

Landscape Scale Conservation in the Northeast and Midwest

A Position Paper from the Three Mission Areas¹ of the USDA Forest Service:
Eastern Region, Northeastern Area, and Northern Research Station; and
the Northeastern Area Association of State Foresters.

Foreword

Effective land stewardship in the face of change is a compelling issue in the Northeastern and Midwestern United States. Climate change, urbanization, fire, and pests are among many threats to the integrity of our Nation's forests and the ecosystem services they provide. With one-quarter of the Nation's forests, and nearly half (43%) of the Nation's population in this region, "...*conserving our forests is not a luxury, it is a necessity.*"² The USDA Forest Service in the Northeast and Midwest and the Northeastern Area Association of State Foresters (NAASF) together offer an inclusive vision of landscapes³ and landscape scale conservation⁴ designed to address these and other threats by reaching across ownership boundaries. In his recent groundbreaking speech, USDA Secretary Tom Vilsack advanced the need to conserve America's forests through an *all-lands* approach, accentuating community health and wealth, sustaining clean and abundant water, restoring forests, and protecting communities from wildfire. The National Association of State Foresters (NASF) has recently articulated an all-lands vision for forests that recognizes the value of all forests and trees—rural and urban, public and private—in all states and U.S. territories.⁵ Secretary Vilsack's visionary statement holds that the Forest Service shall not be viewed solely as an agency concerned with the fate of our National Forests, which encompass 7 percent of the region's forested lands, but must use its direct *and* indirect role to help steward all of America's forests, including state, tribal, private, and urban lands. The Forest Service and NAASF together recognize that public benefits as well as forest threats cross boundaries and are best addressed through integrated partnerships and infrastructure (markets, resource professionals, and information).

Forest Service and NAASF Vision

The work of the Forest Service and state forestry agencies is focused on maximizing the public benefits derived from trees and forests. The Forest Service and state forestry agencies are positioned to serve people in this region through a cohesive, comprehensive Landscape Scale

Landscape³ may be defined by a combination of geography and resource issues or opportunities, and may be of varying scale and scope. They give rise to communities of interest and a family of local, state and federal resource agencies, tribes, and other landowners bound together by a mutual interest in the outcomes within the landscape.

Landscape Scale Conservation⁴ is an emerging framework to conceive, plan, finance, and manage projects with significant conservation value – ecological, economic and social. The broad concept of Landscape Scale Conservation includes three basic features:

- 1.** There is a *regional* system of interconnected properties (lands).
- 2.** Actions are organized to achieve one or several specific *conservation objectives*.
- 3.** Landowners and managers within a given conservation region *cooperate or collaborate* in some concrete fashion to achieve those objectives.

Conservation (LSC) approach to land management, protection, and wise use. We look forward to working with willing partners in a process to design collaboration in pursuit of LSC. Using the concept of LSC, we seek to work seamlessly within the Forest Service, state forestry agencies and a broad array of partners at a landscape level to achieve conservation objectives consistent with the issues and priorities that define and identify those landscapes. **LSC shall be a foundational concept of Forest Service and state forestry agency behavior and actions across the Northeast and Midwest.**

Foundations of Collaboration

The successful pursuit of LSC requires exceptional collaboration; open to multiple goals and approaches, but with shared purpose and responsibility. A driving principle of the LSC approach is to take advantage of existing programs and efforts, while lending focus to the efforts of willing partners to address issues on landscapes. The Statewide Forest Resource Assessments and Strategies, National Forest Land and Resource Management Plans, and outputs from the Northern Forest Futures Project are integral to emerging LSC opportunities. Five key aspects of successful collaboration, referred to here as Foundations of Collaboration, include Information; Shared Landscapes, Issues, and Investments; Risk Management; Communication; and Implementation.

Information is at the core of decision-making both at the ground and policy levels. High-quality information must be produced, gathered, synthesized, and shared to create the basis of informed decision-making. This information ranges from basic science and resource assessments, through adaptive management techniques and other applied science, to sharing information about management goals across ownerships and landscapes. Multiple scientific and management entities working together can better identify and fill knowledge gaps, and address public concerns and benefits.

Shared Landscapes, Issues, and Investments form focal points of intensive collaboration, integrating cutting edge science, assessment, adaptation, monitoring, and other appropriate actions between the Forest Service, State Foresters, and other partners. The intent is to bring shared expertise and resources to bear on existing priorities and efforts with ongoing investments in the short term, such as contributing to the development of statewide forest resource assessments and strategies that identify and address priority landscapes, and developing and applying new techniques in land management, and many others. In Shared Landscapes, the overarching goal would be to *integrate* these and other efforts where appropriate and possible, while fundamentally enhancing collaboration and public involvement and awareness throughout the region in the long term.

Risk Management involves the assessment and mitigation of various ecosystem stressors and effectively tests potential management responses at the landscape scale. Key tenets of adaptive management include accepting some risk for failure, monitoring and evaluating results, and learning from experiences. By focusing our collaborative efforts on specific portions of Shared Landscapes, we ensure that we efficiently test ideas and approaches, and thereby replicate wise use decisions through sound ecosystem management and protection.

Communication is a critical component of successful collaboration, allowing all parties to benefit from the synergy of working together: sharing lessons learned, supporting common priorities, and accommodating different management objectives. Documenting and effectively communicating the processes described above will better enable management recommendations and guides for decision making that have a documented basis in science, testing, collaboration, and future predictions. Outreach is crucial in educating the public about current and future ecosystem challenges, the options in meeting those challenges, and why it matters.

Implementation of activities on the ground is ultimately where success will be determined. The Forest Service, States and other partners must identify and implement priority activities. Ultimately, success will be determined by how the elements work in concert to affect the provision of public benefits from forests in the Northeast and Midwest. Furthermore, the level of success will be correlated with the ability of the Forest Service and States to do this work in manner that builds on existing mechanisms and is done in concert with existing and new partners. The Forest Service and state forestry agencies provide important resources, services, coordination, infrastructure, oversight, research, and professional expertise needed to manage and protect forests across all ownerships.

Context of Forest Service Interest

The Forest Service contributes to LSC as one of many interests in the intricate web of conservation. The Forest Service is itself an internal community of interests and service. By creation of the Forest Service, more than a century ago, the Mission Areas of the agency are bound together in a fundamental mission of “*sustaining the health, diversity, and productivity of the Nation’s forests and grasslands to meet the needs of current and future generations.*” The Eastern Region, the Northeastern Area, and the Northern Research Station maintain overlapping goals and unique roles in meeting the Agency mission across the twenty states of the Northeast and Midwest and the District of Columbia. Each has land stewardship at its core, with authorities respectively focused on land management, landowner and community assistance, and basic and applied ecosystem science and technology development.^{1,6}

Context of State Forester Interest

The state forestry agencies are responsible for protecting and sustainably managing the forests of their respective states, including the District of Columbia. They accomplish this through direct action, guidance to other forest landowners, and through an array of partnerships. As public servants, State Foresters are credible sources of information and provide leadership based on detailed knowledge of local economies, forest resources, partners, and landowners. State forestry agencies provide essential “boots on the ground” infrastructure that includes delivering technical and financial assistance to landowners, administering best management practices (BMP) programs and forest practices regulations, implementing conservation tools such as easements, and providing wildland fire suppression and invasive species control. State Forests and state tree seedling nurseries supply essential elements for landscape-scale conservation. Most importantly, State Foresters foster partnerships with citizens and local, regional, and national stakeholders that multiply the efforts of all resource professionals and conservation experts. The infrastructure provided and supported by state forestry agencies is essential for maximizing public benefits from forests and meeting emerging challenges.⁶

Statement of Intent

The Forest Service and State Foresters in the Northeast and Midwest will cooperate in the pursuit of LSC with other federal, state, tribes, and local agencies, private landowners, and non-profit organizations to:

“...foster a greater appreciation in this country for our forests and that all Americans, regardless of where they live, see the quality of their lives and the quality of their forests as inseparable.”²

Tom Vilsack, Secretary of Agriculture

We commit to support the positions in this paper in pursuit of Landscape Scale Conservation.



Kent Connaughton,
Regional Forester, Eastern Region

12/29/09
Date



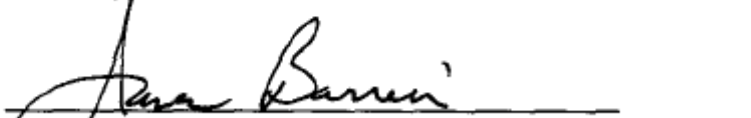
Kathryn P. Maloney
Director, Northeastern Area

12/16/09
Date



Michael T. Rains
Director, Northern Research Station

12.16.2009
Date



James S. Barresi
President, Northeastern Area Association of State Foresters

12-17-09
Date

¹Eastern Region - National Forest System – Protection and management of natural resources on National Forest System lands; Northeastern Area - State and Private Forestry – Community assistance and cooperation with State and local governments, forest industries, and Indian tribes, and private landowners to help protect and manage non-Federal forest and associated range and watershed lands to improve conditions in rural and urban areas.); Northern Research Station - Research and Development: Working at the forefront of science on all aspects of forestry, rangeland management and forest resource utilization [Source: <http://www.fs.fed.us/aboutus/meetfs.shtml>]

²Vilsack, Tom. USDA Secretary. Speech in Seattle, Washington, “National Vision for America’s Forests”. August 14, 2009

³Levitt, James N. *Grappling with the Green Matrix*. Land Lines: January 2004, Volume 16, Number 1.

⁴Ericson, Peter. *Conservation on the Edge: Landscape Scale Conservation at Colorado's Urban-Rural Interface*. Massachusetts Institute of Technology, Department of Urban Studies and Planning. 2004

⁵National Association of State Foresters. “All-Lands Policy Platform: A Seven-Point Plan for America's Forests”. [Source: http://www.stateforesters.org/all_lands_policy_platform]

⁶See Appendix A for specific contributions for LSC by the three Mission Areas of the USDA Forest Service and the Northeastern Area Association of State Foresters.

Appendix A

Forest Service and NAASF Contributions for Landscape Scale Conservation in the Northeast and Midwest

The leaders of the US Forest Service in the Northeast and Midwest (Eastern Region, National Forest System; Northeastern Area, State and Private Forestry; and the Northern Research Station, Research and Development) met in Philadelphia, PA on September 30, 2009 to discuss Forest Service contributions to Landscape Scale Conservation (LSC). The “Philadelphia Meeting” called for each Forest Service Mission Area to describe its specific contributions toward LSC in the Northeast and Midwest. The Forest Service leaders then met with the State Foresters from the 20 northeastern and midwestern states and the District of Columbia to discuss the specific contributions of the Northeastern Area Association of State Foresters (NAASF) and how these contributions are integral to successful LSC implementation. The contributions of the Forest Service and NAASF are detailed in this Appendix and tiered to the “Foundations of Collaboration.”

The Forest Service and NAASF currently work closely together on several landscape scale conservation projects, bringing individual strengths and authorities to the forefront. Together, we collaborate on development of the Northern Forest Futures Project; on submission of project proposals and strategies for the EPA-led Great Lakes Restoration Initiative; on implementation of the Upper Mississippi River forestry partnership; and on design and implementation of the Climate Change Response Framework for the Chequamegon-Nicolet National Forest and the northern portion of the state of Wisconsin. We are collectively working together on the development of Statewide Forest Resource Assessments and Strategies, in accordance with the 2008 Farm Bill. Additionally, we are committed to further enhancing our collaborative efforts with each other and partners in pursuit of Landscape Scale Conservation.

The Foundations of Collaboration – The successful pursuit of LSC requires exceptional collaboration; open to multiple goals and approaches but with shared purpose and responsibility. Five key aspects of successful collaboration, referred to here as Foundations of Collaboration, include *Information; Shared Landscapes, Issues, and Investments; Risk Management; Communication; and Implementation.*

Forest Service Mission Areas and NAASF in the Northeast and Midwest

Each of the Forest Service units (NA, NRS and the Eastern Region) and NAASF is able to address and contribute differently to the five foundations of collaboration, based on mission and authorities. That very fact lends itself to the added value of this collaboration. The sum is truly greater than the parts, with the opportunity for synergy and innovation. Listed below are the foundations and the contributions each entity is best able and suited to share. Through time, the collaboration will result in new processes, opportunities, and accomplishments to be monitored, captured, and replicated as appropriate.

Eastern Region – National Forest System – In 2005, the U.S. Forest Service celebrated the legacy of its first century of service. At that time, leaders in the Eastern Region asked "what will our legacy for the next century be?" This led to the development of a vision for the Region which is "Courageous Conservation," a sustainable future, and a legacy of restoration. Traditionally, the National Forest System (NFS) mission area focuses on lands it manages and is somewhat limited in its authorities outside of National Forest boundaries. However, by serving as "Living Laboratories" and working closely with Research and Development and State and Private Forestry, the NFS can have a wide and profound influence on land stewardship and Landscape Scale Conservation. In accordance with its mission of long-term land stewardship, the Eastern Region commits to adopting the Foundations of Collaboration. NFS provides a permanent nucleus, base, or foundation of forest resource from which to build and extend positive benefits (e.g. corridors and expansion of forest interiors).

Northeastern Area – State and Private Forestry – State and Private Forestry (S&PF) is collaborative by design, with this collaboration mandated by the 2008 Farm Bill. Several components of S&PF's Redesign, on which sections of this most recent Farm Bill was developed, are intended to shape and influence forest land use on a scale and in a way that optimizes public benefits from trees and forests for current and future generations.

The Northeastern Area works with state forestry agencies and others to address one of the largest concentrations of privately-owned forests in the world: more than three-quarters of the 170 million acres of forestland in the Northeast and Midwest are privately owned. NA's suite of programs provides technical and financial assistance and forest protection from pests and fire to non-federal forest landowners. A boundary-less approach is critical to sustain these forestlands and their benefits enjoyed by all Americans, particularly the forty-three percent of the Nation's population who call this region "home."

Northern Research Station – Research and Development – By the nature of the work in the Research and Development mission area, discovery and technology transfer reaches across all lands and all ownerships – from the natural to the rural to the urban environment. The Northern Research Station (NRS) is one of the largest forest science organizations in the world, with active research in all major components of forest ecology. The NRS commits to providing a unique contribution to Landscape Scale Conservation, expressed through the Foundations of Collaboration.

Northeastern Area Association of State Foresters – The State Foresters from the 20 northeastern and midwestern states and the District of Columbia collectively provide a direct link to 5 million family forest landowners and nearly 23 million acres of state forest land. They serve as the delivery mechanism for a suite of federal programs aimed at protecting, conserving, and enhancing the forest resources across the region. The State Foresters have the lead for developing Statewide Forest Resource Assessments and Strategies, which will focus on-the-ground activities by states, partners, and the Forest Service.

Mission Area Contributions through Collaboration Foundations

Information is at the core of decision-making. High-quality information must be produced, gathered, synthesized, and shared to create the basis of informed decision-making.

Eastern Region – The Eastern Region seeks to revolutionize effectiveness and efficiency. This involves developing cost-efficient, easy-to-use information systems that facilitate work at multiple scales. We will work to increase the public benefits we deliver by working at broader scales, seamlessly managing information, and changing our regional management processes to facilitate flexible and effective results.

Northeastern Area – The success of the states in development and implementation of their statewide assessments and strategies is part of our shared success. States are addressing landscape scale conservation through these efforts. A fundamental question in all we do, and as NA facilitates, coordinates, and assists state efforts is “What can help states be successful in developing their state assessments and strategies?” Through these collective efforts, the spark of collaboration begins to ignite, catch, and lead to a dynamic seamless landscape strategy.

The Northeastern Area (NA) and the Northeastern Area Association of State Foresters (NAASF) have provided a guidance and framework for statewide assessments that build from a subset of the Montreal Process Criteria and Indicators and from spatial data developed through the NA/NAASF joint spatial analysis project. Similarly, NAASF and NA have established guidance for the states’ statewide strategies. NA staff specialists continue to stay focused on helping individual states with information gathering and synthesis. The NA staff accomplishes this by facilitating access to data and specialists relevant to state assessment and strategy development and by maintaining the Forest Sustainability Indicators Information System, providing the technology transfer of ecological, social, and economic information relevant to 18 indicators of forest sustainability chosen by NA and NAASF. Data are presented in user-friendly graphs, maps, and tables that track trends over time at State, multistate, and other scales for the Northern United States, a region that includes the 20 Midwestern and Northeastern States and the District of Columbia. Much of the information provided is developed and maintained by NRS and other Research and Development units.

Northern Research Station – The NRS will produce, synthesize and share high-quality information from numerous sources to create the basis of informed decision-making and effective land stewardship. Full consideration of issues requires information about present and potential future conditions. The NRS will continue to lead, in collaboration with NA and NFS, and NAASF, the development of the Northern Forest Futures Project in producing cooperative assessments and future predictions. This project will offer projections based on alternative futures reflecting different possible responses to issues raised in its scoping activity. These issues, based in part on results of statewide issue identification associated with direction from the latest Farm Bill, might include, but are not limited to:

- Sustaining forests in the face of climate change,
- Addressing the needs of forest wildlife as forests change,
- Effective control of invasive species and changing disturbance regimes,
- Restoration of forests and ensuring clean water and adequate supply,
- Open space management and development, and
- Alternative energy sources using wood.

The NRS will document and share the findings from its science and technology development actions to enable other landscapes and partnerships to contribute to community health and wealth. Management

recommendations and guides for decision making will have a documented basis in science, testing, collaboration, reasoning, and predictions.

NAASF – State assessments and strategies provide State Foresters and partners with a powerful, collaboratively developed tool to assess the forest resources across all ownerships in each state. State assessments can help inform the management of public and private lands and identify data gaps that warrant further investment. These assessments incorporate data and information from many sources and incorporate components of State Wildlife Action Plans, Community Wildfire Protection Plans, and other state and partner planning documents. State results from stakeholder involvement with state assessments have provided a significant portion of the scoping input for the Northern Forest Futures Project.

Shared Landscapes, Issues and Investments form focal points of intensive collaboration, integrating cutting edge science, assessment, adaptation, monitoring, and other appropriate actions between the Forest Service, State Foresters and other partners.

Eastern Region – This involves working with partners, using traditional and creative new approaches, to expand the amount of National Forest System land managed for public benefit. We will cooperatively manage ecosystems at the larger landscape level, using both traditional approaches and new models of interest-based public, tribal, and private collaboration.

Northeastern Area – NA works with states and other partners to provide technical assistance and support identified in resource-driven strategies through existing authorities and the suite of S&PF programs (Forest Stewardship, Forest Legacy, Urban and Community Forestry, Forest Health Protection and State Fire Assistance, and others). The state strategies are focused on priority issues and priority places (e.g. landscapes) within a state, and across state boundaries, regardless of jurisdictional and ownership boundaries, along a rural to urban continuum. Because states are directed to involve all stakeholders and consider existing plans (e.g. Comprehensive State Wildlife Action Plans, Community Wildfire Protection Plans, etc) these strategies will serve as the foundational drivers for program and organizational integration among all land management entities.

Northern Research Station – The NRS will focus our science and technology development efforts on landscapes, targeting place-based conservation. The landscapes shall be delineated from a set of agreed to criteria and be focal points for addressing issues through a concentration of available resources that integrate leading-edge science including, assessments, adaptation tactics, monitoring, prediction models and other appropriate actions. Science and technology development in these landscapes will be collaborative in nature and utilize past and current work. Using landscapes will enable the investments in science and technology development to be more focused to better meet the needs of land managers and others being served. Effective and efficient solutions will be replicated to other landscapes.

NAASF – State Foresters work across a landscape from largest metropolitan areas such as New York City and Chicago to some of the most rural forested areas in the country. Partners, whether NGOs, other state agencies or others, are an integral part of successful program delivery and strategic thinking. State Foresters will focus federal, state and other resources in a strategic manner on landscapes identified as high priority.

Risk Management involves the assessment and mitigation of various ecosystem stressors and effectively tests potential management responses at the landscape scale.

Eastern Region – The Eastern Region will work with federal, state and academic researchers to create Living Laboratories in which adaptive management is aggressively pursued at multiple spatial scales and at all levels of management.

Northeastern Area – NA and NAASF are undertaking the Stewardship Project, with National support and involvement to reform delivery of the Forest Stewardship Program. Reform will expand and expedite the influence of the program through a focus on the landscape and stakeholders within the landscape. The reformed Stewardship Project will allow for rapid, coordinated assessment and mitigation of ecosystem stressors across a landscape scale.

Through the Stewardship Project and implement of statewide strategies landscape scale planning, technical assistance and support in priority landscapes will engage communities and businesses while benefiting forest landowners. The reformed program will expand its influence on private forest management and help build broad-based support for forest management. The program will focus at a landscape scale to provide technical forestry assistance, access to ecosystem services markets, coordinated government services and support for associated collaborative efforts.

Competitive project proposals from state forestry agencies are solicited by NA and evaluated annually by NA and NAASF according to the following criteria: 1) Priority Issues or Landscapes. 2) Measurable Results and Significant Outcomes. 3) Capacity for Replication. 4) Partnerships and Collaboration. States are encouraged to take risks in innovation and collaboration through the competitive grants without jeopardizing their core program delivery and existing commitments. This balance in risk and consistency leads to solid program delivery.

Expected benefits of the reforms from the Stewardship Project and potentially from competitively granted projects include effective landscape scale forest planning and management, supported by forest landowners, communities and other stakeholders, including those who depend upon the benefits they derive from healthy, productive forestland. Lessons will be learned and applied through critical evaluation and adaptive management.

Northern Research Station – Choosing different landscapes with varied conservation issues will enable Research and Development to more effectively test potential management responses, more efficiently focus work, and develop new alliances. One tenet of adaptive management is accepting some risk for failure. The NRS will work with partners to develop appropriate monitoring protocols and systems designed to provide rapid feedback supporting adaptive management. Fully understanding shortfalls will ensure that we replicate good forest stewardship decisions.

NAASF – A new set of comprehensive performance measures has been developed to monitor and evaluate the success of state forestry programs over time. These measures, along with information captured over time by a national assessment, will provide states and others with valuable feedback on program delivery effectiveness and necessary adjustments. The State Foresters are front line in

providing technical advice to landowners on the appropriate mitigations to any potential ecosystem stressors.

Communication is perhaps the most important component of successful collaboration, allowing all parties to benefit from the synergy of working together: sharing lessons learned, supporting common priorities, and accommodating different management objectives.

Eastern Region – Connecting citizens to the land involves building greater capacity to engage citizens in our work by using partnerships, agreements, budgets, training, and management to get work done. We will link potential partners and volunteers to high priority programs. We will increase communication, education, and outreach efforts to make National Forest users more informed about LSC and the knowledge gained in the previous Foundations.

Northeastern Area – NA Director works in true partnership and collaboration with State Foresters of the Northeast and Midwest, to share in decisions affecting the state forestry agencies. The State Foresters are integrally involved in the Northeastern Area decisions that affect them directly and indirectly including funding allocation formulas, changes in funding levels, competitive grant project selection, and program direction and emphases.

Integration is a core principal of NA, looking for, facilitating, and responding to opportunities to integrate among the state forestry agencies and the people they serve, Forest Service Eastern Region and Northern Research Station, and other partners, including other state, federal and local agencies, tribes private landowners, and non-profit organizations.

Northern Research Station – The NRS is committed to effective science delivery through multiple platforms. Traditional outlets include publication of scientific results and recommendations in general technical reports, manager’s guidebooks, and peer-reviewed scientific journals. General information is released through pamphlets, brochures, and circulars. The NRS also supports technology transfer through websites, “webinars”, videoconferences, and same-time-same-place conferences, workshops, and seminars.

NAASF – State forestry agency staff, working through NAASF’s committees, provide a valuable staff-level conduit of information not only with NA, NRS, and the Eastern Region, but also with a wide range of partners and other state agencies. In addition, the NAASF Executive Committee will continue to serve as an executive-level forum for the Forest Service and NAASF leadership to discuss priority investments and program direction. State Foresters and their staff also provide direct communication with private landowners.

Implementation of activities on the ground is ultimately where success will be determined. Public lands (federal, state and local) provide a nucleus of forest habitat, access and the stewardship of forests, particularly in the Northeast and Midwest where forests are fragmented.

Eastern Region – The Eastern Region is tasked with directly managing the nearly twelve million acres of national forest system lands in the Northeast and Midwest on behalf of the American people. The

National Forests work beyond boundaries to collaborate with many other owners and interests to affect a more successful ecological outcome through planning and environmental analyses. Using the best available sciences, these public lands can be used for demonstration purposes as living laboratories, contributing to understanding and controlling threats.

Northeastern Area – The Northeastern Area provides coordination in shared landscape planning and implementation with state forestry agencies, NRS, and the Eastern Region, focusing on non-federal forest lands for program delivery oversight. NA with NAASF and other partners point to several successes of landscape planning including the New York City Watershed efforts; the Highlands of New York, New Jersey, Connecticut, and Pennsylvania; Chesapeake Bay watershed forestry efforts and many others.

NA works with NAASF to strategically invest well, and optimize return on investment, with full disclosure and opportunities to economize and share resources. Focus on existing commitments; learn from those experiences, then shift elsewhere.

Northern Research Station – Engaging in science-based resource management is fundamental to pursuing sound stewardship and maintaining public credibility. With a shared sense of purpose and responsibility, the NRS provides more than just decision support tools – it provides people. The NRS thus creates information necessary for science-based management, and then seeks to work with land managers in the conversion of science to management. This outreach takes place by individual scientists as well as through specific groups within the NRS created for that purpose.

NAASF – State forestry agencies have the primary role in implementing the broad suite of federally funded programs aimed at maximizing public benefits from private forests. State staffs serve as a direct connection to family forest owners, communities and non-governmental organizations. Additionally, state forestry or other state agencies implement regulatory programs to address water quality, forest practices, invasive species, and other key issues.

Appendix B

Partnerships in Landscape Scale Conservation in the Northeast and Midwest

The original partners of Landscape Scale Conservation in the Northeast and Midwest¹ eagerly anticipate expanding the partnership in pursuit of landscape scale conservation, consistent with the issues and priorities that define and identify those landscapes. This appendix documents the commitment of partners in Landscape Scale Conservation efforts in the Northeast and Midwest. As included, partners will describe their missions and their intended contributions, tiered to the five Foundations of Collaboration, following the format of Appendix A. New text may be added between brackets. A new sub-appendix will be added for each new partner, describing their contribution, according to the following outline:

[Sub-Appendix B.x]

[Partner] Contributions for Landscape Scale Conservation in the Northeast and Midwest

[A general description of purpose and intent of collaborating through the LSC process. Brief examples of ongoing collaborative efforts, as appropriate.]

The Foundations of Collaboration – The successful pursuit of LSC requires strong and dedicated collaboration; open to multiple goals and approaches but with shared purpose and responsibility. Five key aspects of successful collaboration, referred to here as Foundations of Collaboration, include *Information; Shared Landscapes, Issues, and Investments; Risk Management; Communication; and Implementation.*

[Partner Mission]

[General description of the Partner’s mission.]

Mission Area Contributions through Collaboration Foundations

Information is at the core of decision-making. High-quality information must be produced, gathered, synthesized, and shared to create the basis of informed decision-making.

[Partner’s contribution to this Foundation.]

¹ US Forest Service: Eastern Region, Northeastern Area, Northern Research Station; and the Northeastern Area Association of State Foresters (NAASF).

Shared Landscapes, Issues and Investments form focal points of intensive collaboration, integrating cutting edge science, assessment, adaptation, monitoring, and other appropriate actions between the Forest Service, State Foresters and other partners.

[Partner’s contribution to this Foundation.]

Risk Management involves the assessment and mitigation of various ecosystem stressors and effectively tests potential management responses at the landscape scale.

[Partner’s contribution to this Foundation.]

Implementation of activities on the ground is ultimately where success will be determined. Public lands (federal, state and local) provide a nucleus of forest habitat, access and the stewardship of forests, particularly in the Northeast and Midwest where forests are fragmented.

[Partner’s contribution to this Foundation.]

Statement of Intent

We commit to support the positions in this paper in pursuit of Landscape Scale Conservation.

Signature

Date

B.1

USDA Forest Service Forest Products Laboratory Contributions for Landscape Scale Conservation in the Northeast and Midwest

Pending.

Appendix C

Responding to Climate Change: An Integrated Plan for Landscape Scale Conservation in the Northeast and Midwest

Climate change affects all lands, requiring a widespread and coordinated response by land stewards. In November 2009, Chief Tidwell requested that Forest Service entities and partners establish regional collaborations to address climate change through landscape scale conservation. The Chief’s request corresponds with ongoing activities in the Northeast and Midwest. These activities include (1) the establishment of a landscape scale conservation partnership (initially the Eastern Region, Northeastern Area, Northern Research Station, Northeastern Area Association of State Foresters (NAASF), and Forest Products Laboratory), as detailed in the main document associated with this appendix, and Appendices A and B; (2) creation of a USDA Forest Service eastwide strategy for climate change response (Appendix C.1; including Research and Development, State and Private Forestry, National Forest System, and International Programs in the Eastern US); and (3) creation of a Northeast and Midwest strategy for climate change response (Appendix C.2; including the Eastern Region, Forest Products Laboratory, Northeastern Area, and Northern Research Station), which tiers to the eastwide strategy.

The climate change response strategies referenced in (2) and (3) above tier to the Forest Service’s Strategic Framework for Responding to Climate Change, and define outcomes, strategies, and specific actions as directed in the Chief’s November 2009 letter. Although these adaptation and mitigation strategies and actions were drafted prior to the formal adoption of our landscape scale conservation approach, our intention is to review and revise as needed, and deploy them through the five Foundations of Collaboration. This includes integrating the activities of all partners wherever possible and appropriate.

As the strategies are revised and new information and opportunities become available, this appendix will be updated with appropriate details and given a new version number. Additions to the appendix will also include descriptions of Case Studies that exemplify the landscape scale conservation approach in response to climate change.

C.1

The Operating Framework for Climate Change Management in the Eastern United States

Please see attached document “The Operating Framework for Climate Change Management in the Eastern United States”.

From the document Foreword: The east-wide climate change framework will focus on helping rural and urban forests adapt successfully to changing climate through developing, testing, and pursuing a suite of ecosystem services and markets for them; and, mitigating the adverse impacts of climate change

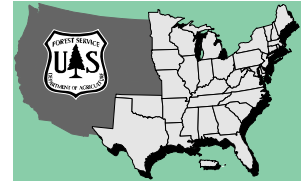
through delivery of targeted and cooperative management actions. This east-wide climate change framework is tiered to the national climate change framework and includes operating principles, significant program components, key activities and effective actions designed to improve subject matter awareness; delineate our unique niche; and, define the specific means that we will add value to better serve our constituents in the east. The framework will enable the CELT [Combined Eastern Leadership Team] to better join forces to cost-effectively respond to contemporary conservation issues associated with climate change.

C.2

Restoration and Sustainability of Eastern Forests through Climate Change Mitigation, Adaptation, and Bioenergy: A Strategy for Research, National Forests, and State and Private Forestry

Please see attached document “Restoration and Sustainability of Eastern Forests through Climate Change Mitigation, Adaptation, and Bioenergy: A Strategy for Research, National Forests, and State and Private Forestry”.

From the document Introduction: This strategy document presents an approach to mitigating and adapting to climate change in Forest Service [Eastern] Region 9. It is tiered to the Forest Service Strategic Framework for Climate Change, a cohesive strategy for the nation and all of the Forest Service (Figure 1 and Appendix 4). The strategic elements presented here address the Chief’s goals of increasing carbon sequestration, increasing use of biofuels, and reducing threats to U.S. forests. This strategy document is also tiered to the Forest Service Global Change Research Strategy for 2009-2019 (Figure 1 and Appendix 5), to the Forest Service Woody Biomass Utilization Strategy (Figure 1 and Appendix 6), and to the Sustainable Operations Strategy (<http://www.fs.fed.us/sustainableoperations/index.shtml>). We have identified gaps in science, management, and technology transfer, and developed a set of near-term and longer-term actions items involving the 4 Forest Service entities and our partners.



The Operating Framework For Climate Change Management in the Eastern United States

- Research and Development
- National Forest System
- State and Private Forestry
- International Programs

Foreword. The Combined Eastern Leadership Team (*CELT*) asked that a Climate Change Framework Team develop a cohesive action framework and strategy, including a statement of governance, describing an east-wide approach by the Forest Service to carryout an effective program direction in climate change. This paper describes the team’s work to date.

The east-wide climate change framework will focus on helping rural and urban forests adapt successfully to changing climate through developing, testing, and pursuing a suite of ecosystem services and markets for them; and, mitigating the adverse impacts of climate change through delivery of targeted and cooperative management actions. This east-wide climate change framework is tiered to the national climate change framework and includes operating principles, significant program components, key activities and effective actions designed to improve subject matter awareness; delineate our unique niche; and, define the specific means that we will add value to better serve our constituents in the east. The framework will enable the *CELT* to better join forces to cost-effectively respond to contemporary conservation issues associated with climate change.

The East-wide Climate Change Framework Team for the Forest Service mission areas in the east is:

Name	Program Area	Organizational Unit	Telephone
Kier Klepzig*	Research and Development	Southern Research Station	(828) 257-4307
Monica Tomosy*	Research and Development	Northern Research Station	(610) 557-4016
Tamara Heartsill	Research and Development	International Institute of Tropical Forestry	(787) 766-5335
Donna Hepp	National Forest System	Region 9	(414) 297-3538
Logan Lee	National Forest System	Region 9	(414) 297-3646
Chris Liggett	National Forest System	Region 8	(404) 347-3183
David Meriwether	National Forest System	Region 8	(404) 347-4663
Wes Nettleton	State and Private Forestry	Region 8	(404) 347-2719
Ken Skog	Research and Development	Forest Products Lab	(608) 231-9360
Barb Tormoehlen	State and Private Forestry	Northeastern Area	(812) 279-4744

*Co-leads

The Climate Change Framework:

- Primary Purpose:** To coordinate east-wide on problem identification and to collaborate on integrated solutions that address climate change and its management in the eastern rural and urban forests.
- Goals:**
 1. Help rural and urban forests adapt successfully to changing climate through developing, testing and implementing a suite of approaches to sustain ecosystem services and economies.
 2. Mitigate adverse impacts of climate change by developing and delivering targeted and cooperative management actions in the context of emerging market and policy approaches.

❑ **Management Philosophy:**

1. Be pragmatic and show specific progress based on investments.
2. Add value by working together and sharing resources.
3. Focus on the highest priority *Driving Questions* regarding climate change and its impacts.
4. Identify *Required Information* to effectively address the *Driving Questions*.
5. Clearly outline and effectively deploy all planned actions of work.
6. Establish performance measurements and monitor for success.
7. Effectively communicate results.

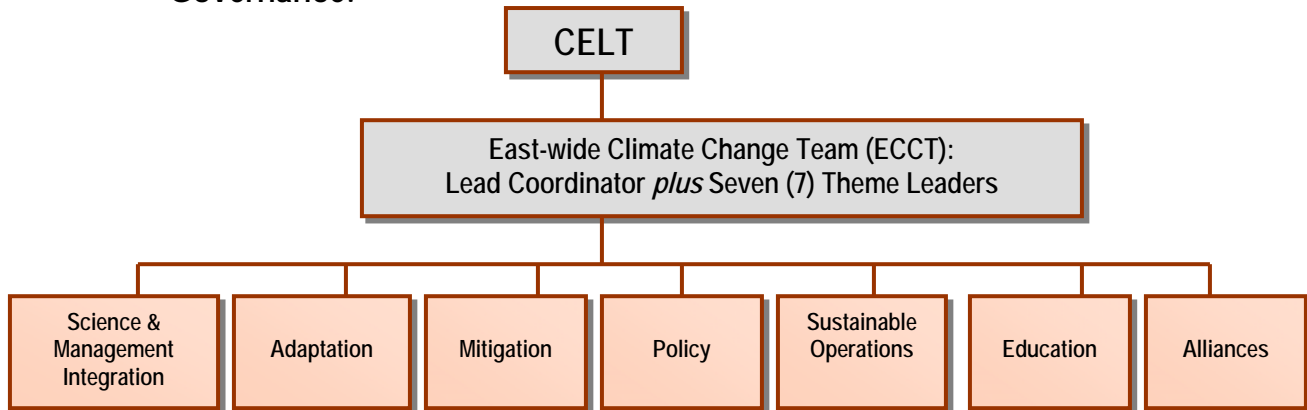
❑ **Guiding Principles:**

1. The East-wide Climate Change Team (ECCT) will act as liaisons, making the connections between people doing the science and people needing and using the science; looking for matching needs and opportunities.
2. Strive to establish priority actions based on existing strategies and plans.
3. Fully utilize partnerships and current agency capacity in all mission areas.
4. Develop and implement common monitoring practices for cross-program and east-wide comparisons.
5. Foster innovation and incorporate measurable results into on-the-ground management practices.
6. Develop and deploy leading-edge, science-based technology transfer to serve a wide-range of constituents.
7. Expand the awareness of how east-wide activities respond to the national climate change framework.

❑ **Major Themes:** The direction of the east-wide climate change framework will be guided by the following major themes:

1. **Science/Management Integration.** Deploy leading-edge science into best management practices.
2. **Adaptation.** Enhance the capacity of forests and grasslands to adapt to the effects of climate change.
3. **Mitigation.** Promote the management of forests and grasslands to reduce the buildup of greenhouse gases.
4. **Policy.** Integrate climate change, as appropriate, into Forest Service policies, program guidance and a wide-range of communications.
5. **Sustainable Operations.** Reduce the environmental footprint of the Forest Service operations.
6. **Education.** Advance the awareness and understanding of climate change and our role in mitigation and adaptation.
7. **Alliances.** Establish, enhance, and retain strong alliances and partnerships to understand and reduce the adverse impacts of climate change.

Governance:



□ Guidance for Governance:

1. The CELT will provide overall guidance and direction on inter-program and inter-region stewardship efforts of eastern forests in the face of climate change.
2. The sideboards of the ECCT's efforts: The team responsibilities are limited to facilitating collaboration and recommendations, and will not guide all climate change efforts in the east. Where east-wide needs and eastern-focused opportunities are greatest, the ECCT will facilitate inter-region and inter-station efforts, advocating for consistency and cooperation.
3. The ECCT will be composed of a rotating, full-time Lead Coordinator, responsible for the implementation of this Framework, and seven (7) Theme Leaders. Theme leads will be selected by the CELT. The rotation term will be up to three years (or as approved by the CELT).
4. The roles of the ECCT will be to:
 - Have full awareness of what activities are taking place in each theme area, east-wide.
 - Recommend appropriate collaboration among CELT mission areas, and recognize projects and activities of the mission areas that are best addressed by the individual mission area, and capture the full realm of efforts, both joint and individual.
 - Facilitate necessary interactions.
 - Coordinate research and management efforts to maximize effectiveness.
 - Communicate for awareness and to minimize redundancy; utilize all available mechanisms to ensure dialogue across eastern programs.
 - Evaluate whether the ECCT members are asking the right questions.
 - Review and evaluate ECCT progress.
 - Advise the CELT on needs for east-wide research and management.
 - Recommend program priorities and estimate required resources to achieved planned actions to the CELT.
5. Each Theme Lead within the ECCT will propose a plan of action to advise the CELT on priorities within the individual theme. The Theme Leads will maintain awareness and communication across all Themes. Because of overlap in the themes, and implementation has not yet begun, Theme Leads may elect to integrate their priority actions into the action plans for other themes; yet each Theme Lead would monitor progress related to that Theme for reporting.
6. The ECCT will communicate at a minimum quarterly, and as often as necessary when opportunities or needs arise.
7. The ECCT will develop a corporate template for accomplishment reporting to the *CELT*.
8. The *CELT* will report regional accomplishments to the Chief.

- **Outcomes:** The east-wide climate change framework will strive to achieve these outcomes:
 1. A **more informed citizenry** about climate change and associated impacts and concepts, including sustainable resource consumption.
 2. **Science-based approaches** for addressing climate change and greenhouse gas reductions in forest and project-level planning.
 3. **Land management decision-support tools** for assessing climate change impacts and adaptation efforts and for conserving carbon in forests and wood products.
 4. Forest and grasslands that are **adapting successfully** and can in some cases be **managed to mitigate** climate change and reduce greenhouse gas concentrations.
 5. **Best management practices** on federal and nonfederal forests and grasslands to better **adapt** to climate change.
 6. A science application **program** that educates users and the public on science-based knowledge, tools, and stewardship techniques for addressing climate change to ensure healthy, sustainable forests.

- **Program Components: Current Primary East-wide Agency-wide Needs (to be considered by the ECCT):** The following are the current primary areas of need to be considered by the ECCT for the Themes of the east-wide climate change framework. The current primary needs will help define a plan of action for each Theme. (not in order of priority)
 1. **Incorporating Climate Change in Planning at the Forest and Project Levels.**

Description of need: National Forest and State Forest plans, project plans and NEPA require specific documentation of efforts to account and plan for climate change effects. Research and tech transfer would include addressing carbon storage and balance as related to harvest, recreation, prescribed burns, etc., in order to manage for resilience in the face of uncertainty, and sustain forest goods and services, including carbon sequestration and water availability.
 2. **Climate Change Pilot Forests: East-wide Science Based Management**

Description of need: There is a clear need to move beyond cataloging effects of climate change and implement large scale, scientifically rigorous, management actions on forests; communities of interest can work together and learn together to manage the shared landscapes of the East
 3. **Establishing an Eastern Forest Climate Change Monitoring Network**

Description of need: There is a need, and even mandate, for forest managers to be able to measure and characterize the effects of climate change on eastern U.S. forests. This work would develop an east-wide network (utilizing national and experimental forests) to assess and provide clear representation of these impacts.
 4. **Changing Ecosystems and Species Composition: Detection and Adaptive Management**

Description of need: As forest managers seek to deal with the effects of climate change, there is a need to prioritize efforts to address species and systems experiencing the greatest change. In addition, some species and systems may serve as early indicators of the need to adaptively manage for climate change.
 5. **Climate Change Adaptation Strategies**

Description of need: As forest managers deal with climate change effects at the forest level, there is a need for ecosystem or landscape level approaches to adapting to these effects. Understand affects of climate change and land management in response to climate change, in order to support best management practices at various scales.

6. Land Management and Policy Decision Support Tools:

Description of need: Principles and techniques for assessing circumstances and alternative actions when the future is uncertain are necessary. There needs to be a way to link projections of climate change, ecosystem change, and resource change with the indicators of climate change and management actions intended to support adaptation and mitigation, and to be able to upscale and downscale those projections. It will be necessary for policy makers and land managers to understand and incorporate biological, ecological, economic, and societal information in decision processes that support sustainable operations, mitigation, and adaptation.

7. Technology Transfer:

Description of need: Mechanisms such as web sites, demonstration projects, guidebooks, teaching aids, and expert consultations will be necessary to support science-based decision making, and to improve communications internally and externally.

8. Use of wood biomass for energy:

Description of need: Forest managers have a need to understand biomass development opportunities, with possible supply and resource management limitations. This will require development of technologies to match resource and management. Carbon dynamics science delivery is needed for managers to address tradeoffs in decision making.

9. Socio-Economic Influences and Impacts:

Description of need: Information is needed on how the impacts of climate change may influence or change the demand for socioeconomic benefits from forest. Understanding the dynamics between society and forests in the context of climate change is important in making policy decisions. For example, demand for wood for biomass, sale of carbon sequestration credits, impacts from carbon emitting recreation uses, or changing needs for trees in urban areas. Information is also needed on how climate change and climate change policies will change the ability of forests to provide socio-economic benefits. For example, how will recreation opportunities change, and how will species migration influence wood-using industry and jobs. Managing forests in the context of this relationship between climate change and society is critical to meeting adaptation and mitigation objectives.

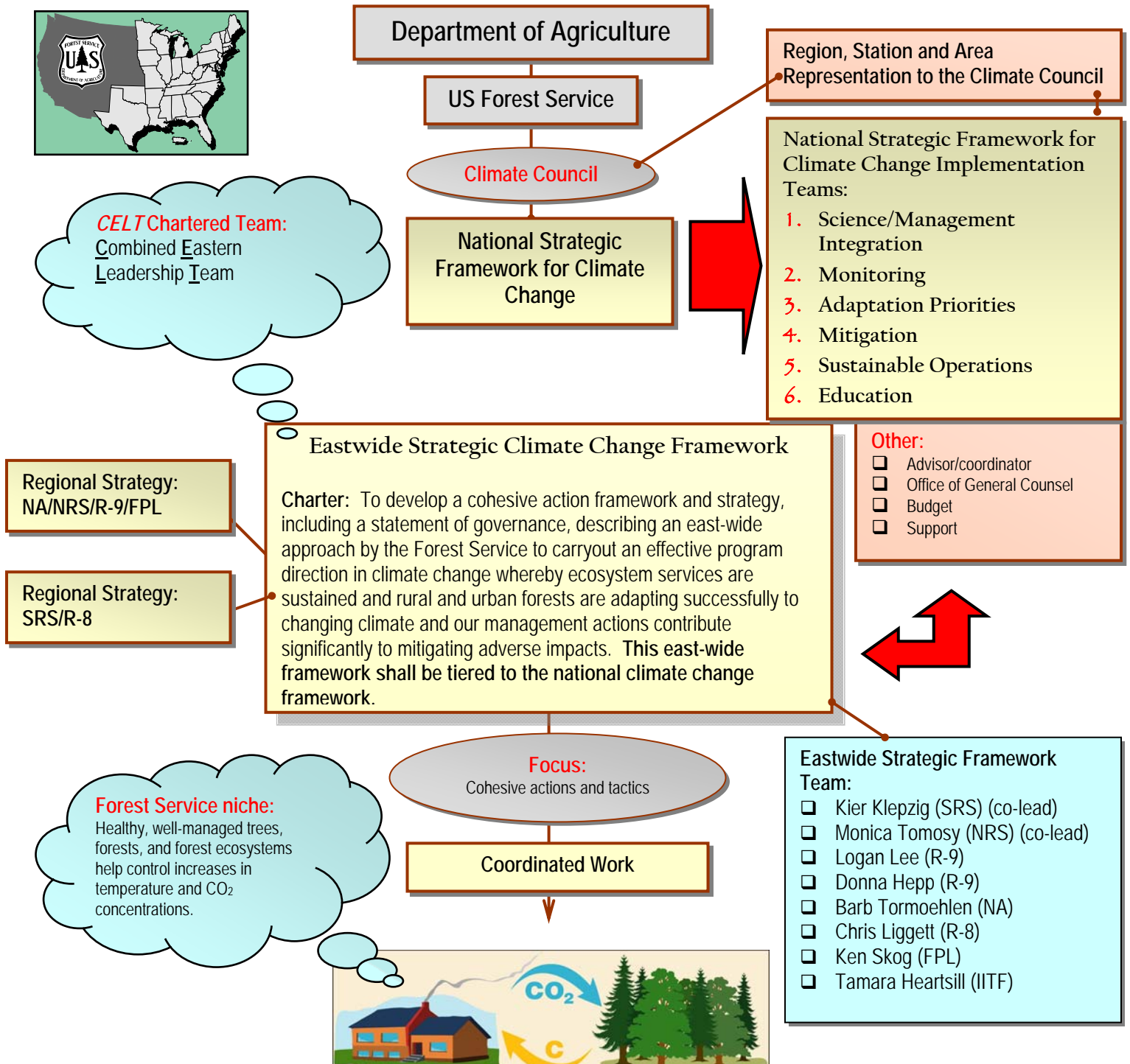
10. Managing Water Resources in a Changing Climate:

Description of need: The demand for water resources is increasing across the eastern US at a time when future water sustainability is uncertain. There is a need to understand how changing climate conditions will affect water yields and flows and timing, water temperatures, and aquatic systems; i.e., potential land cover changes due to climate change could impact the sustainability of water systems. Adaptation and mitigation practices may also influence water yields, flows, and timing. The need is to have information to prepare for areas and causes of water shortages, including evaluation of options for local to regional scale water shortage mitigation across the eastern US over the next 50 years. This information can be used to evaluate and mitigate impacts to aquatic and riparian ecosystems, drinking water supply, recreation, and other ecosystem services provided by forested watersheds. There is also an opportunity to explore water quality trading and the integration of water with carbon markets.

**Plan of Action by National Strategic Framework Themes and Current Priority Needs:
Proposal to CELT as Assessed in April 2009**

NEED	Science & Management Integration	Adaptation	Mitigation	Policy	Sustainable Operations	Education	Alliances
Incorporating Climate Change in Planning at the Forest and Project Levels.							
Climate Change Pilot Forests: East-wide Science Based Management							
Establishing an Eastern Forest Climate Change Monitoring Network							
Changing Ecosystems: Detection and Adaptive Management							
Climate Change Adaptation Strategies							
Land Management and Policy Decision Support Tools							
Technology Transfer							
Biomass:							
Socio-Economic Impacts							
Water							

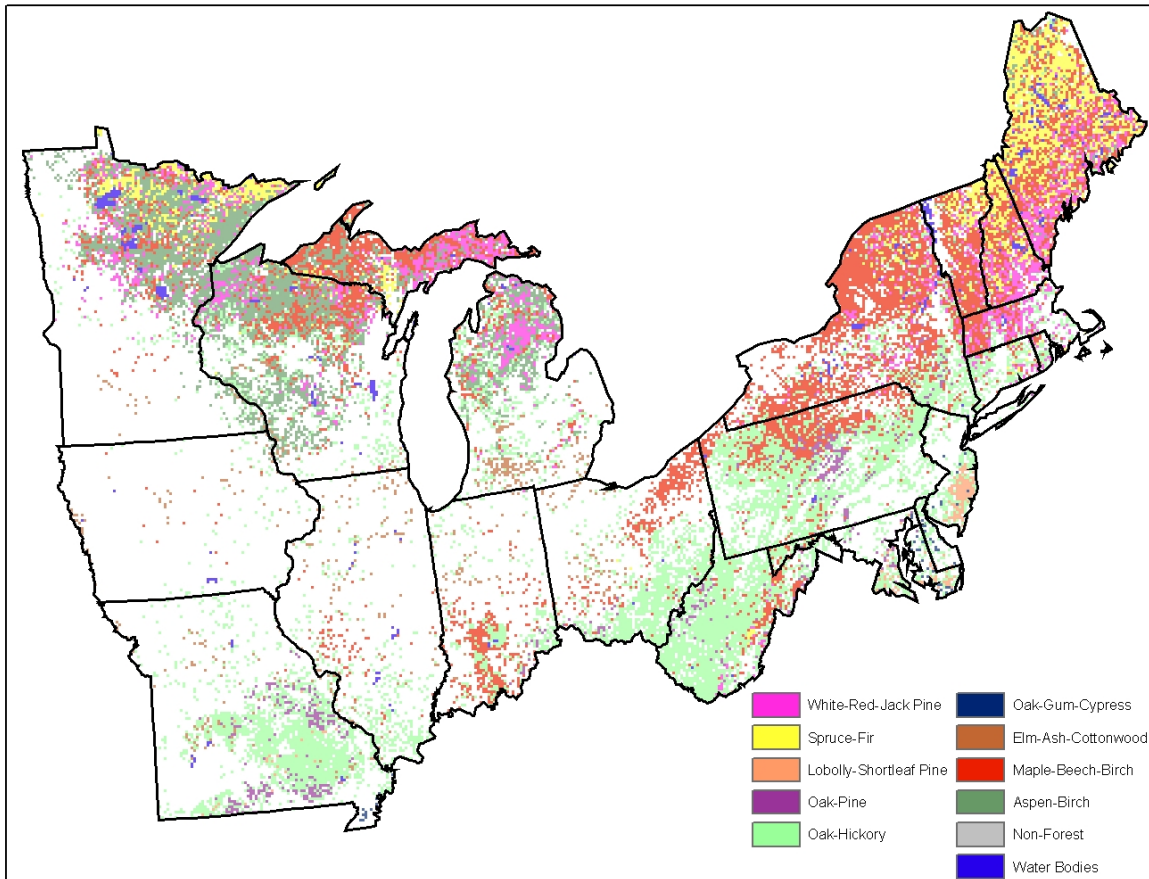
Graphic Illustration: East-Wide Strategy for Global Climate Change (R-8; R-9; FPL; NA; NRS; SRS; IITF)¹ United States Forest Service



¹ CELT (**C**ombined **E**astern **L**eadership **T**eam): Liz Agpaoa, Regional Forester (Southern Region); Kent Connaughton, Regional Forester (Eastern Region); Chris Risbrudt, Director (Forest Products Laboratory); Kathy Maloney, Director (Northeastern Area); Michael T. Rains, Director (Northern Research Station); Jim Reaves, Director (Southern Research Station); and, Ariel E. Lugo, Director (International Institute of Tropical Forestry).

Restoration and Sustainability of Eastern Forests through Climate Change Mitigation, Adaptation, and Bioenergy

A Strategy for Research, National Forests, and State and Private Forestry



Developed by U.S. Forest Service

Northern Research Station
National Forest System, Eastern Region
Northeastern Area, State and Private Forestry
Forest Products Laboratory

Writing Team

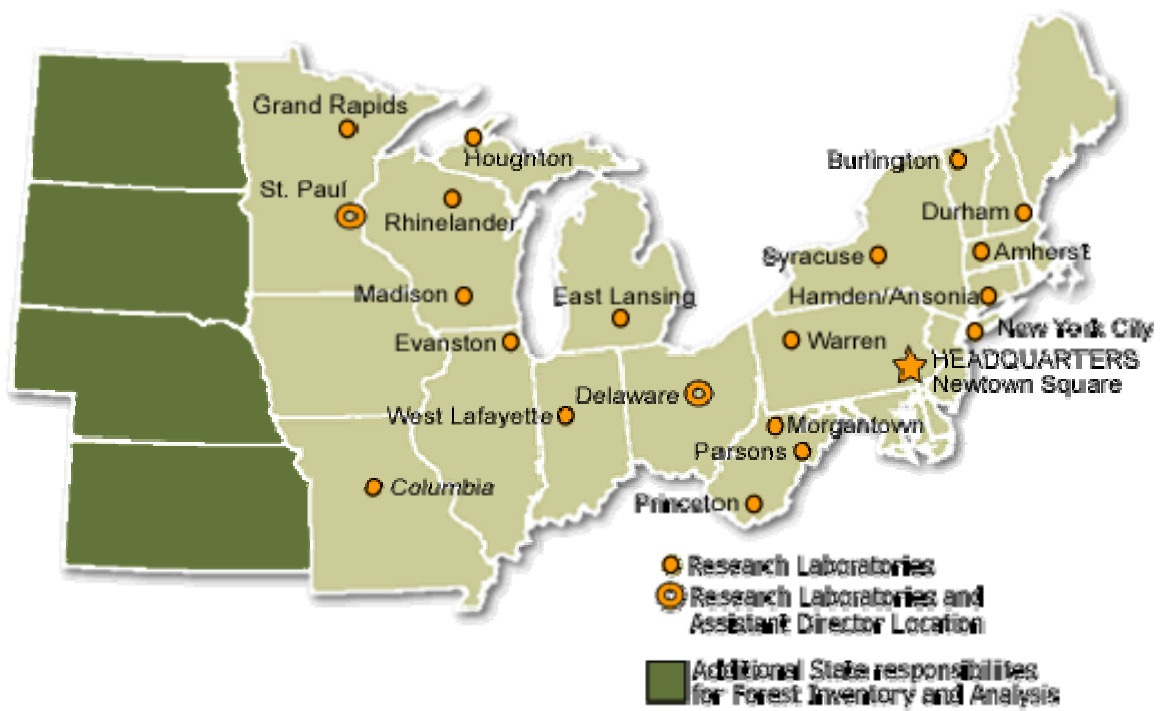
Northern Research Station: Richard Birdsey, Neil Nelson, Alex Friend, Maria Janowiak

Northeastern Area: Mark Buccowich, Lew McCreery, Sarah Hines

Region 9: Thomas Doane, Paul Strong, Sheela Doshi

Forest Products Lab: Ken Skog

August 11, 2008



Restoration and Sustainability of Eastern Forests through Climate Change Mitigation, Adaptation, and Bioenergy

A Strategy for Research, National Forests, and State and Private Forestry

Introduction

Human activities (primarily the burning of fossil fuels and changes in land use) have increased levels of greenhouse gases in the atmosphere and caused alterations to the global climate. Eastern forest landscapes are changing because of climate, land use, and other environmental impacts (Appendix 1). Changing forest ecosystems affect the ecosystem services people depend on -- clean air and water, forest products, biological diversity, and recreation. According to the latest findings by the Intergovernmental Panel on Climate Change, significant impacts of climate changes on forests are inevitable. The world, the nation, and states in the Eastern Region are all developing action plans for mitigating and adapting to climate change.

We need to manage our eastern forests so that they continue to provide ecosystem goods and services under climate change and other stressors while simultaneously: (1) increasing the use of woody biomass as a substitute for fossil fuel; and (2) developing long-term management strategies that optimize the role of eastern temperate forests in storing sequestered carbon. Mitigation strategies such as afforestation, improved forest management techniques, and increased storage of carbon in wood products could result in sequestration of an additional 100 to 200 million tons annually in the U.S. (Appendix 2). Woody biomass has equally significant potential to serve as a substitute for fossil fuel energy because CO₂ produced in the burning of such materials is absorbed by the plants while alive and results in little or no net CO₂ accumulation in the atmosphere (Appendix 3).

Our region's forests are a strategic asset for greenhouse gas emissions reduction, carbon sequestration, and rural economic health. Improved and sustainable forest management provides opportunities to increase the income stream of private landowners, and to enhance the ecosystem services derived from forests by society. Given the current and potential forest land base in the region, we are uniquely suited to lead research and technology transfer activities that will allow this strategic asset to be realized to the economic benefit of our communities and the environmental benefit of the global community. As forests come under increasing stress from climate variability and change interacting with other factors such as land-use change and air pollution, we must devise strategies and management plans that take into account the latest scientific findings about prospective future changes and ways to adapt.

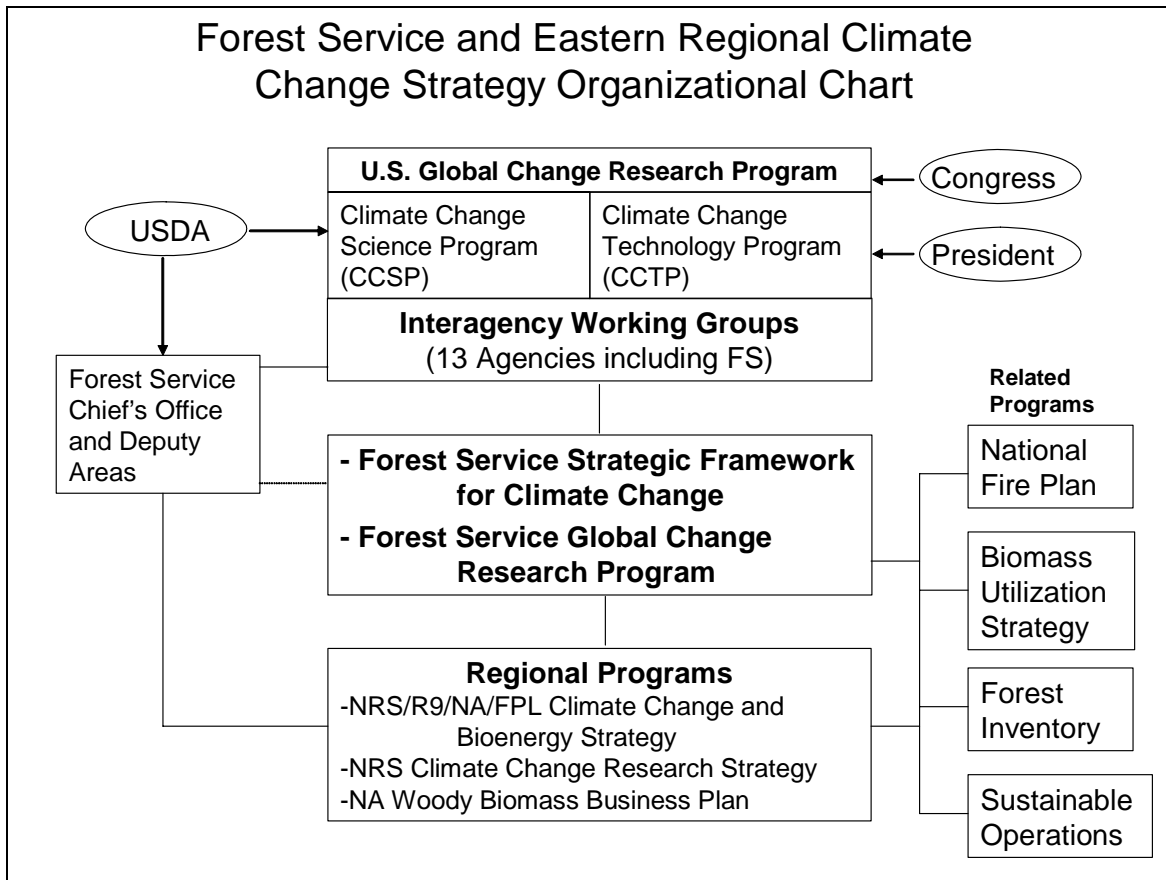
This strategy document presents an approach to mitigating and adapting to climate change in Forest Service Region 9. It is tiered to the Forest Service Strategic Framework for Climate Change, a cohesive strategy for the nation and all of the Forest Service (Figure 1 and Appendix 4). The strategic elements presented here address the Chief's goals of increasing carbon sequestration, increasing use of biofuels, and reducing threats to U.S. forests. This strategy

document is also tiered to the Forest Service Global Change Research Strategy for 2009-2019 (Figure 1 and Appendix 5), to the Forest Service Woody Biomass Utilization Strategy (Figure 1 and Appendix 6), and to the Sustainable Operations Strategy (<http://www.fs.fed.us/sustainableoperations/index.shtml>). We have identified gaps in science, management, and technology transfer, and developed a set of near-term and longer-term actions items involving the 4 Forest Service entities and our partners

Goal and Scope

Our goal is to enable the U.S. Forest Service and others to reduce the impacts of climate change by providing innovative management and technology solutions to sustain forests, forest-based values, and quality of life in the 20 states of the Northeast and Midwest, and the nation. Our objectives contribute to strategic assessments of future forests as affected by climate change mitigation and adaptation policies and management actions. By addressing the mitigation of climate change through trees, forests, forest ecosystems and renewable fuels technologies, we will increase national energy security, improve rural economies, and help maintain clean air and water in the region. Mitigation actions will be developed and applied in concert with developing strategies for adapting forests to climate change and with actions underway in the Forest Service to reduce the environmental footprint associated with facilities, fleet, and other operations. Although this document does not specifically include recommendations for strategies to reduce emissions from operations, which are included in separate planning documents, it is important to recognize the linkage between sustainable land management and sustainable operations. Activities in both domains affect the atmosphere, one by sequestering emissions and the other by reducing emissions.

Figure 1. The Eastern Region Climate Change Strategy is conducted within the broad structure of an interagency Global Change Research Program authorized by Congress and the President, and is tiered to the Forest Service strategies for climate change and climate change research.



Forest Management for Climate Change

The U.S. emits about 25% of the world's greenhouse gases. U.S. forests and forest products currently remove 200 million tons of carbon from the atmosphere each year, offsetting approximately 10% of the U.S. emissions from fossil fuels. Fossil fuel emissions from the Eastern Region constitute about 10% of the world's total emissions of greenhouse gases according to the U.S. Energy Information Administration. The area of forests in the Eastern Region is about 2% of the world's forest area. These forests offset about 0.5% of the world's greenhouse gas emissions and about 5% of the Eastern Region's emissions. Maintaining and potentially increasing the magnitude of emissions offset under the threats from climate change, air pollution, land use, invasive pests, wildfire, and other factors represents a significant challenge to the Region's forestry community.

Gaps in Science, Management, and Technology Transfer

- *Provide science-based decision-support tools.* We need to develop and maintain science-based decision-support tools to assist landowners and businesses, in urban and rural areas, with making decisions about forest management and climate change, and with participating in carbon markets and incentive programs. A specific application mandated in the Federal Register is to complete and maintain the Carbon OnLine Estimation (COLE) model, a portal and web tool designed to provide “one-stop-shopping” for forest carbon inventories, reporting, and management.
- *Support regional policy and decision making.* Capability to provide expert scientific support, customized analyses, and demonstration projects, to support climate policy and carbon management decisions by international, federal, state, and private interests.
- *Increase understanding of socioeconomic issues.* Additional support for understanding the socioeconomic aspects of carbon management and adaptation to climate change: reducing barriers to technology deployment; economies of scale and transaction costs; and optimal design of policies such as carbon trading systems and the role of incentives for carbon sequestration and abatement.
- *Develop new forest management strategies.* We need to extend and expand experimental work and applications of research findings by developing forest management strategies, systems, best practices and decision support systems to sustain and enhance productive, healthy, resilient ecosystems to deliver the values, goods, and services that people want.
- *Improve monitoring and verification.* We need to improve our ability to monitor and verify the changes in carbon storage that result from forest management activities and wood product substitution, and to provide an “early warning” of climate change impacts on forest ecosystems.
- *Establish demonstration projects.* We need to demonstrate the technological potential for reducing greenhouse gas emissions at selected Forest Service facilities.

Near-term Action Items for Sustainable Forest Management (see Table 2 for Summary).

1. **Decision-Support for Carbon Management.** NRS, NA, R9, and FPL provide the leadership and coordination to develop and maintain science-based decision-support tools to assist landowners and businesses, in urban and rural areas, with making decisions about

managing forests to increase carbon sequestration, and with participating in carbon markets and incentive programs. The main decision-support tools currently available are: (1) the Carbon OnLine Estimator (COLE) which queries the FIA data base and converts forest inventory data to carbon stocks; (2) the Forest Vegetation Simulator (FVS) which is a stand-level forest management model that has a carbon reports for forests and wood products; and (3) the Urban Forest Effects model (UFORE) which estimates the effects of urban tree planting on air pollution and carbon. Also available are measurement, estimation, and accounting guidelines (see <http://nrs.fs.fed.us/carbon/tools/> for more information about available decision support). NRS also contributes substantially to national RPA assessments and other climate change assessments by the U.S. government, and maintains several modeling and assessment tools for this purpose. Additional needs include spatial analysis tools for analyzing mitigation opportunities and impacts on the climate system; for example, estimating the opportunities and impacts of afforestation and avoided deforestation. There is a critical need to fully integrate wood products and energy use calculations (Life Cycle Analysis) into the analytical capabilities of existing decision support tools. We also need to ensure the availability of resources to support our activities related to national assessments.

NRS will improve integration among existing research and science applications programs (FIA, Global Change, the Northern Institute of Applied Carbon Science, and the Northern Science, Technology, and Applied Results Program), and will develop research proposals to (1) augment regional and national decision-support to provide full accounting for effects of mitigation, adaptation, and land use on the climate system, and (2) develop spatial analysis tools for analyzing mitigation opportunities and the additional effects on carbon stocks. *FPL will* provide methods and estimates to monitor the contribution of wood products toward sequestering carbon and offsetting carbon emissions from fossil fuels. *NA and R9 will* develop education and outreach plans to raise awareness of these tools among private and public forest managers. Some of these actions can be accomplished or provide initial products within months, although fully implementing all of the proposed new work will take longer and is contingent upon additional funding.

Desired future effects:

- Increased numbers of industrial and non-industrial private forest landowners as well as county, state, tribal, and federal agencies that manage forest lands will participate in carbon markets and make management decisions based in part on carbon management.
- Positive contributions of wood products in offsetting carbon emissions are well recognized and included in the development of policies affecting forest and wood product management and use.

2. **Carbon Market Exploration.** Region 9 private and public forests are being considered for eligibility as part of recognized carbon markets and greenhouse gas registries. R9, NRS and NA disseminate information about carbon markets and registries to help public and private land managers make informed decisions about participation in carbon credit trading. NRS and NA are engaged in multi-stakeholder processes to further develop protocols for expanded inclusion of forestry practices (forest management and avoided deforestation) within RGGI and other GHG registries, as appropriate. NRS is working with the American Forest Foundation to develop an approach for “aggregators” to bundle up projects from individual

landowners for efficient market participation. R9 has initiated work on a national Memorandum of Agreement with Chicago Climate Exchange (CCX) to work together on sharing research, skills, and knowledge and agreeing to promote pilot demonstration projects. R9 works with the Delta Institute, a non-profit aggregator, to enroll pilot carbon offset projects on Midewin National Tallgrass Prairie and the Shawnee National Forest in CCX. NA is working with the Michigan DNR and the Delta Institute to facilitate private landowner participation in the CCX. Additional needs include decisions on legal authorities and financial arrangements for public lands to participate in carbon markets, analysis and communication of the benefits and costs of this participation, and further exploration of how the measurement and accounting protocols in different registries affect the net benefits.

R9 will continue work on demonstration projects with CCX and produce briefings and case studies. R9 will identify other opportunities for its forests to participate in carbon markets and registries as they develop. Briefings on the progress of demonstration projects and the current state of carbon markets can be developed and will be periodically updated. Analysis and recommendations will be developed after demonstration projects have been in place for one year. **NRS will** (1) investigate opportunities for demonstration projects at Experimental Forests to serve as examples and baseline cases for improving carbon management, and (2) work with emerging carbon markets and registries (state, regional, national, and global) to ensure consistent and credible accounting rules and estimation guidelines. At CCX request, an NRS representative will serve on its forestry technical panel. **NA will** develop communications to inform state and private land managers about opportunities to participate in carbon markets and registries; work with partners to influence policy so as to include forest management and avoided deforestation in carbon crediting schemes; and work with partners and carbon aggregators to optimize the economics of forest carbon offset trading (increase economies of scale, thereby decreasing transaction and measurement costs). **FPL will** develop and/or advise on the use of measurement tools that fully account for carbon stores in harvested wood products and the energy used in manufacturing and distributing wood products.

Desired future effects:

- National Forests provide credits to other entities needing to offset emissions, leading to greater recognition of forest values.
- Public and private land managers will understand the current state of carbon sequestration measurement and accounting protocols.
- Public and private land owners will fully understand opportunities to enter carbon markets.
- The economic costs associated with small private forest owners' participation in voluntary carbon markets are minimized.
- Forest carbon loss as a result of development and deforestation within the Northeast and Midwest is minimized.

3. **Adapting to Climate Change.** Future forest planning will require analyses of future scenarios of climate change effects on forest productivity, health, and species composition, and increased ability to consider uncertainty and risk. This will involve personnel with new skills to perform such analyses, and development analytical technology -- i.e., models of

various kinds. For example, forest management models such as SILVAH are not sensitive to climate variability and will require additional features or linkage to other models that can simulate responses to changing atmospheric chemistry or changing disturbance patterns. NRS has a long history of research on the impacts of climate change and other factors on forest health and productivity, and on silvicultural practices for sustainable forest management. NRS and R9 are developing and testing collaborative approaches to prepare the Region's foresters to understand and cope with potential climate change effects including consideration of interactions with other factors, and developing adaptation strategies for each of the National Forests of R9.

NRS and R9 will (1) increase employee awareness of climate change and impacts on forests through a silviculture workshop and educational materials, and (2) initiate a process to work with individual forests (starting with the Chequamegon-Nicolet National Forest) to develop and implement management strategies that integrate mitigation and adaptation with forest planning and operations. The outcome of these pilot projects will be evaluated to develop a curriculum for future workshops geared to including the best available science about climate change into the forest planning process. *NRS will* develop proposals for new research to identify areas that are highly vulnerable ("hotspots") to the effects of climate change, determine the likely impacts, and develop appropriate response strategies. *NA will* review advice given to landowners regarding forest management under climate change, and adjust messages as new knowledge emerges.

Desired future effects:

- Land managers increase awareness of the potential impacts of climate change on forest resources, and opportunities to enhance the resilience of forests to expected changes.
- Managers and policy makers develop forest plans that consider the uncertainty of future climate change effects.
- Land managers take actions to increase carbon sequestration while sustaining production of other forest benefits.

Potential Future Action Items for Sustainable Forest Management

1. **Increased science support.** NRS enhances capacity to provide expert scientific support, customized analyses, and demonstration projects to support sustainable forest management while considering carbon markets and future effects of climate change. **Desired future effect:** Coordinated and effective policies and decisions at all levels of government and the private sector.
2. **Develop new management practices.** NRS extends experimental work by developing forest management strategies, systems, and best practices to sustain removal of greenhouse gases from the atmosphere while maintaining the values, goods, and services that people want. **Desired future effect:** New technology and land management systems become available to support climate change mitigation and complementary goals of land managers.
3. **Improved monitoring and verification.** NRS develops new methods to improve our ability to monitor and verify the changes in carbon storage that result from forest management activities and wood product substitution. **Desired future effect:** Reduced cost, increased

accuracy and improved predictability of carbon flux in forests to be used in scientific analyses as well as information for the public and policy makers.

4. **Improve understanding of climate change effects.** NRS expands research on the extent to which temperature and greenhouse gas trends, and interactions with other stressors, may affect the ability of forests to sequester carbon and to be sustainably managed for bioenergy. **Desired future effect:** Improved decision making based on sound science; increased capability for adaptive management.

Table 1. Summary of Near-term Action Items for Sustainable Forest Management

Proposed Action and Link to National Plan	Current Effort	Additional Emphasis with Current Resources	Additional Resources Needed
<p>Decision-Support Tools for Carbon Management</p> <p>FS Strategic Framework goals 3 & 6: manage forests to reduce GHGs; and advance awareness</p> <p>FS Research Program Element: Improve Decision-support Tools</p>	<p>NRS: COLE, FVS, UFORE, and other tools developed for carbon estimation.</p> <p>Participation in regional and national assessments. Limited outreach and training offered.</p>	<p>NRS: Decision-support tools integrated with FIA program; improved collaboration between NIACS and NorthStar</p> <p>FPL: provide methods for estimating wood products and fossil fuel offsets; provide wood biomass supply curves for biofuels / bioenergy</p> <p>NA and R9: develop education and outreach plans</p> <p>R9: Work with external partners (e.g. MNRG, TNC) on collaborative strategies and information repositories</p>	<p>NRS: augment decision-support to provide full accounting for effects of mitigation, adaptation, and climate change on the climate system</p> <p>NRS: develop spatial analysis tools for analyzing mitigation opportunities and impacts</p>
<p>Carbon Market Exploration</p> <p>FS Strategic Framework goals 3 & 7: manage forests to reduce GHGs; and develop strong alliances and partnerships</p> <p>FS Research Program Element: Enhance Carbon Sequestration and Biofuel</p>	<p>NRS: develop accounting rules and guidelines</p> <p>NA: raise awareness among private landowners about opportunities for engagement in CCX</p> <p>R9: National MOU with CCX; Midwin and Shawnee pilot projects with CCX</p>	<p>NRS: investigate opportunities for demonstration projects at Experimental Forests; scientists participate in CCX forestry technical panel and other emerging market panels</p> <p>NA: develop communications to inform state and private land managers; work with partners to influence policy and optimize trading</p> <p>R9: identify additional opportunities to participate in carbon markets; develop briefings on progress; make recommendations</p> <p>FPL: advise on including full accounting for wood products</p>	<p>NRS: work with emerging carbon markets and registries (state, regional, national, and global) to ensure consistent and credible accounting rules and estimation guidelines</p>
<p>Adapting to Climate Change</p> <p>FS Strategic Framework goals 1, 2 & 6: advance understanding; enhance adaptation capacity; and advance awareness</p> <p>FS Research Program Element: Enhance Ecosystem Health and Sustainability</p>	<p>NRS: conducts basic research on impacts of climate and other stressors on forests</p> <p>R9: team to consider impacts and adaptation at regional level</p> <p>R9 and NRS: pilot workshop with Forest leadership on Chequamegon-Nicolet NF</p>	<p>NRS and R9: increase employee awareness of climate change and impacts on forests through a silviculture workshop and educational materials; and work with CNNF to develop a general approach to integrate adaptation and mitigation into planning</p> <p>R9: Work with external partners (e.g. MNRG, TNC) on collaborative strategies and information repositories</p> <p>NA: adjusting advice to landowners regarding forest management under climate change</p>	<p>NRS and R9: augment forest planning tools for considering climate impacts and adaptation</p> <p>NRS: conduct climate change “hotspot”, impact, and response analyses</p>

Bioenergy

Energy use and climate change mitigation are inextricably linked. Most greenhouse gas management protocols allow substitution of biofuel for fossil fuel to receive the same credit as a reduction in emissions. The Eastern Region has an ample supply of woody biomass and capacity to grow more; therefore, increasing the use of wood for fuel represents a significant opportunity for the region to help reduce dependence on fossil fuel.

Gaps in Science, Management, and Technology Transfer

- *Measure the existing forest-based biomass supply and develop new sources:* Much timber is harvested each year, but parts of those trees remain underutilized. We need to determine the amount and distribution of this harvest “residual” using our Forest Inventory and Analysis expertise. Geneticists and silviculturists need to develop management systems and new trees that grow quickly as energy crops and for other uses.
- *Understand the economics of biomass production:* Our economists can determine the costs of harvesting, transporting, and preparing biomass and how these costs depend on the surrounding landscape, which are important parts of bioenergy investment decisions. Further, we need to evaluate the benefits and costs of existing and potential government policies for increasing forest-based biomass supply such as large-scale afforestation of agricultural land under various management scenarios to include short rotation woody crops, high production forestry and extensive forestry.
- *Improve wood to biofuels conversion technologies:* Our chemists and wood products technologists need to improve the efficiency of converting wood components to sugars, improve the fermentation of sugars to biofuels and improve the efficiency of gasifying wood and converting the gas to biofuels.
- *Quantify the environmental implications of a bioenergy economy:* Our ecologists need to determine how biomass harvests from the forest or the farmer’s field affect ecosystem sustainability and help design sustainable systems.
- *Lend reason to future debate:* Our social scientists need to gauge the perspectives of communities and society to changing forest management and land uses and help communicate scientific principles and socioeconomic outcomes of forest-based biofuels.
- *Learn how bioenergy fits the landscape:* Our landscape ecologists need to map places where agriculture, forests, and energy crops can jointly contribute to new and existing biomass refineries. We need to better understand how cities can provide “waste” biomass from the urban landscape. We need to determine how biomass and bioenergy may change rural economies and the relationship between rural and urban America.
- *Establish demonstration projects:* We need to demonstrate the potential for biomass for energy by converting one of our facilities to bioenergy.

Near-term Action Items to Increase Bioenergy Use (see table 3 for summary)

1. **Develop Research and Applications Programs.** NRS and NA will develop biomass for energy research, development, and technology transfer programs, complementing the bioenergy conversion research at FPL.

NRS will work with the Southern Research Station to develop a joint business plan research and development on bioenergy; accelerate development of data products on biomass energy; and complete a research and development program plan for biomass, focused on feedstock production and including a full energy crop development program, in FY 2008. **NA will** develop a bioenergy technology transfer program at the Wood Energy Resource Center (WERC), linked with the NRS and FPL research programs, in FY 2008. **NRS and NA will** transfer research and technology results for the production and use of wood biomass for energy to public and private landowners and the forest products and energy industries, beginning in FY 2008. Fully implementing the research, development, and delivery will take longer and is dependent on additional funding. **R9 will** provide feedstock in pilot projects (Allegheny, Mark Twain, Superior), engage in technology transfer, and identify additional opportunities to provide feedstock

Desired future effects:

- A major integrated research, development, and applications program is in place for the eastern region of the United States, providing critical information for the production of biomass for energy.
- A sustainable cellulose-based bioenergy industry significantly expands in the eastern region.
- The use of wood biomass for energy is accelerated and contributes significantly to national energy needs.

2. Improve Biofuels Conversion Technologies. **FPL will** provide research needed to use wood as a raw material to make transportation fuels and chemicals including pulping pretreatments that make more cellulose available for enzymatic saccharification; efficient ways to use the five-carbon sugars in hardwoods; improved gasification with less char and a higher energy yield; **FPL will** develop a 10-year program of research, development, and deployment of wood biomass utilization in support of the Advanced Energy Initiative. **NRS will** provide economic evaluation of business cases for wood-based biorefineries and for wood electric power and heat facilities.

Desired future effect:

- Forest biorefinery technologies and wood electric power facilities become increasingly competitive as ways to make biofuels, chemicals, and electricity and are rapidly adopted.

3. Bioenergy Demonstration Projects. NRS, NA, R9, and FPL will demonstrate the potential of biomass as an energy source by converting Forest Service facilities to bioenergy and supporting bioenergy projects in non-Forest Service facilities. Currently, R9 engineers are designing a pellet or woodchip electrical generator that will power the White Mountain National Forest Supervisor's Office and provide sufficient power to offset electricity used on the Ranger Districts. FPL's Research Demonstration House includes a facility with BioMax 5, combined heat and power from wood chips. Rhinelander Forestry Sciences Laboratory, NRS, has written a proposal to convert its heating to wood energy. Additional steps include exploring conversion of other facilities to bioenergy and developing communications about the demonstration facilities.

NRS and NA will explore opportunities to convert their facilities to bioenergy, possibly as part of an Energy Savings Performance Contract (ESPC). A pilot study is under consideration for the

Rhineland, WI research laboratory. **FPL will** provide laboratory/ pilot scale demonstration technologies that convert biomass to energy including equipment for biochemical and thermochemical conversion of wood to fuels. **FPL will** provide publications, tours and virtual tours of its Biomax heat/ electric power facility. **R9 will** continue planning and construction on the biomass cogeneration system, with facility completion scheduled for 2009. **R9 will** disseminate publications highlighting this technology and incorporate bioenergy into design of new facilities. **NA will** implement current demonstration projects through WERC and initiate additional projects as new funding becomes available.

Desired future effects:

- The Forest Service will be seen as a leader in bioenergy technology and will demonstrate the feasibility of this technology.
- Biomass energy will contribute a significant portion of the energy required by Forest Service facilities.

Potential Future Action Items to Increase Bioenergy Use

1. **Increase biomass production.** NRS facilitates an increased use of bioenergy to supplement fossil fuels by providing critical new knowledge, tools, genotypes, and systems for biomass production necessary for commercialization. **Desired future effect:** the supply of biomass is increased while sustaining other forest values.
2. **Increase biomass use and improve forest health.** FPL implements the Woody Biomass grants program in collaboration with NA, R9 and NRS in all regions. **Desired future effect:** On NFS lands, reduced woody biomass, reduced fire hazard, reduced costs for forest management activities and nationwide increase in woody biomass energy use.
3. **Strategic analysis of biomass supply.** NRS, NA, and R9 define biomass supply for energy on the public and private forested lands in the 20-state northeastern area. **Desired future effect:** Provide industry with comprehensive information that will influence decision-making on new biomass plants.
4. **Understand environmental impacts of biomass use.** NRS, NA, and R9 determine the potential environmental impacts of forest biomass harvesting to provide management guidance. **Desired future effect:** Biomass is produced in an ecologically sustainable manner than adds both economic and environmental value to the region's forests.

Table 2. Summary of Near-term Action Items to Increase Bioenergy Use

Proposed Action and Link to National Plan	Current Effort	Additional Emphasis with Current Resources	Additional Resources Needed
<p>Develop Bioenergy Research and Applications Programs</p> <p>FS Strategic Framework goal 3: manage forests to reduce GHGs</p> <p>FS Research Program Element: Enhance Carbon Sequestration and Biofuel</p>	<p>NRS: FIA biomass estimation, Rhinelander energy crops (<i>Populus</i>) research</p> <p>NA: WERC Biomass development projects with multiple cooperators</p> <p>R9: NFs provide feedstock in pilot projects (Allegheny, Mark Twain, Superior)</p>	<p>NRS: accelerated biomass for energy data product development; NRS and SRS writing joint business plan for R&D on bioenergy</p> <p>R9: engage in technology transfer and identify additional opportunities to provide feedstock</p> <p>FPL: provide wood biomass supply curves for biofuels / bioenergy</p>	<p>NRS: comprehensive biomass for energy R&D program for northern U.S. focused on feedstock production, including full energy crop development program</p>
<p>Improve Biofuels Conversion Technologies</p> <p>FS Strategic Framework goal 3: manage forests to reduce GHGs</p> <p>FS Research Program Element: Enhance Carbon Sequestration and Biofuel</p>	<p>FPL: Conduct research on processes to convert wood to fuel for transportation and other energy needs.</p> <p>FPL: evaluation of business cases for wood-based biorefineries (thermochemical & biochemical)</p>		<p>NRS: economic evaluation of business cases for wood-based biorefineries and wood electric power and heat facilities</p> <p>FPL: 10 year program of research, development, and deployment of wood biomass utilization in support of the Advanced Energy Initiative</p>
<p>Bioenergy Demonstration Projects</p> <p>FS Strategic Framework goals 3 & 6: manage forests to reduce GHGs, and advance awareness</p> <p>FS Research Program Element: Improve Decision-support Tools</p>	<p>R9: White Mt. Natl. Forest wood electrical generator</p> <p>FPL: Research Demo House BioMax 5</p> <p>NA: Multiple demo projects supported in MD, MN, MO, MI, NH, OH, PA, and WV</p>	<p>FPL, NRS, NA, R9: expanded communications about the demo projects</p>	<p>NRS: Rhinelander FSL heating conversion to wood energy; new boiler in construction plan for ≥ 2010, considering wood</p> <p>NA: implement additional demo projects through WERC contingent on available funding</p> <p>FPL: Demonstration of biofuels technology as part of 10 year biomass utilization initiative</p> <p>R9: Utilize bioenergy in new buildings; retrofit when possible</p>

APPENDIX 1: CHANGING NORTHERN FORESTS

The Northeast and North Central U.S. is 41% forested, covering over 169 million acres (Smith et al. 2004). Although the acreage of forestland in the region has been increasing since the early 1900s, current forestland covers only 57% of what is estimated to have been present in 1630.

Forestland in the region is largely (76%) privately-owned (Smith et al. 2004). Both regional and nationwide trends point towards increasing numbers of forest landowners combined with decreasing ownership size (Birch 1996, Sampson and DeCoster 2000). A greater degree of fragmentation and parcelization is expected to increase the complexity of forest management activities and/or require focused efforts in the communication and adaptation of management strategies for smaller woodlots (Sampson and DeCoster 2000). Likewise, increased landscape fragmentation coupled with increases in population density necessitates the consideration of urban forests as an important and unique management challenge (Nowak et al. 2005).



Forest ecosystems are undergoing dramatic transformations due to human-induced climate change. Observable changes are apparent in the timing of biological events (phenology) of both plant and animal species. For example, many spring events, such as flowering and leaf-out, now occur several days earlier than in the 1960s (Walther et al. 2002). According to the most recent IPCC report, there is very high confidence that North America has experienced locally severe economic damage, plus substantial ecosystem, social and cultural disruption from recent weather-related extremes, including hurricanes, other severe storms, floods, droughts, heatwaves and wildfires (Field et al. 2007). Continuing increases in the global temperature are beginning to force shifts in range as species move to higher latitudes or elevations as well as overall changes in community assemblages.

Also according to the IPCC report, there is very high confidence that the vulnerability of North America depends on the effectiveness and timing of adaptation and the distribution of coping capacity, which vary spatially and among sectors. Climate change will constrain North America's over-allocated water resources, increasing competition among agricultural, municipal, industrial and ecological uses (very high confidence).

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APPENDIX 2:**What Proportion of U.S. Carbon Dioxide Emissions Can be Stored in U.S. Forests by 2020?**

prepared by Josh Trapani, Policy Analysis

Summary—U.S. forests are currently a sink for carbon. This sink is expected to decrease over time, but this projected trend may be slowed or reversed by actions to increase carbon storage. Sequestration on public and private lands will respond to different types of incentives: legislative mandates are more important for the former, and market forces for the latter. Many assumptions affect estimates of how much carbon can be sequestered in U.S. forests in 2020, but most estimates indicate that the equivalent of 1 billion tons of carbon dioxide (equal to about 16 percent of current U.S. carbon dioxide emissions, and about 14 percent of projected 2020 emissions) or more can be sequestered, using a combination of activities such as afforestation/reforestation, forest management, and sequestration in wood products and landfills.

Background—In the U.S., the terrestrial carbon sink (forestry and agriculture) currently sequesters an amount equivalent to about 11-12 percent of U.S. greenhouse gas emissions (EPA, 2005; 2007). Over 90 percent of this sink occurs on U.S. forestlands, which currently sequester about 600-700 million metric tons of carbon dioxide per year in biomass, soils, and products (Birdsey et al., 2006; Woodbury et al., 2007).

U.S. forests constitute a net sink because the amount of carbon dioxide currently taken up through photosynthesis and stored in biomass, soils, and products exceeds the amount released through respiration, harvesting and natural disturbances. Recent land-use trends also contribute, as there has been a net movement of land from agriculture to forests. Additionally, the age-class structure of U.S. forests currently favors younger, faster-growing trees (EPA, 2005).

However, over the next decades, U.S. forest sequestration rates are expected to decline, largely due to a slowing of land reverting from agriculture to forestland, additional pressures to convert timberland to developed uses, aging forests growing slower, and increasing natural disturbances (EPA, 2005). By 2020, annual sequestration in U.S. forests is projected to decrease five percent or more, though sequestration in wood products will remain approximately constant (USDA, 2007; Skog & Nicholson, 2000).

Mitigation activities—According to the Intergovernmental Panel on Climate Change (2007), mitigation activities in the forest sector can be grouped into four general categories:

1. maintaining or increasing the forest area through avoided deforestation, afforestation, and reforestation;
2. maintaining or increasing stand-level carbon density through reduction of forest degradation and through planting, site preparation, tree improvement, fertilization, uneven-aged stand management, or other appropriate silviculture techniques;
3. maintaining or increasing landscape-level carbon density using forest conservation, longer forest rotations, fire management, and protection against insects; and
4. increasing off-site carbon stocks in wood products and enhancing product and fuel substitution using forest-derived biomass to substitute products with high fossil fuel requirements, and increasing the use of biomass-derived energy to substitute fossil fuels.

Variables affecting estimates—The prospective role of forestry in stabilizing atmospheric carbon dioxide depends upon a wide variety of factors, including harvesting and disturbance rates, future forest productivity, and use of technology and forest practices to increase carbon retention (Birdsey et al., 2006). Two distinguishing characteristics are the saturation over time of carbon sequestration in vegetative biomass and soils, and the potential release back to the atmosphere of sequestered carbon through natural or anthropogenic disturbances (EPA, 2005).

There are gaps between estimates of technical potential and those that attempt to estimate economic potential under specific conditions or policies (Schneider & McCarl, 2006), or account for political and social factors. Also important to estimating future carbon sequestration are projections of the cost and availability of land

and the price of carbon (Richards & Stokes, 2004; McCarl & Sands, 2007). Estimates may vary due to assumptions related to prices, strategies examined, or regional scope. Finally, different pressures may apply to public and private lands, with the former subject to legislative mandates and the latter more dependent upon market forces (EPA, 2005).

Carbon storage in U.S. forests in 2020—According to Forest Service scientists, it is possible to increase carbon sequestration by 350 to 700 million metric tons of carbon dioxide each year (Birdsey et al., 2006), though this estimate is not tied to any particular date. Implementing these actions will require development of new forestry technology and transfer of new technology to land managers; improvements in measuring, monitoring, and verifying carbon dioxide exchange between forests and the atmosphere will also be required. Adding this increase to estimated business-as-usual sequestration in 2020 (estimated at five percent below today's levels) provides an estimate of about 920 million to about 1.35 billion metric tons per year (see table).

An analysis of eight studies estimating potential for forest carbon sequestration at the national level (Richards & Stokes, 2004) provides a range of 147 million to 2.3 billion metric tons of carbon dioxide per year from afforestation and forest management, at carbon prices ranging from \$1.36 to \$40.87 per ton. These analyses were also not tied to particular years.

A 2005 report by the Environmental Protection Agency on mitigation potential of private U.S. forestlands (EPA, 2005) includes estimates of above-baseline sequestration under different carbon prices in different years. Activities considered include afforestation, forest management, and biofuels. Additional sequestration correlates with carbon prices. The report considers prices of \$1 to \$50 per ton of carbon dioxide. For comparison, carbon prices on the Chicago Climate Exchange have recently been around \$3-\$4 per ton, and prices in the European markets have been around \$25-\$30.

At prices of \$5 per ton of carbon dioxide, the report estimates additional sequestration of around 90-130 million metric tons, for a total of 660-800 million metric tons. At prices of \$15 per ton, the report estimates an additional 300-550 million metric tons may be sequestered, for a total of 870 million to 1.2 billion metric tons. At prices of \$30 per ton, the model predicts sequestration of an additional 820 million to 1.1 billion metric tons, for a total of 1.4-1.75 billion metric tons. Note that these figures are minimums, as forest management activities above business-as-usual on public lands are not included: the maximum possible benefit from these activities is about an additional 700 million metric tons (EPA, 2005).

Summary of Estimates

Estimate	Sequestration *	Proportion of today's CO2 emissions **	Proportion of projected 2020 emissions ***
Forest Service	600–700 (today)	≈10%	--
Forest Service	920–1350 (future)	≈15%–22%	≈13%–19%
8 studies	147–2300 (future)	≈2%–37%	≈2%–33%
EPA: \$5/ton	660– 800+ (2020)	≈11%–13%+	≈10%–12%+
\$15/ton	870–1200+ (2020)	≈14%–20%+	≈13%–17%+
\$30/ton	1400–1750+ (2020)	≈23%–29%+	≈20%–25%+
This paper	1000 (2020)	≈16%	≈14%

* - in million metric tons of carbon dioxide

** - 2005 U.S. CO2 emissions are 6089.5 mmt (EPA, 2007)

*** - 2020 U.S. CO2 emissions projected at 6944 mmt (EIA, 2007)

Conclusion—U.S. forestry can play an important role in mitigating the effects of climate change (McCarl & Schneider, 2004). With the right policies and incentives in place, U.S. forests could sequester 1 billion tons of carbon dioxide or more by 2020. This is equivalent to about 16 percent of current U.S. carbon dioxide

emissions (EPA, 2007), and about 14 percent of projected U.S. carbon dioxide emissions in 2020 (EIA, 2007). Over the longer term, it is expected that forestry can serve to provide a substantial portion of initial attainable reductions in net greenhouse gas emissions, serving as a bridge to more permanent technological solutions (McCarl & Sands, 2007).

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APPENDIX 3: U.S. BIOFUEL POTENTIAL

In 2005 about 216 million oven dry tons of wood harvested in the U.S. were used to make 193 million tons of industrial wood products (Howard 2007), and an additional 226 million dry tons of “sustainably recoverable” forest biomass is estimated to be available for energy consumption (Perlack et al. 2005). The goal of the Department of Energy (Perlack et al. 2005) to have one billion tons of biomass feedstock for bioenergy production annually by 2030 cannot be met without the dedication of over 72 million acres to energy crops, including trees, such as hybrid poplars and willows, and perennial agricultural crops such as switchgrass (Riemenschneider 2007). Such large scale utilization of wood for energy has definite implications for forest management and will require committed research.

In 2007, the President initiated the “20 in 10” effort to reduce U.S. gasoline use by 20% by 2017. The plan calls for increasing renewable and alternative fuels by setting a mandatory fuels standard of 35 billion gallons of production annually (15% offset) and by improving gasoline conservation and fuel mileage in cars and light trucks (5% offset).¹ Currently the U.S. consumes about 147 billion gallons of gasoline annually.² If corn can provide 15 billion gallons of ethanol we still need improved cellulosic conversion technologies to competitively provide 20 billion gallons of fuel by 2017. If research improves technologies to yield 90 gallons of ethanol per ton of biomass we would need to supply 222 million tons of agricultural and forest biomass by 2017. If wood provides a third of this tonnage (74 million oven dry tons) the amount would be 34% of our current harvest for industrial wood products.

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¹ www.whitehouse.gov/stateoftheunion/2007/initiatives/energy.html

² <http://auto.howstuffworks.com/question417.htm>

APPENDIX 4: Forest Service Strategic Framework for Climate Change (Summary 6/27/08)

The Forest Service Mission is to: *Sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations.*

The Nation's forests and grasslands provide clean water, scenic beauty, biodiversity, outdoor recreation, natural resource-based jobs, forest products, renewable energy and carbon sequestration. Climate change is one of the greatest challenges to sustainable management of forests and grasslands and to human well-being that we have ever faced, because rates of change will exceed many ecosystems' capabilities to naturally adapt. Without fully integrating consideration of climate change impacts into our planning and our actions, the Forest Service can no longer fulfill its mission.

The Forest Service has a unique opportunity and responsibility to sustain forests and grasslands in the United States and internationally. This responsibility includes: 1) stewardship of 193 million acres of national forests and grasslands, 2) partnerships with States and Tribes for assisting communities and owners of 430 million acres of private and Tribal forests, and with other federal agencies, 3) international cooperation, 4) research and development to provide science and management tools. These responsibilities make it imperative that we understand and be able to respond to the effects of climate change on the Nation's forest and grassland resources.

This document provides a strategic framework for the Forest Service to guide current and future actions to meet the challenge of climate change.

PROPOSED GOALS

We have identified seven key goals that will help the Forest Service carry out the mission of sustaining forests and grasslands for present and future generations under a changing climate.

To achieve these goals the Forest Service will need to work collaboratively with a broad range of agencies, partners, and stakeholders, including other federal agencies, States, Tribes, communities, private landowners and the public at large. Internally, the Deputy Areas and functional lines will need to work together to make full use of expertise and resources to accomplish this work.

Forest Service goals for addressing climate change for the benefit of human and ecological health and wellbeing:

1. **Advance our understanding** of the environmental, economic and social implications of **climate change** and related adaptation and mitigation activities on forests and grasslands.
2. **Enhance the capacity of forests and grasslands to adapt** to the environmental stresses of climate change and maintain ecosystem services.

3. **Promote the management of forests and grasslands to reduce the buildup of greenhouse gases**, while sustaining the multiple benefits and services of these ecosystems.
4. **Integrate climate change into all Forest Service policies, program guidance, and communications** and put in place effective mechanisms to coordinate across and within Deputy Areas.
5. **Reduce the environmental footprint** of Forest Service operations.
6. **Advance awareness and understanding** regarding principles and methods for sustaining forests and grasslands, and sustainable resource consumption, in a changing climate.
7. **Establish, enhance, and retain strong alliances and partnerships** with federal agencies, State and local governments, Tribes, private landowners, and non-governmental organizations to provide sustainable forests and grasslands for present and future generations.

APPENDIX 5: Forest Service Global Change Program Research Strategy, 2009-2019 (Summary 08/08/08)

Objective: In keeping with the research goals of the US Climate Change Science Program, the USDA Forest Service (FS) Research and Development agenda helps define climate change policy and develop best management practices for forests (both rural and urban) and grasslands in order to sustain ecosystem health, adjust management for ecosystem services (“adaptation”), and increase carbon sequestration (“mitigation”), all under changing climate conditions. The fundamental research focus of the FS Global Change Research Strategy is to increase understanding of forest, woodland, and grassland ecosystems so that they can be managed in a way that sustains and provides ecosystem services for future generations.

Basis: Climate changes already observed and those predicted for the future differ considerably from the past. Accordingly, ecosystem services in the future will differ from the past. Geographic variability in climate and ecosystem services will increase. These geographic differences manifest in both biophysical conditions and socioeconomic systems, and as such, land management plans and actions must differ locally to account for this variability. There are also national needs to link these local actions so the sum of their impacts can be considered in policy. A challenge posed by changing climate that must be resolved through land management is the need to enhance adaptation of these ecosystems to increasing climate changes while removing carbon from the atmosphere through sequestration in ecosystems and wood/energy products.

To address this challenge, a FS Global Change Research Strategy and the concomitant research activities are needed to balance and coordinate responses. This strategy is the basis for a unified approach to managing within the range of uncertainty provided by a changing climate.

Approach: The FS Global Change Research Strategy balances research across a range of management, science, and technology transfer actions aimed at developing adaptation and mitigation approaches to sustain healthy ecosystems. The following research elements serve as the organizing mechanism.

1. The first element focuses on research that will advance management options under a changing climate to enhance ecosystem health and sustainability, insure the flow of ecosystem services such as water, wildlife, biodiversity, recreation, forest and grassland products, and reduce losses of ecosystem function from climate-altered disturbances such as wildfire, insects and invasive species.
2. The second element focuses on research that will assist managers in enhancing carbon sequestration via management that could increase forest growth rates and area of forested lands; will enhance biomass extraction and utilization research, and will increase understanding of long term carbon product storage pools.
3. The third element integrates the first two research elements by developing decision support tools and approaches for policymakers, planners, and land managers.
4. A fourth element is focused on the shared research needs for infrastructure, scientific collaboration, and technology transfer needed over the next decade to facilitate and implement in natural resource planning, the research and applications in the first three elements.

APPENDIX 6: Forest Service Woody Biomass Utilization Strategy (Summary February 2008)

This strategy describes how Forest Service, U.S. Department of Agriculture, programs can better coordinate to improve the use of woody biomass in tandem with forest management activities on both Federal and private land. Although the focus of this strategy is on the use of woody biomass, the primary objective is sustaining healthy and resilient forests that will be able to survive in an environment of natural disturbances and threats, including climate change, so that they will continue contributing to America's ecological, social, and economic well-being into the future. Use of woody biomass can be an important tool to help forest managers achieve those goals.

STRATEGY GOALS

GOAL 1: Identify and build partnerships through collaboration. Strong partnerships with diverse stakeholder groups can help leverage human and fiscal resources and can also help with establishing relevant and meaningful priorities.

GOAL 2: Develop and deploy the needed science and technology. Effective use of woody biomass will require new information about the growth, resilience, and adaptability of forests considering climate change effects; new silvicultural techniques and management guidelines; energy efficient, light-on-the-land harvesting, handling, and processing technologies for woody biomass; and new uses and technologies for converting woody biomass into energy and other biobased products. The new knowledge and tools must then be transferred to practitioners. This will involve cooperation with other Federal agencies, universities, organizations, and industries.

GOAL 3: Help develop new and expanded markets for bioenergy and biobased products. Markets are dynamic—changing in response to costs, perceived risks, social pressures, and technological advances. The Forest Service strives to capture emerging opportunities, find markets for various uses of woody biomass and new products, and enable cost-effective biomass utilization at both local and regional levels.

GOAL 4: Facilitate a reliable and sustainable supply of biomass. The Forest Service will use all existing authorities, including the Healthy Forest Initiative/Healthy Forest Restoration Act, stewardship contracting, and cooperative forestry authorities, to facilitate a long-term and predictable supply of woody biomass from public and private lands. The agency will develop estimates of biomass expected to be generated from vegetation management treatments. To attain this goal, the agency will actively engage with community, tribal, business, and environmental leaders in planning, execution, and monitoring.

Appendix 7. Northeastern Area Climate Change Education and Market Exploration

NA has not developed a formal education and outreach plan to date, but has engaged in a variety of outreach activities, including: 1) ongoing engagement with the RGGI Stakeholder working group to incorporate the use of FIA data into RGGI forestry offset baseline measurement; 2) presentations to state representatives, private forest landowners, and other stakeholders to promote awareness of NRS carbon measurement tools and options for engaging in the voluntary carbon market (WCI Offset Workshop; New England Climate Change Workshop; Great Lakes Forest Alliance Conference) 3) creation of customizable “Carbon Footprint” posters to generate awareness of NRS-GTR-343 carbon lookup tables 4) ongoing development of NA Carbon Website 5) regular updates on carbon markets and climate change related legislation presented quarterly at NA ELT meetings and 6) Sarah Hines delivers regular carbon & biofuels update newsletters to a listserv of 100+ NA & FS employees and external stakeholders.

NA states Michigan and Indiana competed successfully for S&PF competitive grant funding for carbon market exploration. Finally, NA has provided financial support and technical assistance for the creation of the Bay Bank, a Chesapeake Bay-based “markets for ecosystem services” project; however, the project is largely NA-independent at this point.

Appendix 8: Northeastern Area Bioenergy Projects

WERC Funded Project Highlights: (further information on each project is available at www.na.fs.fed.us/werc/)

Alternative Solid Fuel Boilers: An Analysis of Selected Anheuser-Busch Facilities - Anheuser-Busch, Inc. St. Louis, MO

This project supported the evaluation of the availability, quantity, accessibility, and price stability of woody biomass fuels at specific Anheuser-Busch facility locations in New Hampshire, New York, New Jersey, Missouri, Virginia, Georgia, Florida, Colorado, and California. Projects at Merrimack, NH, Baldwinsville, NY, and St. Louis, MO are moving forward. At St. Louis, MO Anheuser-Busch is using a 70-30 mixture of wood and coal in coal fired boilers to reduce greenhouse gas emissions.

The Eastern Hardwood Forest Region Woody Biomass Energy Opportunity - Summit Ridge Investments, LLC Charlestown, MA

This project examined, from an economic perspective, the opportunity to use woody biomass energy in the eastern hardwood forest region. The assessment encompassed value-creating opportunities from procuring the raw material through to the end market. The economic drivers are identified and evaluated. The final report is available at <http://spfnic.fs.fed.us/werc/finalrpts/06-DG-300.pdf>

Exploring Woody Biomass Retrofit Opportunities in Michigan Boiler Operations - Southeast Michigan RC&D Boiler Assessment

This study reviewed current boiler operations in Michigan to determine the feasibility and market potential for growth of wood-fueled systems in the state. This project included the development of an interactive website that allows users to do a preliminary analysis of their costs in converting to a wood-based fuel source. Additional funding for this project is from the Michigan Department of Labor and Economic Growth's Energy Office. The interactive website and final report are available at: <http://michiganwoodenergy.org/ctareport.php>

Increasing Community-Scale Biomass Heating in New Hampshire - North Country RC&D Laconia, NH

This project is promoting the use of small, community-scale wood energy systems for schools and other municipal buildings that can utilize New Hampshire's abundant supply of low quality wood. Five feasibility studies are underway on new woody biomass heat energy systems including engineering and design of a biomass project for a new state facility.

Investments by NA and Partners in Northeastern Area Woody Biomass Business Plan Implementation, 2007-2008

[in support of Near-Term Bioenergy Action Item 3: Bioenergy Demonstration Projects]

WBBP Strategy						
State	1	2	3	4	5	Grand Total
AL		\$175,279				\$175,279
AR	\$44,036					\$44,036
DC		\$72,000	\$200,000			\$272,000
GA	\$222,600					\$222,600
IL		\$200,000	\$40,000			\$240,000
MA	\$399,064					\$399,064
MD		\$125,000				\$125,000
ME	\$311,004	\$150,000		\$56,944	\$170,000	\$687,948
MI	\$155,938	\$1,072,548	\$123,000	\$399,405	\$97,400	\$1,848,291
MN		\$131,353		\$155,950		\$287,303
MO	\$108,034	\$200,000			\$80,470	\$388,504
NH					\$153,000	\$153,000
NY	\$70,000				\$194,600	\$264,600
SC		\$260,000				\$260,000
VT	\$150,000					\$150,000
WI	\$120,390		\$385,000	\$119,900		\$625,290
WV		\$131,175	\$35,090			\$166,265
Grand Total	\$1,581,066	\$2,517,355	\$783,090	\$732,199	\$695,470	\$6,309,180