

This project is especially important as it can act as a model for future endeavors. Many communities in the Region are built along similar small tributaries and creeks that can serve as the backdrop for beautiful mixed use waterfront property. These areas would hold the promise of creating walkable city centers containing community gardens and cycling paths thus fulfilling smart growth goals while preserving the land from development and maintaining biodiversity and ecosystem services.

Over time, this project will be tracked and its impacts measured so as to provide progress tracking of the different phases over time.

6.6 Enabling Strategies

6.6.1 Sustainable Agriculture Education and Training

Historically farming has been a trade handed down from generation to generation requiring a lifetime of learning. Some sustainable agriculture practices require a shift in the techniques that farmers have spent generations perfecting. Others may require the use of new technology that is complicated or difficult to learn. In order to obtain Region-wide adoption of sustainable

agricultural practices it is necessary to provide farmers with access to training programs and facilities.

Initiatives should focus on helping farmers learn best management practices for sustainable agriculture to help farmers in the Region stay on the cutting edge.

Climate change is a major challenge that will directly impact farmers. Educational programs that look to provide farmers better information on what they will be facing as a result of climate change will allow them to be proactive. This is especially important for industries like the maple syrup industry which may be impacted significantly by climate change.

Example Initiative

Rapid Response Training and Tools

As promoted by the Cornell Cooperative Extension (CCE), the Rapid Response Training and Tools program aims to help farmers adapt to extreme weather and climate change. CCE staff plan to first assess and determine the impacts of extreme weather on agricultural operations and then work to develop specific tools and strategies farmers can use to address those impacts.

One example of a tool already developed is Cornell's Adapt-N Tool for nitrogen management. This tool uses computer modeling and high resolution weather information to provide information on farm-level nitrogen needs. It not only saves the farmers money by noting exactly how much nitrogen fertilizer is needed to be applied, but it also helps prevent non-point sources of water pollution by limiting the runoff that occurs as a result of over fertilization.

6.6.2 Branding Mid-Hudson Agricultural Products

Projects in this category would work to strengthen the Region's agricultural branding, to create a connection between the food produced with the region and the farmers who grow it. Food distribution networks can then be set up around the local brand such that food from the Region is sold as a specialty, high value, and/or high quality good. Agricultural branding efforts should seek to align with other branding efforts going on throughout the Region, such

as the Hudson Valley Bounty program[108] and the Buy Pure Catskill[109] program, to ensure consistent messaging.

Example Initiative

INSERT

[108] www.hudsonvalleybounty.com
[109] http://www.buypurecatskills.com/

7 Water

This Chapter includes:

1. A review of the baseline conditions for water in the Region
2. A discussion of GHG emissions as well as potential climate change impacts
3. A presentation of objectives and indicators for water management
4. A review of priority projects, which include:
    a. Low Impact Development (LID) and green infrastructure
    b. Infrastructure upgrades to achieve water and energy efficiency and mitigate the impacts of climate change
5. A discussion of enabling strategies, including:
    a. Watershed management planning and programs
    b. Education and outreach
    c. Water infrastructure benchmarking

The relative abundance of both surface and groundwater, as compared with other parts of the country, is a primary asset of the Mid-Hudson Region. With effective water management the Mid-Hudson Region can competitively differentiate itself from other parts of the country, helping attract investment and improving the economy. For this reason, water management is a priority focus area when discussing the Region's sustainable development.

7.1 Baseline Conditions

As noted in the 2011 Regional Economic Development Plan, the Mid-Hudson Region includes *"The Catskills, Delaware River, and the Hudson River and its watershed[110], which provide spectacular scenery and abundant water supplies, and the Long Island Sound, which offers boating, swimming, fishing, and commercial activities."* The major watersheds of the Mid-Hudson Region are shown

[110] A watershed is the area delineated by terrain from which all surface and groundwater drains to a single point. Watersheds are also called drainage basins or catchments.

in Figure 7.1. Much of the watershed area that supplies New York City with drinking water lies within the Region.

Benefiting from approximately 40 inches of precipitation annually[111], the Region is also bisected by the Hudson River, which gathers water from a 12,000 square mile watershed. These watersheds replenish groundwater, which provides a critical drinking water supply for many residents. Groundwater is particular susceptible to pollution, because it is not frequently replenished like surface water. These sources result in a regional supply that exceeds demand, despite considerable withdrawals. In 2005, over 5 billion gallons per day of water were withdrawn, of which approximately 90% came from surface water sources[112]. These data include NYC withdrawals for public supply.

While supply generally exceeds demand, there are local areas where water scarcity, especially in dry weather, is a real concern. Conversely, flood risk is significant, both along the Hudson River and Long Island Sound, but also in upland areas such as the Catskills. Water quality is impaired in certain water bodies, including the main branch of the Hudson. These challenges underscore the need for effective watershed management.

Within the Region, a number of jurisdictions and organizations have prepared watershed management plans[113] and are currently at various stages of implementation. A selection of these plans and planning processes is listed in Appendix F. Despite these efforts, there is an inherent tension between planning at the regional scale and the home rule land use authority of local government. Most planning and zoning decisions are made by individual municipalities rather than at the watershed scale. In many cases, municipalities and other entities participating in watershed management have limited budgets and no authority to implement plan recommendations for the entire watershed.

---

[111] Fall 2010, Center for Research, Regional Education and Outreach, Discussion Brief #4, Hudson Valley Water: Opportunities and Challenges.

[112] United States Geological Survey (USGS) Estimated Use of Water in the United States, County-Level Data for 2005

[113] Watershed plans provide a framework for evaluating and prioritizing existing conditions, goals and needs, and prioritizing action items for managing and protecting water resources. Planning from a watershed level rather than a municipal level is more desirable for managing water resources and the impacts of water use on the natural environment; although administratively, more enforcement and planning tools are available to municipal entities than existing watershed entities in the Region. Watersheds usually do not fit neatly within political boundaries, so watershed planning entails collaboration among multiple political entities.

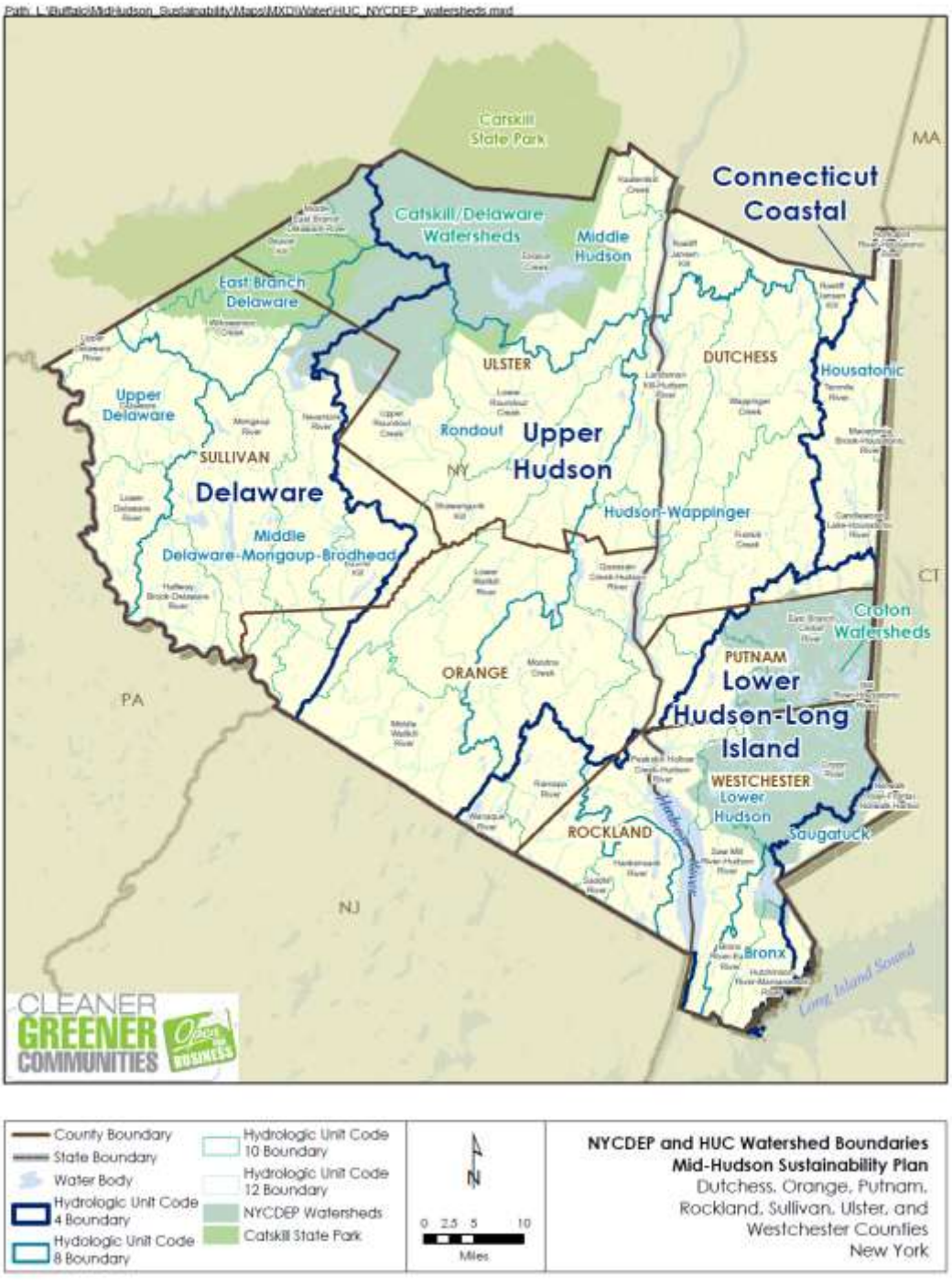


Figure 7.1 The Watersheds of the Mid-Hudson Region: Delaware, Upper Hudson, and Lower Hudson-Long Island

7.1.1 Water Use and Capacity

Water use is defined as "water that is withdrawn for a specific purpose, such as for public supply, domestic use, irrigation, thermoelectric-power cooling, or industrial processing[114]". Water that is removed from the available supply and not returned to its source watershed is said to have been used consumptively (or consumed)[115]. Reduced consumption directly increases the available water supply, can save energy required for treatment, reduce new infrastructure needs, and reduce impacts to stream flows and groundwater resources.

Water Demand

Approximately 70% of the Region's population is served by public water systems, with 30% of the population on self-supply (typically private groundwater wells)[116]. Table 7.1 shows the water withdrawals by sector in the Region. Note that these figures include withdrawals to serve NYC, which skews the data, particularly for Ulster County.

TABLE 7.1 WATER WITHDRAWALS PER SECTOR (MGD)[1]

County	Public Supply	Domestic Supply	Industrial	Irrigation	Livestock	Aquaculture	Mining	Thermo-electric
Dutchess	22.60	7.62	3.57	1.14	0.18	0.31	3.25	0.00
Orange	33.07	5.75	9.14	1.81	0.36	0.00	0.81	804.15
Putnam	105.23	4.91	0.71	0.44	0.00	0.00	0.09	0.00
Rockland	26.36	0.80	5.51	0.60	0.00	0.00	1.36	972.84
Sullivan	97.68	2.23	0.78	0.59	0.21	5.82	0.44	0.00
Ulster	458.33	6.89	1.43	1.63	0.09	3.33	0.77	0.00
Westchester	30.27	2.24	22.51	2.28	0.01	0.00	0.00	2471.68

[114] United States Geological Survey (USGS) Estimated Use of Water in the United States, in 2005, Circular 1344

[115] The amount of water used is typically less than water withdrawn (or water produced, in other parlance). A portion of the water withdrawn will not reach its end users due to losses during storage and distribution (leakage, evaporation, etc.). When water is withdrawn from an available supply, part of the withdrawal will evaporate, another part will return to the watershed from where it was withdrawn, and yet another part may return to another watershed or the sea.

[116] United States Geological Survey (USGS) Estimated Use of Water in the United States in 2005, County-Level Data. http://water.usgs.gov/watuse/

TABLE 7.1 WATER WITHDRAWALS PER SECTOR (MGD)[1]								
County	Public Supply	Domestic Supply	Industrial	Irrigation	Livestock	Aquaculture	Mining	Thermo-electric
Total	**773.54**	**30.44**	**43.65**	**8.49**	**0.85**	**9.46**	**6.72**	**4248.67**
Percent of Total	15.1%	0.6%	0.9%	0.2%	0.0%	0.2%	0.1%	83.0%

Notes
1. Source: *United States Geological Survey (USGS) Estimated Use of Water in the United States, County-Level Data for 2005*

7.1.2 Water Supply and Wastewater Infrastructure

Water and wastewater infrastructure include water sources (e.g., reservoirs and wells), collection systems for wastewater, treatment systems for potable water and for wastewater, and distribution systems for potable water. Regional infrastructure also includes stormwater infrastructure for drainage and, increasingly, treating and restoring water quality when water is returned to the local watershed – this is discussed later in the Chapter.

The Mid-Hudson Region has well-developed water and wastewater infrastructure, but considerable maintenance is needed to ensured continuing functionality. Over the next 20 years, NYS needs to spend at least $28.7 billion on drinking water treatment infrastructure[117] and $36.2 billion on wastewater infrastructure[118]. Many of these investments are to meet regulatory mandates to protect public health, such as the Disinfection Byproduct Rule and the Surface Water Treatment Rule, and are not expected to reap energy or water conservation benefits. The primary existing sources of funding for most municipalities to implement infrastructure projects are loans from the NYS Environmental Facilities Corporation and municipal bonds, which are another form of borrowing. The USDA Water Environmental

> "Much of the existing infrastructure is old and in need of repair or, in some cases, replacement… In 2008, for example, the Region's clean water and sewer infrastructure investment needs were estimated to be approximately $2.75 billion, with Westchester, Rockland and Putnam's request totaling about $1.4 billion alone."

[117] New York State Department of Health, 2008. Drinking Water Infrastructure Needs of New York State. http://www.health.ny.gov/environmental/water/drinking/docs/infrastructure_needs.pdf
[118] NYSDEC, 2008. Wastewater Infrastructure Needs of New York State. http://www.dec.ny.gov/docs/water_pdf/infrastructurerpt.pdf

Programs provide loans, grants, and loan guarantees for small municipalities with populations under 10,000[119]. Figure 7.2 shows a graphical representation of wastewater infrastructure needs for the Region. Capital improvement needs are weighted based on the population served by the individual facility, the condition of existing facilities, available financing, and the ability of the applicant to complete the project.

There is considerable potential to reduce water withdrawal through leak reduction and efficiency at water and wastewater plants[120]. Typical systems lose about 10% of their water to leakage. However, many of the needed upgrades require large capital expenses[121].

[119] USDA Water and Environmental Programs. http://www.rurdev.usda.gov/UWEP_HomePage.html

[120] USEPA, 2010. Control and mitigation of drinking water losses in distribution systems. Office of Water. http://water.epa.gov/type/drink/pws/smallsystems/upload/Water_Loss_Control_508_FINALDEc.pdf

[121] New York State Energy Research & Development Authority. 2010. Water & Wastewater Energy Management http://www.nyserda.ny.gov/Page-Sections/Commercial-and-Industrial/Sectors/Municipal-Water-and-Wastewater-Facilities/~/media/Files/EERP/Commercial/Sector/Municipalities/best-practice-handbook.ashx

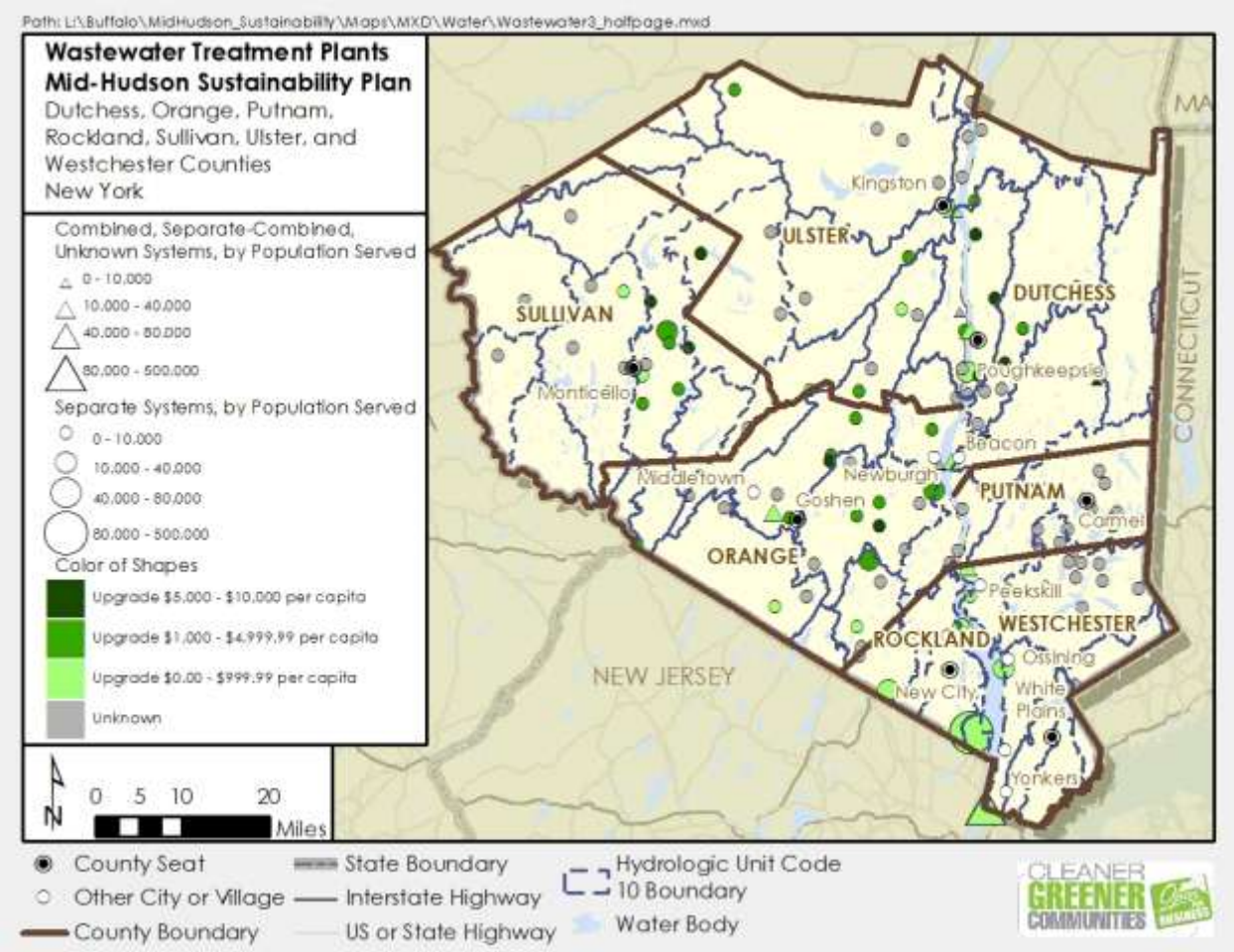


Figure 7.2 Wastewater Treatment Upgrade Needs

Wastewater Treatment

According to available county GIS data, approximately 12.5% of the Region's geographic area is serviced by sewers. These data are limited, and are not adequate for detailed mapping of sewer service areas. Based on the assumption that the sewer areas correlate with the population on public water supply, then approximately 78% of the Region's population lives within an area served by sewer, and approximately 22% of the population uses septic wastewater treatment.

Energy Consumption for Water and Wastewater Treatment

In the US, the water cycle (pumping, distribution, treatment) accounts for 13% of total electricity use, or 520 million MWh (equivalent) annually[122]. Electrical consumption for wastewater treatment alone represents about 3% of the US' entire electric demand, or 100 million MWh[123]. As noted earlier, the potential exists to reduce electrical usage through equipment upgrades and leak repairs by at least 10%, which would lower the Region's electrical consumption and save millions of dollars. GHG emissions would be reduced proportionally. Precise numbers are difficult to estimate – because of the mix of operators (private companies, municipalities, counties, etc.), there is no consistent tracking and reporting of water and wastewater treatment energy use at the individual water or sewer system, county, or state level.

Wastewater treatment represents 21% of the electricity costs for the City of Kingston, or $335,992 per year.

7.1.3 Water Quality

NYSDEC monitors surface water quality in compliance with the Clean Water Act (Section 303d). NYSDEC identifies the sources of impairment for any water bodies that do not meet the applicable standards. These impaired waters are shown in Figure 7.3.

When a water body is determined to be impaired (see Table 7.2 for results), a Total Maximum Daily Load (TMDL) plan must be created to reduce the impairment in accordance with Section 303(d) of the Clean Water Act[124]. The TMDL process requires identification of the source of impairment and enactment of a remediation plan with a margin of safety to assure that the impairment is addressed. Note that note all water bodies have been assessed.

[122] American Council for an Energy-Efficient Economy, Alliance for Water Efficiency. 2011. Addressing the Energy-Water Nexus, A blueprint for action and policy agenda.

[123] Energy Conservation Measures for Wastewater Treatment Facilities. EPA 832-R-10-005. U.S. Environmental Protection Agency. September, 2010. Office of Wastewater Management. 1200 Pennsylvania Avenue NW. Washington, DC 20460. Accessed 8-19-12. http://water.epa.gov/scitech/wastetech/upload/Evaluation-of-Energy-Conservation-Measures-for-Wastewater-Treatment-Facilities.pdf

[124] NY listings are explained and can be downloaded at: http://www.dec.ny.gov/chemical/31290.html

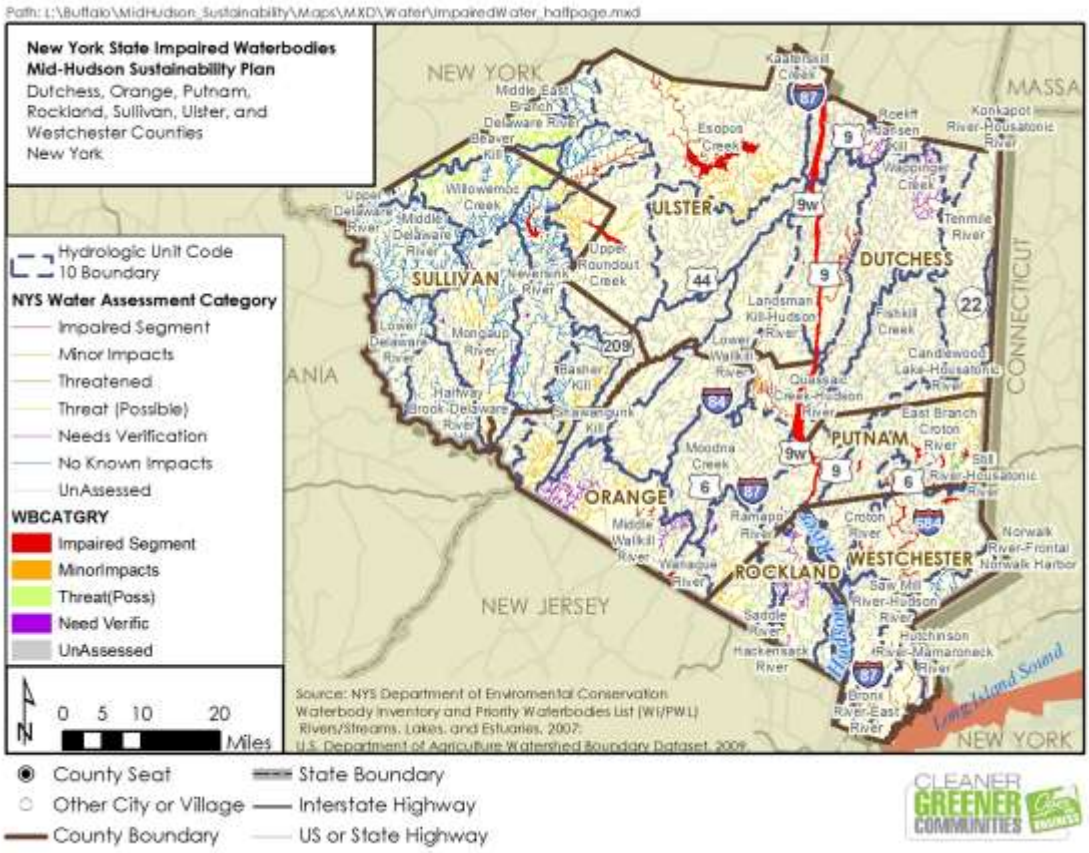


Figure 7.3 Impaired Water Bodies in the Mid-Hudson Region

To assess water quality in streams, NYSDEC also uses biological monitoring of the community structure and diversity of insects and other animals (macroinvertebrates) that live in streambeds for part of their life cycle. Table 7.3 summarizes the results of the biological monitoring. Biomonitoring provides a holistic evaluation of water quality based on cumulative impacts over time, and is therefore relevant to the health of fisheries and other wildlife, water quality for drinking, recreation and other human uses.

TABLE 7.2 WATER QUALITY IMPAIRMENTS

County	Number of Impaired Streams/ Water Bodies	Total Assessed	% Impaired of Total Assessed	Assessed/Total
Dutchess	3	15	20.0%	15/108
Orange	3	22	13.6%	22/155
Putnam	10	24	41.7%	24/103

TABLE 7.2 WATER QUALITY IMPAIRMENTS				
County	Number of Impaired Streams/ Water Bodies	Total Assessed	% Impaired of Total Assessed	Assessed/Total
Rockland	5	15	33.3%	15/48
Sullivan	6	78	7.7%	78/234
Ulster	7	20	35.0%	20/139
Westchester	16	29	55.2%	29/110
Total	**50**	**203**	**24.63%**	**203/897**

1. *United States Geological Survey (USGS) Estimated Use of Water in the United States, County-Level Data for 2005*

TABLE 7.3 WATER QUALITY BIOMONITORING		
County	Number of Stream Reaches (moderate to severe)	Assessed/Total
Dutchess	27	27/118
Orange	54	54/164
Putnam	22	22/53
Rockland	15	15/41
Sullivan	4	4/122
Ulster	56	56/409
Westchester	90	90/195
Total	**268**	**258/1102**

1. *United States Geological Survey (USGS) Estimated Use of Water in the United States, County-Level Data for 2005*

The Catskill-Delaware system in Ulster, Greene, Sullivan, and Delaware Counties supplies 90% of New York City's water and requires only disinfection to safely supply over a billion gallons a day to eight million customers. Conversely, the Croton system, in Westchester and Putnam Counties, which is much less under the control of NYC, now requires filtration per the USEPA and NYSDOH. The new Croton Water Treatment Plant occupies 28 acres in the Bronx, and will cost $3 billion in capital costs and ongoing operational costs in perpetuity to supply only 10% of the City's needs. For this reason, the preservation of the Catskill Delaware watersheds west of the Hudson is a very high priority for NYC, which has invested $1 billion in watershed protection efforts. NYC recognizes that the best way to continue to avoid filtration of the Catskill-Delaware system is to manage land use in the watersheds. The failure to maintain watershed protection could require NYC to build the largest water treatment plant in the country. Filtration avoidance through watershed management is by far the best choice for NYC.

Watersheds that supply drinking water are also vulnerable to degradation, and some reservoirs and aquifers have been impacted by human activities. Sources of contaminants include siltation and other stormwater runoff impacts, industrial discharges, agricultural chemicals, and residential waste disposal. Reservoir watersheds, wellheads and groundwater recharge areas need to be protected to maintain water quality and ensure access to safe drinking water. One study shows that pesticides that are commonly used on turf were detected in the Croton River, one of the watersheds that replenishes groundwater and provides drinking water to Westchester County communities and to NYC[125].

Wetlands (swamps, marshes, bogs, and similar areas) are areas saturated by surface or ground water sufficient to support distinctive vegetation adapted for life in saturated soil conditions. In the Region there are two main types of wetlands: tidal wetlands, and freshwater wetlands. These wetlands provide the following benefits:

- Serve as natural habitat for many species of plants and animals
- Provide areas of recreation for the public (hunting, fishing, etc.)
- Provide surface and groundwater protection from pollution through filtration
- Absorb the forces of flood and tidal erosion to prevent loss of upland soil[1]

Wetlands are protected explicitly by the federal Clean Water Act of 1972. The Army Corps of Engineers protects all wetlands that are connected to regulated Waters of the U.S. NYS regulates tidal wetlands via the Tidal Wetland Act of 1973. The State preserves fresh water wetlands in accordance with the Freshwater Wetlands Act of 1975. This Act aims to preserve, protect and conserve freshwater wetlands and their benefits, consistent with the general welfare and beneficial economic, social and agricultural development of the state[2]. The national government also protects wetlands through its Wetlands Conservation provision that prohibits USDA program participants from converting wetlands on their agricultural operations to cropland, pasture, or hay land unless the wetland acres, functions, and values are compensated for through wetland mitigation.[3]

1. http://www.dec.ny.gov/lands/305.html
2. http://www.dec.ny.gov/lands/4937.html
3. http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/water/wetlands/

In addition to surface water quality, groundwater is a very important resource, and quality is carefully monitored. Public groundwater wells are tested for a range of potential contaminants, but individual private wells are seldom sampled. Limited one-time sampling is

[125] Patrick J. Phillips and Robert W. Bode. 2002. Concentrations of Pesticides and Pesticide Degradates in the Croton River Watershed in Southeastern New York, July-September 2000. U.S. Geological Survey. WRIR 02-4063

only required when new subdivisions are platted. Westchester County and Dutchess County have made varying commitments to managing the quality of groundwater resources (see sidebar). Dutchess County, for examples, maintains a regional groundwater level monitoring network, has issued guidance for minimum sustainable densities for individual septic systems, and has developed a model aquifer management zoning ordinance for Towns to adopt. Dutchess County recently sampled 250 widely distributed domestic wells to help inform policy related to domestic well management, road salt use and septic system management.

Another issue that affects water quality is large withdrawals for thermal cooling. Not only can these withdrawals cause impacts due to warming of the receiving waters, the actual withdrawals can result in mortality to fish that become impinged on impact screens. The largest use for this purpose is the Indian Point nuclear reactor, which uses 2.5 billion GPD, and serves as the largest single energy source in the Region, producing over 2,000 MWh per day[126]. Indian Point may have to recycle its cooling water to receive a new operating permit[127].

New York City regulates portions of the Region and the City is under a mandate to protect surface water quality. A Memorandum of Agreement between many agencies and organizations underlies the watershed protection program in the NYC watersheds. Smaller municipal supplies also implement certain measures to preserve water quality in some drinking water supply watersheds. One key legal mechanism enabling this in NYS is known as watershed rules and regulations. Currently, these rules and regulations are not being utilized to their full potential due to resource limitations.

7.1.4 Stormwater

Both urban and rural development have altered and impacted the natural environment in the Region through changes in land use. Urban development is traditionally characterized by large areas of paved and roofed, or impervious, surfaces. These surfaces rapidly convey stormwater, along with its acquired pollutant load, to storm drains which often discharge directly to nearby surface waters. Additionally, development often significantly compromises or destroys wetlands. The destruction of these natural buffer areas significantly limits the

[126] NYSDEC.2003. Fact Sheet. New York State Pollutant Discharge Elimination System (SPDES) Draft Permit Renewal with Modification: Indian Point Electric Generating Station. Buchanan, NY - November 2003. http://www.dec.ny.gov/docs/permits_ej_operations_pdf/IndianPointFS.pdf

[127] A summary of the adjudicatory proceedings is available at: http://www.dec.ny.gov/docs/legal_protection_pdf/indianir.pdf

water storage capacity of an area. In fact, the EPA estimates that a 1% loss in wetlands lowers the storage capacity of that watershed by 7%.

A significant portion of the runoff generated in cities, villages and other areas with sewers flows into sanitary sewer lines. During rainstorms, the wastewater plants connected to these systems are overwhelmed by the resulting volume of water and the overflows are discharged directly to a receiving water body as diluted raw sewage. When sewers overflow with stormwater, the release of effluent is called a Combined Sewage Overflow (CSO). The Wet Weather Water Quality Act of 2000 requires combined sewer systems to conform to the requirements in the EPA's National CSO Control Policy. The requirements of the Control Policy include implementing Nine Minimum Controls[128] and developing a Long-Term Control Plan. In the Mid-Hudson Region, systems in the cities of Kingston, Newburgh, Poughkeepsie and Yonkers are designated CSOs and they are required to develop and implement Long Term Control Plans to remediate these problems. Wastewater overflows from CSOs are a large source of water pollution in the Region, and the projected costs to fix these problems are a daunting challenge. A significant portion of the runoff generated in cities, villages and other areas with sewers flows into sanitary sewer lines. During rainstorms, the wastewater plants connected to these systems are overwhelmed by the resulting volume of water and the overflows are discharged directly to a receiving water body as diluted raw sewage. When sewer systems that combine storm and sanitary sewers overflow due to stormwater, the release of effluent is called a Combined Sewage Overflow (CSO). Overflows can also occur as a result of infiltration and inflow that results when groundwater infiltrates or is directly discharged into sanitary sewer lines due to intentional pumping (pumping a basement) or unintentional cracks and leaks in pipes.

The Wet Weather Water Quality Act of 2000 requires combined sewer systems to conform to the requirements in the EPA's National CSO Control Policy. The requirements of the Control

[128] USEPA. 1995. Guidance document, Combined Sewer Overflows: nine minimum controls. Office of water. http://nepis.epa.gov/Exe/ZyNET.exe/200041XP.TXT?ZyActionD=ZyDocument&Client=EPA&Index=1995+Thru+1999&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A\zyfiles\Index%20Data\95thru99\Txt\00000002\200041XP.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h|-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=p|f&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL

Policy include implementing Nine Minimum Controls[129] and developing a Long-Term Control Plan. In the Mid-Hudson Region, systems in the cities of Kingston, Newburgh, Poughkeepsie and Yonkers are designated CSOs and they are required to develop and implement Long Term Control Plans to remediate these problems. Wastewater overflows from CSOs are a large source of water pollution in the Region, and the projected costs to fix these problems are a daunting challenge.

Impervious Surface Coverage

One key factor for assessing the health of local watersheds and streams is impervious surface cover. When watersheds for smaller streams exceed about 10% impervious cover, water quality and stream health begins to be impacted significantly[130]. Impervious cover also virtually eliminates groundwater recharge, which causes other changes to streams, including a reduction in the base flow that is critical for supplying streams in dry weather. Where impervious surfaces are interconnected and rapidly drained, they can create heat stress and waste transfer into rivers and lakes, which impact biological communities and water quality.

Watershed plans and studies show that in parts of the Region, significant portions of certain watersheds have exceeded the 10% imperviousness threshold, sometimes by a substantial margin. There may be opportunities for significant water quality improvement through relatively small investments by focusing efforts on reducing imperviousness in areas that feed small headwater basins.

Average percentage of impervious cover for larger areas is usually not a good metric for assessing watershed health in specific streams or basins. However, for comparison purposes, Westchester and Rockland counties have the highest percentages of impervious cover, totaling 17.6% and 11.2%, respectively, and Sullivan County has the lowest impervious cover, at 1.6%.

Soil Loss and Chemical Transport

In addition to impacts from urban areas, agricultural soil exposure and management can have negative impacts on water quality. Open fields, and particularly newly plowed fields, can result in runoff over bare soil directly to surface waters during storm events. Additionally, animal waste can be conveyed to surface waters and fertilizer over use can result in the

[129] Idem

[130] http://www.stormwatercenter.net/monitoring%20and%20assessment/imp%20cover/impercovr%20model.htm

discharge of nutrients that lead to blooms of algae. Release of toxic insecticides can also disrupt aquatic food chains.

Dams, Bridges and Culverts

New York's dam infrastructure is aging and in need of repair (see Figure 7.4). The design lives of many dams have been exceeded. Many dams were not built, nor are being maintained according to today's engineering standards. There are 33 NYSDEC inventoried dams in the Mid-Hudson Region, with likely double that number of smaller dams. Of those dams, 27 are rated as high hazard, five as significant, and one as low. Hazard rating refers to the probability of loss of human life should a dam failure take place.

Additionally, there are thousands of bridges and culverts in the Mid-Hudson Region. Most of these were constructed years ago, are in poor condition and are not sized adequately to pass the flows of the largest floods. This can threaten life and property during major storm events.

Figure 7.4 Damage to Winona Lake Spillway in Orange County on Quassaick Creek.

7.2 Climate Change, Water

7.2.1 GHG Emissions

Greenhouse gas emissions data from energy used in treating and distributing water are included as part of overall energy-related GHG emissions, and are presented in Chapter 4.

Additional water-related GHG emissions occur when organic waste material in wastewater degrades during the treatment process, emitting both methane and nitrous oxide. The amount of methane and nitrous oxide emitted from wastewater depends on the wastewater treatment processes used.

Wastewater treatment emissions are approximately 222,873 $MTCO_2e$. Table 7.4 lists wastewater treatment emissions by county. These data should be reviewed with caution, as they are estimated on a per capita basis and thus do not directly reflect the actual practices in place in the Mid-Hudson Region's wastewater treatment plants.

TABLE 7.4 WASTEWATER TREATMENT EMISSIONS (MTCO2E) BY COUNTY, 2010

	CO_2	CH_4	N_2O	Total
Dutchess	-	20,009	8,933	28,942
Orange	-	25,076	11,195	36,270
Putnam	-	6,707	2,994	9,701
Rockland	-	20,964	9,359	30,323
Sullivan	-	5,216	2,329	7,544
Ulster	-	12,275	5,480	17,754
Westchester	-	63,838	28,500	92,338
Mid-Hudson Region Total	**-**	**154,083**	**68,789**	**222,873**

7.2.2 Climate Change Vulnerability – Water

Water resources in the Mid-Hudson Region may be subject to a variety of impacts from climate change. This section examines the effects of climate change on the Region's water quality, supply, and infrastructure. Water quality may be affected by:

- Changes in water temperatures (which correlate with dissolved oxygen levels)
- More frequent CSOs from intense precipitation events
- Late summer droughts that cause lower stream flows
- Salt water intrusion
- Sea level rise eroding protective natural buffers such as wetlands

- Direct impacts from flooding[131]

For the full list of effects see Table 7.5.

TABLE 7.5 SUMMARY OF WATER RELATED CLIMATE EFFECTS

Asset	Climate Impact	Climate Effect	Description
Water Quality	Increased precipitation	Increase in CSOs	Heavy precipitation results in CSOs, which discharge untreated sewage into receiving water bodies.
	Increase in annual average temperature; Extreme heat	Increased Surface Water Temperatures; Low oxygen levels	Warmer air and water temperatures generally lead to diminished dissolved oxygen (DO) levels in water bodies. DO is critical for the survival of most aquatic species, including trout, which have higher mortality rates in low DO environments or warmer water temperatures.
	Extreme heat; Drought; Warmer winters	Lower Stream Flows	Lower stream flows could occur from periods of drought, higher evaporation rates, and warmer winters with less snow and an earlier peak flow. Lower stream flows can increase the concentration of water pollutants and lead to warmer water temperatures.
	Sea level rise and flooding	Loss of Wetlands and Riparian Buffers	Wetlands and riparian buffers could be lost and/or damaged by sea level rise and flooding.
Water Supply	Extreme heat; Drought	Reduced Water Supply	Water supplies most vulnerable to climate change include run-of-the-river systems and communities dependent on small aquifers without a backup water supply. Higher evaporation rates due to higher temperatures could stress the Region's water supplies.
	Drought, Sea lever rise	Saltwater Contamination of Water Supplies	Historical periods of low flow indicate the salt front location on the Hudson is susceptible to shifting up the Hudson River, threatening contamination of water withdrawals from the Hudson River at Poughkeepsie. Periods of drought and accompanying decline of water tables may result in near-shore wells that currently extend into fresh water to withdraw the intruding salt water.

[131] Although no single weather event can be attributed to climate change, the scale of impacts from catastrophic weather events if they occur more frequently in the future justifies preventative measures. The cost to New York State of Tropical Storm Irene in 2011 was estimated at $1.3 Billion (http://www.huffingtonpost.com/2012/08/27/hurricane-irene-damage-statistics-2011_n_1832342.html).

TABLE 7.5 SUMMARY OF WATER RELATED CLIMATE EFFECTS			
Asset	Climate Impact	Climate Effect	Description
Water Infra-structure	Sea level rise and flooding	Damage to wastewater and sewage treatment plants, and pump stations	Wastewater and stormwater treatment plants and pump stations are especially vulnerable to sea level rise and flooding since they are typically located along rivers.
	Increased precipitation; Storm events	Increased flooding resulting from undersized stormwater management infrastructure	Stormwater management systems, such as culverts, inlets, and drains, may be undersized for larger storm events. Areas with large amounts of impervious surfaces may be particularly vulnerable.
	Sea level rise; Flooding; Storm events	Increased risk of damage to dams	Increased flooding, sea level rise, and storm events may contribute to the risk of dam failures.

Climate change is likely to result in lower stream flows in the late summer and early fall due to reduced precipitation during this time of the year and increased evaporation rates from warmer air temperatures; a warmer winter may also bring less snow and an earlier snow melt. Increased agricultural production resulting from a longer growing season could also affect stream flows since agricultural irrigation often draws directly from rivers and streams. Low flowing streams and rivers in the spring will not be as resilient to the hot and dry summers.

As water levels fluctuate, wetland habitats will move to coincide with the new water-lines. In undeveloped areas, the buffers and wetlands will migrate upland. However, this will not be possible in many areas due to development or steep slopes (cliffs) along the river and may cause an increase in flooding.

Additionally, a shifting salt front could threaten some communities' water supply along the Hudson. Approximately 75,000 people rely on drinking water from the Hudson River withdrawal at Poughkeepsie, as do another 10,000 from the Town of Esopus. During a severe drought in the 1960s, the salt front moved up to the intake point for the Town of Poughkeepsie. A combination of lower flows and sea level rise makes these water intakes for the City of Poughkeepsie and the Town of Esopus potentially vulnerable in the future to salt contamination, compromising the quality of the water (NYSERDA 2011).

Currently, there are only four permitted combined sewer systems in the Region: Kingston, Poughkeepsie, Newburgh, and Yonkers. Without any major upgrades to sewer and stormwater infrastructure, CSOs will occur more often, releasing even more contaminants into the Hudson and its tributaries.

Wastewater treatment plants (WWTPs), also referred to as sewage treatment plants (STPs) are typically located at the lowest point in a landscape so the wastewater can be conveyed via gravity. This makes them highly vulnerable to flooding. Such facilities often have flood protection systems in place; however, these systems may not be able to withstand flooding combined with sea level rise. For a list of WWTPs that may be affected see Table 7.6.

TABLE 7.6 WASTEWATER FACILITIES WITHIN THE CLIMATE HAZARD ZONES

	FEMA Floodplain Existing (2011)	2080 Floodplain	Cat. 3 – Existing (2012)	Cat. 3 2080
New Rochelle STP	■	■	■	■
Yonkers Joint WWTP	■	■	■	■
Mamaroneck WWTP	■	■	■	■
Ossining Wastewater Treatment PLANT	■	■	■	■
Joint Regional Sewerage Board WWTP			■	■
Haverstraw Joint Regional Sewage Treatment Plant			■	■
Stony Point (T) STP		■	■	■
City of Poughkeepsie Water Pollution Control Plant		■	■	■
Ulster (T) SD STP	■	■		
Kingston (C) Sewers & WWTP	■	■		■
New Paltz WWTP	■	■		
City of Newburgh Water Pollution Control		■		■
New Windsor STP		■		■
Wallkill (T) STP	■	■		
Goshen WWTP	■	■		
City of Rye DPW/Blind Brook WWTP	■	■		■

SOURCE: See Appendix XYZ: Climate Change Vulnerability Assessment

7.3 Objectives

WA1: Increase available water supply by minimizing water consumption

- Water efficiency and conservation measures are important as part of an overall strategy for sustainability in the water sector. There is an opportunity to include increased focus on water efficiency in existing building upgrade programs.

WA2: Reduce the energy usage and GHG emissions at water and wastewater treatment facilities

- Improving energy efficiency of treatment processes, equipment, and distribution systems can reduce the overall energy footprint and annual operating costs of the Region's water and wastewater infrastructure. Additionally, investing in green infrastructure can reduce the volumes of stormwater requiring treatment.

WA3: Reduce impervious surface area and increase connectivity of permeable surfaces

- Green infrastructure and low-impact development strategies can increase stormwater infiltration and detention and increase groundwater recharge. This can improve watershed quality, increase habitat, and reduce stormwater flows to treatment facilities.

WA4: Improve the reliability of water and wastewater treatment

- Asset management and proper planning for water and wastewater infrastructure can head off unexpected and costly investments, resulting more reliable systems and predictable long term expenses. Also reducing flow to facilities through conservation or green infrastructure can help to save on energy usage, require lower chemical addition, and reduce wear and tear on treatment equipment. Additionally, the repair of existing infrastructure (piping) and the enforcement of sump pump removal would help to reduce the load on wastewater treatment plants and therefore increase the reliability of the system.

WA5: Protect habitat and water quality

- Improve regional waters in order to provide a healthy habitat for wildlife, a clean drinking water supply, opportunities for recreation, and sufficient supply for economic sectors. Implement source protection and maintain aquatic baseflow needs and watershed carrying capacity. Watersheds are vulnerable to human activities and watershed management planning can provide strategies for enhancing water quality for habit while still meeting human needs.

WA6: Encourage watershed management planning

- The implementation of coordinated and enforceable watershed management programs within the region would improve the long-term availability of water supply and maintain or improve watershed quality. Watershed management plans must identify specific and targeted measures to correct or avoid degradation of the resource. Implementing targeted watershed improvements should be planned together with potable supply and wastewater capacity investments. Watershed management will preserve the integrity and quality of groundwater resources, which are difficult or impossible to remediate once they are contaminated. Priority improvements will be in the area of reduced or disconnected impervious surfaces, pollution source reductions, and stormwater management that includes groundwater infiltration practices

7.4 Indicators

Tier 1 indicators were selected based on their ability to meet the objectives of the water management working group and NYSERDA project goals. Additionally these indicators were selected for their ability to inform policy or investment, ease of data collection (preferably from existing data sources), and replicability, so that trends can be assessed on an ongoing basis.

7.4.1 Metrics and Targets

TABLE 7.7 INDICATOR INVENTORY – TIER 1 INDICATORS

Objective	Metric	Current Value	Target – 2020	Target – 2035	Target – 2050
WA1. Increase available water supply by minimizing water consumption	Per capita water withdrawals (gallons per person per day) i. Domestic Self Supply ii. Public Supply[1]	i. 75 gpcd ii. 95 gpcd	Reduce by 25%	Reduce by 45%	TBD
WA2. Reduce the energy usage and GHG emissions at water and wastewater treatment facilities	Energy use per gallon (kilowatt hours per million gallons per day) of: i. Potable Water i. Wastewater	i. Not Available[2] ii. 2,800 kWh/MGD	New construction to utilize Best Available Technology (BAT); Current facility upgrades to BAT	Reduce by 20%	Reduce by 40%
WA3. Reduce impervious surface area and increase connectivity of permeable surfaces	Impervious surface area greater than 10%	7.7% in 2006 7.3% in 2001	Hold at Current	Reduce by 20%	TBD
WA4. Improve the reliability of water and wastewater treatment	Annual expenditure per volume treated A –water production B –wastewater treatment	$0.27 per gpd $1.33 per gpd	Hold at Current	Reduce by 20%	TBD
WA5. Protect habitat and water quality	Number of impaired water bodies	See Figure 6.4	Assess 50% Reduce by 5%	Assess 70% Reduce by 20%	Assess 100% Reduce by 40%
	Stream quality water assessment score (per stream reach)	See Figure 6.5	Assess 50% TBD	Assess 70% TBD	Assess 100% TBD
WA6. Encourage watershed management planning	Percent of regional watershed area covered by a management plan	Unknown	50% of areas with over 10% impervious surfaces	75% of all areas	100% of all areas

Notes:

TABLE 7.7 INDICATOR INVENTORY – TIER 1 INDICATORS					
Objective	**Metric**	**Current Value**	**Target – 2020**	**Target – 2035**	**Target – 2050**

1. Includes NYC deliveries for public supply
2. Water treatment plant flow data not available at the time of this report

TABLE 7.8 DATA SOURCES		
Metric	**Calculation**	**Data Source**
Water Withdrawal	n/a	United States Geological Survey (USGS) Estimated Use of Water in the United States, County-Level Data for 2005
Population	n/a	United States Census, 2010
Energy Use - Water	n/a	Energy Estimate: Water & Sustainability (Volume 4): U.S. Electricity Consumption for Water Supply & Treatment - The Next Half Century, Electric Power Research Institute (EPRI), 2002
Wastewater Flow Public Treatment Facilities (MGD)	n/a	2004 Descriptive Data of Municipal Wastewater Treatment Plants in New York, NYSDEC; United States Environmental Protection Agency (USEPA) Enforcement and Compliance History Online Database
Energy Use - Wastewater	[∑plant capacity in MGD*kWh/MGD for plant capacity category]/MGD of total plant capacity	NYSERDA Statewide Assessment of Energy Use by the Municipal Water and Wastewater Sector. Table 5, Final Report 08-17. November, 2008
Annual Expenditure per Volume Treated	n/a	Office of the New York State Comptroller, Financial Data for Local Governments, 2010
Number of Impaired Water Bodies	n/a	NYSDEC Waterbody Inventory and Priority Waterbodies List (WI/PWL), 2007; U.S. Department of Agriculture Watershed Boundary Dataset 2009.
Stream Water Quality Assessment Score	n/a	NYSDEC Stream Biomonitoring Program, 2012
Impervious Surface Area	n/a	United States Geological Survey (USGS) – National Land Cover Database, Percent Developed Imperviousness, 2001 and 2006

7.4.2 Limitations and Tier 2 Indicators

The metrics and indicators recommended in Table 7.8 have certain inherent weaknesses, due largely to the availability and quality of data. . Known limitations of metrics are provided below:

WA 1. Increase available water supply by minimizing water consumption

- Per capita water withdrawal data includes some commercial and light industry use. Therefore, changes in commercial or light industrial activities and trends may impact these figures.

WA 2. Reduce the energy usage and GHG emissions at water and wastewater treatment facilities

- An average value of kWh/MGD was calculated on the basis of a one-off NYSERDA study. This was calculated by multiplying actual plant capacity by an average kWh/MGD figure for a range of plant capacities – therefore, the estimate is a ballpark figure.
- No data were provided for potable water treatment energy use.
- Future efforts should focus on benchmarking actual performance at individual facilities in the Region (see Table 7.9)

WA 3. Reduce impervious surface area and increase connectivity of permeable surfaces

- Impervious surface data is of limited value at the regionals scale, and should be used for local (sub-watershed) planning purposes only.

WA 4. Improve the reliability of water and wastewater treatment

- Little information is known about the data collected from the Comptroller's office; it is unknown whether operating budget, debt repayment and other costs are included in the figures provided.

WA 5. Protect habitat and water quality

- Impaired water body and biomonitoring data are high-quality. However, not all water bodies in the Region have been assessed.

WA 6. Encourage watershed management planning

- Mapping analysis and a comprehensive inventory of watershed management plans are needed to calculate the percentage of the Region currently under watershed management (see Table 7.9).

- The widespread use of the USGS StreamStats program to calculate 7Q10 discharge for each stream in the Region could provide an invaluable baseline for watershed management planning (see Table 7.9).

TABLE 7.9 TIER 2 INDICATORS

Objective	Metric (units)
WA2	Energy use per gallon of potable water produced (kilowatt hours per million gallons per day)
	Energy use per gallon of water treated for each individual wastewater treatment plant in the Mid-Hudson Region
WA6	Percent of regional watershed area covered by a watershed management plan
	Maintain 7Q10 flow at point of consumption

7.5 Priorities for Implementation

A multiplicity of projects and initiatives will be needed to achieve the Plan's water management objectives. Below, priority project types (referred to as 'priorities for implementation') are presented. To facilitate implementation, a series of programs, policies, and other initiatives (referred to as 'enabling mechanisms') can be put in place at the local and regional level to help target investment and promote sustainable development. Wherever possible, example projects or initiatives have been given that typify the efforts needed to achieve the Plan's objectives. Note that the list of examples is not intended to be comprehensive, or reflect any degree of priority. The examples listed reflect ideas submitted during the planning process with sufficiently well-developed information to illustrate the concepts being proposed. A full list of project ideas submitted can be found in Appendix E.

7.5.1 Implement Low Impact Development (LID) and Green Infrastructure

LID is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product[132]. Green infrastructure refers to natural or constructed stormwater

[132] http://water.epa.gov/polwaste/green/index.cfm

management systems that seek to emulate the function of an undisturbed catchment, and work as part of an overall LID strategy. LID and green infrastructure provide an alternative to conventional storm sewers or combined sewers. The benefits of using green infrastructure go far beyond stormwater management, and include groundwater recharge, the creation or conservation of habitats, water quality improvements, and contribution to healthier, more beautiful neighborhoods.

According to NYSDEC green infrastructure projects can be broken out into the following types:

- Rain Gardens
- Bio-retention Areas
- Vegetated Swales/Dry Swales
- Green Roofs
- Porous Pavement
- Stream Buffer Restoration

Based on review of the impaired water bodies map (Figure 7.3), priority areas for stream corridor improvements to improve water quality include:

- Esopus creek watershed
- Upper Neversink River watershed
- Upper Rondout Creek
- Monagup River
- East Branch Croton River
- Croton River
- Quassaic Creek/Hudson River
- Middle Wallkill River
- Saw Mill River
- Hutchinson River
- Bronx River

Note that this is only a partial list.

Example Project

Poughkeepsie Underwear Factory Demonstration Project

In 2013, Clearwater, Inc., Design Dynamics, LLC, Hudson River Housing, and other partners will construct a multi-practice green infrastructure system at site of the historic Underwear Factory, adjacent to the Fall Kill Creek in the heart of the City of Poughkeepsie. The system will incorporate permeable pavement, modified tree pits, and a bio-retention area to capture and treat stormwater from the .75 acre site. The project will create new public green space along the creek with educational signage, which will complement the mixed-income housing and community space slated for the building, creating a true sustainability hub in a distressed neighborhood.

NYSDEC maintains a list and map of green infrastructure projects in the Mid-Hudson Region on its website (http://www.dec.ny.gov/lands/58930.html). Project summaries can be submitted to NYSDEC via email for inclusion in this list.

The NYSDEC's Hudson River Estuary Program recently conducted a survey on barriers to green infrastructure implementation in the Mid-Hudson Region. Over 120 completed responses from a wide range of green infrastructure practitioners were received. Respondents cited cost, lack of knowledge, and resistance from local, municipal officials as the top barriers to implementation of green infrastructure projects.

Green Infrastructure and Watershed Resilience Project

As proposed in part by SUNY New Paltz, another example of a project promoting green infrastructure is the Watershed Resilience Improvement project in the Saw Mill Brook Watershed. This project looks to implement and monitor the use of green infrastructure and stormwater management practices so as to improve watershed resiliency to climate change and flooding while improving water quality and restoring watersheds.

This project allows the Saw Mill Brook Watershed to be used as an example of ways that the Region as a whole may adopt to adapt to climate change. The project will also help the university teach students in the Region about green infrastructure and demonstrate its capabilities.

7.5.2 Infrastructure Upgrades to Achieve Water and Energy Efficiency and Mitigate the Impacts of Climate Change

Water Efficiency and Energy Efficiency Upgrades

As noted earlier, if less water is used, less water needs to be harvested, treated, and distributed. If less sewage is generated, less collection and treatment is needed. All of these processes require significant amounts of energy, in turn generating GHG emissions. Through equipment retrofits, leak detection, and other efforts, water infrastructure can be made more efficient, resulting in benefits to operators, consumers, and the environment.

One challenge is that reducing water use in municipal water systems causes a drop in revenues, providing a specific disincentive for water managers to move in this direction. This loss of revenue can be recovered by assuring that un-metered uses are minimized, and that everyone pays a fair share. Additionally, lost revenues are offset partially by lower operating costs.

Renewable Energy Production

Wastewater treatment processes generate considerable volumes of sludge (biosolids), which can be used to create energy through a process known as anaerobic digestion. Anaerobic digestion creates methane which can be used to create electricity and power parts of the wastewater treatment plant or nearby facilities. Anaerobic digestion is beneficial in that it stabilizes biosolids for disposal in a landfill, for beneficial reuse, or for incineration.

Additionally, some water infrastructure presents opportunities for other renewable energy technologies, such as solar. Solar photovoltaic (PV) panels can be integrated into buildings, mounted over parking lots or closed reservoirs, or located in vacant properties.

Climate Hardening

Water management infrastructure in the Mid-Hudson Region is often located in areas highly vulnerable to flooding. Projects in this category work to identify and reduce risks faced by water management infrastructure so as to better prepare the Region for the effects of climate change. This can include protecting low-lying treatment infrastructure from surges, climate-proofing pumps and other critical systems, integrating pumping infrastructure into stormwater and effluent outfalls, resizing and replacing culverts, and more. These projects would work well as part of an overall climate resilience strategy for the Region. In some cases, it may be necessary to retreat from particularly vulnerable locations. Climate vulnerability needs to be integrated into long-term planning and capital programs.

Example Project

Culvert Analysis and Resizing

As proposed by NYSDEC Region 3, the Culvert Analysis and Resizing project would examine the Region's culverts and ditches to determine which systems are capable of handling the increased flow expected to occur with climate change. The Region is expected to see an increase in rainfall and major storm events as climate change progresses, and the current system of ditches and culverts is likely unable to handle such an increase in volume.

As a result of this project, local leaders and NYS will be better able to target funds to specific vulnerable locations to protect roadways and other facilities from flooding. This will help ensure cost-effective investment.

7.6 Enabling Strategies

7.6.1 Watershed Management Planning and Programs

Consistent, comprehensive watershed management planning is needed to ensure that waters in the Region provide a healthy habitat for wildlife, a clean drinking water supply, opportunities for recreation, and sufficient supply for economic sectors. This must include implementation of source protection and maintenance of aquatic baseflow needs and watershed carrying capacity.

The implementation of coordinated and enforceable watershed management programs would improve the long-term availability of water and maintain or improve watershed quality. Watershed management plans must identify specific and targeted measures to correct or avoid degradation of the resource. Implementing targeted watershed improvements should be planned together with potable supply and wastewater capacity investments. Priority improvements will be in the area of reduced or disconnected impervious surfaces, pollution source reductions, and stormwater management that includes groundwater infiltration practices.

Watershed management planning should continue to be supported and incorporated into local policy. Counties and municipalities should also take steps to encourage the alignment of jurisdictional planning with watershed management goals. For example inter-municipal agreements and coordinated joint adoption of land use, zoning and other codes or policies can be used to integrate watershed management strategies across municipal boundaries. When determining areas for priority growth, the surrounding water resources and existing infrastructure should be considered.

There is also potential for sharing services for certain programs, such as stormwater management oversight and maintenance, stream corridor planning and management, water resources monitoring, etc. Regional management of infrastructure can be implemented without necessarily centralizing the physical infrastructure systems themselves. In other words, smaller systems should be managed together under a single entity to achieve a higher level of quality control, accountability, and economies of scale in operations. This should be done even if the systems in question are not linked together in a single collection or distribution system.

Example Initiatives

Municipal Septic Density Analysis

As promoted by the Cornell Cooperative Extension (CCE) this initiative would run a GIS analysis of septic densities in the Region, identify hotspots of increased septic system use, and hold meetings and seminars to help educate those areas on proper septic maintenance and sustainability requirements. Educational outreach will help the Region reduce the amount of non-point source pollution stemming from septic tanks as well as limit the money spent for maintenance on septic systems.

Programs like this may also lead to an increase in interconnectivity between communities such that governance on a watershed level may be easier to implement.

This program could be expanded to include repair and rehabilitation of failing septic systems, and possibly the introduction of new alternative technologies to replace failing septic systems.

7.6.2 Education and Outreach

Water Reuse and Rainwater Capture

Due to their potential health risk, water reuse projects face strict standards and restrictions from the New York State Plumbing Code and the New York Department of Health. These regulations are important to the health of the public, however they are not meant to act as a deterrent to the creation of these projects.

Through education and outreach efforts, public perception on the dangers of water systems needs to be changed. There is a need to remove or minimize real or perceived barriers to the widespread adoption of wastewater and greywater recycling. Additionally, programs are needed to raise awareness about the benefits of rainwater capture.

Initiatives in this category should work to increase local understanding of alternative water use systems including greywater and other water reuses. As much as possible, programs should focus on residential and industrial systems alike, so that the public may learn about all of their potential options.

Water Conservation

Water efficiency and conservation measures are critical as part of an overall strategy for sustainability in the water sector. By reducing water demand, the need for withdrawal, infrastructure, maintenance, and more is reduced. Some efficiency efforts can be led by operators, who can invest in infrastructure upgrades, as noted above. Additionally, education and outreach, coupled with smart incentive programs, can encourage changes on the user side. Large commercial, residential, and institutional users – universities, hospitals, etc. – should be encouraged or required to benchmark their water use using tools such as EPA's Portfolio Manager. Additionally, education of students, contractors, and more should be used to promote water efficiency behavior and investment. Programs like the EPA's WaterSense that work with manufacturers and distributors to bring high efficiency goods to market and educate consumers already help promote conservation.

There is also an opportunity to include more focus on water efficiency in existing building upgrade programs such as NYSERDA's Home Performance with Energy Star program, which is now linked to the Green Jobs Green NY home assessment. Outdoor irrigation of lawns and turf, including golf courses, is a major element of water demand and this will likely grow given warmer temperatures in future. Public education is needed to promote alternatives to conventional lawns.

Example Initiatives

Pending

7.6.3 Water Infrastructure Benchmarking

At present, there is relatively little information about energy use in water and wastewater treatment facilities, pump houses, and other infrastructure. A centralized program to benchmark facilities' energy use will provide much needed data that can be used to prioritize

investments in energy efficiency. Tools such as the EPA's Energy Star Portfolio Manager can be readily used for facility benchmarking purposes[133].

Example Initiatives

GAP

[133] http://www.energystar.gov/index.cfm?c=water.wastewater_drinking_water

8 Priorities for a Greener Mid-Hudson

This Chapter includes:

1. A description of overarching strategies to foster sustainable development in the Mid-Hudson Region

In reviewing the priority projects and enabling strategies proposed by the numerous participants in the planning process, several common themes emerged. These themes suggest potential opportunities to positively impact multiple focus areas at the same time. These synergistic opportunities include efforts to:

- Make all growth smart growth
- Invest in infrastructure to create jobs and prepare for the future
- Benefit from and preserve the Region's unique assets through sustainable tourism
- Foster innovation to create green jobs
- Support natural resource sector industries
- Foster the green workforce by investing in education and workforce development

8.1 Make All Growth Smart Growth

The Region's land use and development patterns are at the heart of achieving the Plan's objectives. Achieving sustainable development in the Mid-Hudson Region will require the implementation of comprehensive smart growth strategies. Smart growth aims to create and maintain great neighborhoods and communities by[134]:

[134] http://www.epa.gov/dced/about_sg.htm

1. Mixing land uses
2. Taking advantage of compact building design
3. Creating a range of housing opportunities and choices
4. Creating walkable neighborhoods
5. Fostering distinctive, attractive communities with a strong sense of place
6. Preserving open space, farmland, natural beauty, and critical environmental areas
7. Strengthening and directing development towards existing communities
8. Providing a variety of transportation choices
9. Making development decisions predictable, fair, and cost effective
10. Encouraging community and stakeholder collaboration in development decisions

Local governments need to work hand-in-hand to formalize smart growth strategies in policy, planning practices, and code. This will shift development toward denser centers, saving money on infrastructure, preserving open space, and in many cases improving quality of life.

8.1.1 Challenges to Smart Growth

Achieving smart growth requires a great degree of coordination at the local and regional levels. It is difficult to implement because of the NYS tradition of home rule, whereby each individual municipal government is given ultimate authority over land use decisions. Home rule decision-making, when not made in the context of other, broader political boundaries, promotes a planning culture that ignores the wider impacts of development.

Another challenge to implementing smart growth is the reliance of municipalities on local property taxes to fund services, such as schools, police, and fire. This creates an incentive to zone for commercial uses that generate positive tax revenues, while excluding new residential development that will increase population and, in turn, school costs. This pushes new residential development away from established communities that are likely to be less auto-dependent. Education is needed so that communities understand that multifamily residential development in compact, mixed-use centers can, in many cases, have net-positive fiscal impacts[135]. Additionally, by collaborating with neighboring communities, municipalities can often save money by consolidating services or sharing costs across borders[136].

[135] https://www.db.com/usa/docs/DBLC_Recognizing_the_Benefits_of_Efficiency_Part_B_1.10.pdf Deutsche Bank Report on the benefits of Multi-Family housing

[136] http://bps.westchestergov.com/

Local planning and urban design approaches that encourage more densely developed, mixed use centers are sometimes prohibited by outdated zoning codes. For example, many local zoning codes contain minimum parking requirements for residential units and commercial space that are unduly onerous, discouraging developers from investing in centers if fulfilling the parking requirements is too difficult. These minimum parking requirements often reflect suburban standards developed decades ago and a one-size-fits-all approach that applies to all developments, whether or not they could reduce the need for parking. .

8.1.2 Achieving Smart Growth – Mechanisms for Success

INSERT TEXT on INTER-MUNICIPAL AGREEMENTS as mechanism for collaboration

- Coordinate planning/zoning
- Share services

In addition to inter-municipal collaboration, there are myriad ways to revise codes to eliminate barriers to smart growth:

- Revise existing minimum off-street parking ratios based upon a review of current national standards
- Allow for reductions in the amount of off-street parking required for new developments that are located within close proximity to transit stops or an available public parking resource (e.g., a parking garage in a downtown environment)
- Ensure that shared parking for mixed-use developments is permitted (e.g., allow for uses with differing peak parking demand periods to share parking spaces, reducing the overall number that would be required if each use were considered individually)

Municipalities can develop Natural Resource Inventories or Open Space Plans (CITE NYS Open Space Plan) to prioritize important ecological features and use the recommendations to inform natural resource planning. The lack of a well-defined strategy in open space planning often results in disconnected natural areas that lack value in maintaining a community's resilience to climate change or contributing to high-quality, contiguous habitat or recreational opportunities.

8.1.3 Smart Growth Toolkit

Insert text – pending from RPA/E & E

8.2 Invest in Infrastructure to Create Jobs and Prepare for the Future

The Region's infrastructure is in need of maintenance, repair, or upgrade to continue functioning at desired levels of performance. Proper maintenance of infrastructure extends its service life and can help avoid costly replacement. Replacement or redesign of infrastructure presents opportunities to incorporate new design features and best practices.

When upgrading existing infrastructure or building new infrastructure, it is critical that the Region's sustainability needs be taken into consideration. For example:

1. Transportation infrastructure should be designed to be flexible and allow for multiple modes (e.g. bridges and highways that allow for eventual BRT or rail; roads with shoulder space for separate/protected bike lanes, etc.)
2. All infrastructure should be designed to be resilient to natural and manmade disasters and the effects of climate change. Planning for today's 100-year flood is no longer adequate. In some high risk areas, burying utilities may be required to limit damage from debris and falling limbs. Transportation must be protected to limit disruption to economic activities, waste hauling, food distribution, and more.

Local governments should require consideration of climate change in planning and environmental review documents. This could also be achieved through establishment of vulnerable zones or overlay zoning districts for areas vulnerable to climate change, in order to discourage development and/or encourage incorporation of mitigation strategies.

EXAPND PENDING ADDITIONAL CONTENT

8.3 Benefit from and Preserve the Region's Unique Assets through Tourism

The Region has a strong foundation for tourism that supports many industries, from agriculture to historic downtowns. As part of this strategy, the Region can invest in natural and cultural infrastructure enhancements that improve the quality of life not only for visitors but also for residents and employees.

Fostering a sustainable tourism industry is a potential means to strengthen the Region's economy while also helping to achieve the Plan's environmental and economic objectives and

improving quality of life. Sustainable tourism, as defined by the United Nations, is tourism that "takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities[137]."

By capitalizing on existing trends toward eco- and green tourism, the Mid-Hudson Region can further differentiate itself as a tourism destination, helping generate income and employment. Sustainable tourism can support the service sector (including the hospitality industry) as well as traditional natural resource industries such as agriculture by providing a high-value end market for local products, as well as secondary revenue streams.

Potential for Sustainable Tourism

The Mid-Hudson Region has many assets that already work together to create a destination attractive for its historic, cultural, and natural character. Among them, the Hudson River stands out as "*one of the most scenic rivers in America, with spectacular mountain views, historic estates, wine trails, shopping, outdoor adventures and much more*[138]." The Region's sustainable tourism assets range from small farms and immense forests to historic buildings and battlegrounds; opportunities include ecotourism, agro-tourism, historic sites and buildings ready for adaptive reuse, transit accessible attractions and a whole host of sporting, viewing, touring, tasting, and experiential activities. Sub-regional studies show that returning tourists already privilege activities associated with natural beauty, historic interest, and location-based activities in the Region (CITE).

There are myriad initiatives underway in the Mid-Hudson Region which focus on the fall foliage, romantic getaways and wedding destinations, tours of historic towns and estates; organic and locavore cuisine, pick-your-own, know-your farmer; water sports, hiking and skiing; music festivals, and so on. Destination tourism is already a concept for the Hudson Valley, attesting to effective branding, but there is considerable potential to expand.

There is strong potential for growing the Region's agri-tourism industry. The Region has 2,321 farms, which represents 6.4 percent of farms in NYS[139]. There are 67 agri-tourism sites in the Region, including pick-your-own, specialty, and wholesale. The Region's vineyards are often frequented by tourists, as well as by local residents; 19 are members of the Hudson Valley

[137] http://sdt.unwto.org/en/content/about-us-5
[138] http://www.travelhudsonvalley.org/
[139] http://www.osc.state.ny.us/reports/other/agriculture21-2010.pdf

Wine & Grape Association[140]. With a diverse agricultural economy and assets such as the Culinary Institute of America estate on the shores of the Hudson, the Region makes sense as a food destination.

An abundant variety of locally grown food is directly available from the Region's 76 municipal markets (see Table 8.1). Municipal markets usually run on a weekly or biweekly basis and offer goods from many vendors, including those who sell fresh produce, crafts and canned or prepared foods. Farm markets usually offer goods from a single vendor and are open on a daily basis.

TABLE 8.1 FARMER'S MARKETS

Rank	Location	Households Served Per Farmer's Market[1] (households/market)	Number of Municipal Markets[2]	Number of Farm Markets[2]
1	Dutchess	1,298	15	34
2	Orange	2,040	16	35
3	Putnam	1,615	5	6
4	Rockland	7,428	4	4
5	Sullivan	3,309	7	12
6	Ulster	3,967	9	35
7	Westchester	13,414	20	12
	Region	**3,785**	**76**	**138**

Source: (1) American Community Survey, 2010 (2) County Tourism Offices of Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster and Westchester Counties, 2012.

Restaurants and lodging facilities count highly among the small businesses that support the local tourism industry. Lodging accounts for 28 percent of traveler spending in the Hudson Valley, according to a NYS study. Restaurants are another high-earning piece of the tourism and hospitality industry[141]. Westchester County alone accounts for almost half of restaurants in the Mid-Hudson Region (see Table 1.8)[142].

[140] http://hvwga.com/
[141] http://catskillcitizens.org/learnmore/NYSTourismImpactHudsonValley.pdf
[142] County Tourism Offices of Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster and Westchester Counties, 2012

TABLE 8.2 RESTAURANT AND LODGING FACILITIES		
Location	**Restaurants[1]**	**Lodging Facilities[2]**
Dutchess	223	97
Orange	225	87
Putnam	25	3
Rockland	283	18
Sullivan	98	112
Ulster	207	186
Westchester	910	47
Region	**1971**	**550**

[1] Excludes chain restaurants, diners and delis.
[2] Includes all types of lodging, including hotel chains, bed and breakfasts, etc.
Source: County Tourism Offices of Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster and Westchester Counties, 2012.

There are numerous historic buildings and sites in the Mid-Hudson Region, and their revitalization not only supports the local historic preservation and restoration industry, but enables advances in green retrofits. On a larger scale, these projects contribute to the revitalization of urban centers, as is discussed in depth in Chapter 3. Adaptive reuse of historic sites creates new tourism opportunities while often generating fewer GHG emissions than new construction. There are already more than 1,000 registered historic sites in the Region (see Table 1.8), including historic districts, buildings, houses, cemeteries, farmhouses, churches, inns, libraries, public and private school buildings, mills and more.

TABLE 8.3 HISTORIC SITES		
Location	**Historic Attractions[1]**	**Registered Historic Sites[2]**
Dutchess	37	248
Orange	44	175
Putnam	15	50
Rockland	33	71
Sullivan	15	70
Ulster	30	169

TABLE 8.3 HISTORIC SITES		
Location	**Historic Attractions[1]**	**Registered Historic Sites[2]**
Westchester	45	219
Region	219	**1,002**

[1] Discrete sites that can be visited by the public.
[2] Sites that may or may not be available to the public.
Sources: (1) County Tourism Offices of Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster and Westchester Counties, 2012. (2) National Register of Historic Places, 2012.

INSERT TEXT RE ADAPTIVE REUSE AWARD

Challenges to Tourism in the Region

One challenge the Region needs to overcome is the fragmented nature of tourism and marketing efforts. The Mid-Hudson Region has a strong tourism identity, with a dedicated tourism website[143], a magazine, and numerous other resources. These resources do not utilize a standard method for defining the Region. For example, the Hudson Valley tourism site divides the Mid-Hudson Region into the Mid- and Lower Hudson Valley. This fractured identity is compounded by the NYS Tourism website[144], which divides the Region into the Catskills and the Hudson Valley.

8.3.1 Develop a Mid-Hudson Region Sustainability Brand

The planning process has demonstrated that there is considerable interest in developing a sustainability 'brand' for the Region. This brand would not superseded existing efforts, but rather provide an overarching umbrella that is recognizable and credible and generates grassroots momentum. A branding initiative could benefit tourism efforts, local agriculture, 'greening' of businesses, and more.

A Labeling Initiative to Support Sustainability in the Mid-Hudson Region

[143] http://www.travelhudsonvalley.org/
[144] http://www.iloveny.com/Fall.aspx

Establishing a branded label and pledge that can be used by local businesses will help concretize a larger sustainability branding initiative (INSERT WESTCHESTER GREEN BUSINESS CHALLENGE EXAMPLE).

Any sustainability label developed for the Mid-Hudson Region needs to be upheld by a series of clear, measurable criteria, aligned with the objectives and indicators that have emerged through this planning process. As residents and tourists become increasingly educated about environmental concerns, health and welfare, worker safety, and more, they ask questions about the products and services they consume – credibility is key.

Some of the steps that could ensure the success of the sustainability label are:

- A minimum voluntary 'pledge' that requires local businesses to commit to a series of basic actions, and allows them to post some sort of sticker or label in their shop window showing that they have taken the pledge
- A meaningful ranking for sustainable businesses, in which, for example, a five-leaf business meets all cross-cutting priorities established in this plan; while a one-leaf business is starting on becoming more sustainable, a project at a time.
- Clear guidance, criteria and performance measures that support the ranking and demonstrate success 'putting the pledge into action'
- An annual report on activities in the Region, highlighting leading examples and possibly giving out awards or hosting a gala event

This labeling initiative will help small businesses in the Region demonstrate a credible commitment to sustainable development and better leverage a common purpose, common criteria, and common measures of success. It also helps unite the Region in pursuing the Plan's core objectives for sustainable development.

A concerted effort to promote the Region as a sustainable place, enhancing its attraction as a tourism destination and place for investment will create jobs and generate tax revenue. Critically, it will also help support historic city centers, local farms, cultural institutions, parks and recreational facilities, and other resources that contribute to the Region's exceptional quality of life.

8.4 Foster Innovation in Green Technologies and Services

The REDC Strategic Plan[145] recommends developing high technology clusters in the Mid-Hudson Region. Although the Mid-Hudson Region may not rival Silicon Valley or Colorado or even Saratoga for high-tech energy industries, the Region has the right assets to support a meaningful market for consumer and public sector technologies. There is a strong educated base to underpin such efforts, with proximity to NYC and its markets as well as to Albany and its legislators.

This Planning Process has identified a regional priority to find and nurture talented innovators who develop technologies and services that can be used and tested within the Region, contributing to sustainable development while fostering market development.

No comprehensive data set currently captures the state of sustainable high tech in the Region. However, general economic data suggest that innovation is thriving. In 2011, 1,773 patents were filed in 19 of the Region's key economic centers[146]. Over 1,000 of the patents filed in the study area originated in four communities - Poughkeepsie, Ossining, Fishkill and White Plains. Innovators in these communities have doubled the annual number of patent filings since 2000. In fact, even between 2005 and 2010, ten of these communities doubled their annual number of patents filed. For example, residents and employees of the smaller economic centers (Beacon, Peekskill, New City, Somers, Carmel and Newburgh) filed 480 patents in 2010, compared to 230 patents in 2000.

Anecdotal data suggest that communities in the Mid-Hudson Region are receptive to testing innovative technologies and concepts, and promoting local entrepreneurs. For example, the Solar Energy Consortium (TSEC), founded in 2007, is working to establish a new solar energy industry in NYS.

[145] http://regionalcouncils.ny.gov/themes/nyopenrc/rc-files/midhudson/MHREDCSPFINAL11_12_11.pdf
[146] U.S. Patent Office, 2012. http://patft.uspto.gov

By focusing these efforts, the Region can build upon its strong foundation of innovation to attract sustainability-oriented entrepreneurs and innovators, as well as create new markets for green products and services. Developing local solutions to the Region's sustainable development challenges will help the Region grow by creating new opportunities, new jobs and using the Region as a test-bed for implementation. By actively encouraging regional innovation and resource centers aspiring innovators learn how to bring new concepts and applications to market, and create production centers for export outside the Region.

INSERT INDUSTRIAL ECOLOGY/INCUBATOR EXAMPLE

At the state level, NYS has already made a direct effort to measure the impact of green jobs with the 2011 Green Jobs Survey (see ***Table 8.4***. The survey asked "*companies that produce goods or deliver services that increase energy efficiency or generate renewable energy*" about their green workforce and about industry demand for targeted green services. According to the survey, the following green firms and jobs exist within the Hudson Valley:

While these data reflect a narrower definition of "Green Jobs" than may be appropriate for the Mid-Hudson Region, the survey shows that a substantive number of firms are actively engaging in making their day-to-day work and in turn, the Region, more sustainable.

TABLE 8.4 GREEN JOBS, 2010

Sector	# of Firms	# of Workers
Construction Trades	1,470	10,550
Building Services	470	4,650
Component Manufacturing	30	430
Professional Services	430	2,880

Source: New York State, Hudson Valley Report, 2011: http://labor.ny.gov/stats/green/hudsonvalley.pdf

8.5 Support Natural Resources Sector Industries

Creating new green jobs through innovation is not the only path forward. The Mid-Hudson Region has a strong economy based in the natural resource sector, and this economy should be further developed to maximize its potential. To give one example, agriculture and the food industries are an important source of jobs, yet wages have declined steadily. Fostering the

development of this sector will help maintain the Region's rural character while also maintaining and creating green jobs.

Smart public-private partnerships are also a good way to foster existing industries. They help provide support, feedback, lessons learned, guidance, and critical linkages for the kinds of job creating projects and initiatives that the Mid-Hudson Region is shaping for its future.

Companies can look for co-location opportunities to create eco-industrial clusters, reusing industrial waste in a cradle-to-cradle approach. Already, local businesses are organizing around green rating systems, like the Westchester County Green Business Challenge.

Mature industries can benefit from educational programs to become greener in their daily operations. There are numerous programs that deal with corporate sustainability, and industry-specific guidelines are being developed across the board. By connecting professional and academic communities across the Region that are already implementing and evaluating sustainable business practices, best practices can be shared.

INSERT – NEW CONTENT PENDING

8.6 Strengthen and Support Green Leadership in Government

There is tremendous potential to increase the resource efficiency of existing government and business operations. This has the potential to increase profits and generate work for local vendors and service providers, all while improving environmental performance.

Locally, governments have a long history of leading by example. Many municipalities have completed energy audits, upgraded facilities, established green procurement policies, and much more. Numerous communities have signed on the Climate Smart Communities program (see Table 8.5), among many other examples. The amount of activity in the government sector in the Region is exemplary, and needs to be supported and, where possible shared with other communities whose programs are in their nascence.

Government can also set policy that helps businesses green their operations. Establishing ordinances that incentivize or require new facilities to be built to strict standards is one example. The Leadership in Energy & Environmental Design (LEED) system administered by the U.S. Green Building Council, is one of the most widely accepted standards. LEED provides

a template for design-build projects that incorporates improvements in energy efficiency and responsible building practices. As of 2012, 33 buildings in the region were LEED Certified, with 19 in Westchester County alone. In addition, a total of 114 applications are currently underway in every county. Many alternatives exist, including the EPA's Energy Star building rating system, NAHBGreen from the National Association of Homebuilders and the Living Building Challenge from the International Living Building Institute.

TABLE 8.5 CLIMATE SMART COMMUNITIES (2012)

County	Number of Climate Smart Communities	As a Percentage of existing Cities and Towns[1]
Dutchess	3	7%
Orange	2	3%
Putnam	0	0%
Rockland	4	7%
Sullivan	2	8%
Ulster	6	13%
Westchester	26	30%
Region	**43**	**12%**

Source: New York State Department of Environmental Conservation, 2012: http://www.dec.ny.gov/energy/56876.html

[1] Based on 2010 Census designated places, cities and towns.

INSERT DETAILED ANALYSIS AND RECOMMENDATIONS

8.7 Invest in Education and Workforce Development

Forthcoming

9 Implementation Framework

This Chapter includes:

1. Methods for sustaining regional collaboration
2. Methods for integrating the Plan into local processes
3. Methods for improving information management and collection
4. Tools and resources to aid implementation
5. Methods for measuring success in implementation

9.1 Sustaining Regional Collaboration

The Mid-Hudson Region sustainability planning process represents a major effort at collaborative regional planning at a scale encompassing seven entire counties. As part of the process, government, private sector, and non-profit staff and representatives worked together to identify regional priorities, share data and information, identify best practices, highlight regional success stories, and pool resources in the interest of the Region's sustainable development. The benefits of this regional collaboration are significant and go far beyond the production of this Plan – the networking and knowledge sharing have resulted in new partnerships and projects which will have a lasting impact on the Region. Now is the time to concretize these gains and overcome challenges that have previously beset regional governance for sustainable development.

9.1.1 Governance Challenges

As discussed in Chapter 2, the Region has a long history of collaboration for regional planning. However, the different institutions and governance structures created as part of this collaboration rarely correspond exactly to the Mid-Hudson Region's borders. Hudson River-

oriented bodies often exclude Sullivan County. NYC Metro-oriented bodies often exclude the northern and western counties (Ulster, Sullivan, etc.).

The fragmented regional governance landscape has historically been a detriment to the Region. It is been hard for local planning bodies to demonstrate a strong capacity for regional planning in the absence of a well-defined, consistent region and strong institutions with truly regional coverage. This can impact competitiveness for federal and state funding opportunities, as regions with a more consistent definition and set of aligned institutions can appear to have greater for effective implementation. The multiplicity of regional definitions also makes consistency – in data collection, terminology, project prioritization, etc. – difficult. Rather than pursuing a regional set of priorities, the different bodies within the Region may find themselves competing or working at cross-purposes.

9.1.2 Governance Objectives

A Mid-Hudson Region governance framework for sustainable development is needed to sustain collaboration, facilitate Plan implementation, and track progress. This governance structure should seek to accomplish the following objectives:

RG1: Strengthen and promote the view that "Mid-Hudson Region is a national leader in sustainable development."

- This includes branding, education and outreach efforts within the Region.

RG2: Track progress against indicators.

- This includes developing and implementing a robust metrics management system/data repository.

RG3: Enforce/oversee Plan implementation and updates.

- This includes developing mechanisms to oversee local government efforts to implement the Plan, as well as facilitating periodic updates to the Plan

RG4: Facilitate knowledge sharing.

- This includes organizing events, activities and other platforms (discussion groups, web forums, etc.) that provide regional stakeholders the opportunity to share best practices with regard to Plan implementation.

RG5: Attract funding to the Region.

- This includes coordinating efforts to apply for funding for regional-scale initiatives. Additionally, it includes facilitating local entities with acquiring funds and demonstrating a regional commitment to sustainable development.
    - If entities within the Region want to benefit from funding, they will need to demonstrate a commitment and contribution to regional governance
- Depending on the approach pursued, a regional governance body could also directly fund projects and programs that implement the Plan's objectives

9.2 Governance Strategies

9.2.1 Create a Regional Governance Coordinating Body

Forthcoming

A Baseline Assessment

B GHG Inventory

C Climate Change Vulnerability Assessment

D Public Engagement Summary

E Complete List of Project Ideas

F Selection of Watershed Management Plans

G Attachment Title

H Attachment Title