

# Drivers of Change in Forests and Forestry: An Introduction

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A fundamental precept of strategic foresight research is that there are multiple possible futures (Bengston 2017, Bishop 1998, Dator 2002). These futures can be influenced by myriad social, environmental, economic, and technological trends and events. Strategic foresight research often employs horizon scanning methods to identify weak signals of change that have the potential to influence future conditions (see Table 1 for explanations of some key strategic foresight terms [Bengston 2013, Hines et al. 2019]). There are also stronger, more overarching forces that have changed conditions in the past, are influencing the present, and are anticipated to continue to do so in the future. These larger forces are often called drivers of change or, simply, drivers. Drivers of change are direct or indirect forces expected to shape the future in multiple ways (Nelson et al. 2006). The Millennium Ecosystem Assessment defines drivers of change as “any natural or human-induced factor that directly or indirectly causes a change in an ecosystem” (Nelson et al. 2005: 175). In this report we define “drivers of change” as influential direct or indirect forces expected to shape the future of U.S. forests and the forest sector over the next 20 years.

Drivers of change analyses are useful for many strategic foresight projects, including scenario planning and horizon scanning. The concept of drivers of change has been widely used by scholars and practitioners alike and a Google Scholar search for “drivers of change” returns almost 50,000 results. The natural resources fields have applied the concept of drivers of change extensively as well. For example, the Canadian Forest Futures Project of the Sustainable Forest Management Network compiled a series of 13 reports outlining drivers of change that were used as the basis for scenario planning for forest management in Canada: global climate change, global forest products demand and Canadian wood supply, invasive species, geopolitics, global energy, technology,

governance, aboriginal empowerment, air pollution, conflict over resources, society’s forest values, demographics, and industry profitability (Duinker 2008). The U.S. Federal Emergency Management Agency developed a series of reports outlining nine drivers of change that are anticipated to affect emergency management: changing role of the individual, climate change, critical infrastructure, evolving terrorist threat, global interdependencies and globalization, government budgets, technological innovation and dependency, universal access to and use of information, and U.S. demographic shifts (Federal Emergency Management Act 2012). Similarly, the Millennium Ecosystem Assessment outlines several direct and indirect drivers of ecosystem change that were seen as critical to understand possible global futures (Nelson et al. 2005). In another example, the Great Lakes Futures Project outlined eight drivers of change of the Great Lakes region: economy, energy, geopolitics and governance, water quality, climate change, invasive species, and biological and chemical contaminants (Friedman et al. 2015). In summary, drivers of change form a critical part of many strategic foresight projects. While there may be overlap, specific drivers of change are tailored to the needs of the individual project or topic.

This report explores eight drivers of change expected to influence forests and forestry in the United States over the next 20 years. The drivers were identified through a review of strategic foresight literature and projects, the USDA Forest Service (hereafter, Forest Service) Northern Research Station horizon scanning system (see Hines et al. 2019), and iterative brainstorming by the Forest Service’s Northern Research Station Strategic Foresight Group and partners. Thirteen drivers of change were initially identified: Indigenous rights, urbanization, demographic change, technological change, society’s changing forest values, economy, forestry education, forest products sector, climate change, increasing

**Table 1.**—An overview of strategic foresight and the methods used in it, with references for learning more (hyperlinked to open-access publications)

Term or method	Description	Learn more here
<b>Strategic foresight (also called futures)</b>	A transdisciplinary field of inquiry that uses a variety of methods to explore possible, plausible, and preferable futures. The goal is to develop foresight—insight into how and why the future could be different than today—to improve policy, planning, and decision making. The methods employed help people overcome business-as-usual thinking to better prepare for an uncertain future.	<a href="#">Futures Research: A Neglected Dimension in Environmental Planning and Policy</a> <a href="#">Ten Principles for Thinking About the Future</a> <a href="#">Futures Research Methods and Applications in Natural Resources</a>
<b>Strategic foresight projects</b>	Research projects or applied work to help individuals and organizations think more deeply about possible, plausible, and preferable futures.	<a href="#">Environmental Futures Research: Experiences, Approaches, and Opportunities</a>
<b>Scenarios</b>	<p>Data-based stories of a range of potential futures. Scenarios are one of the most widely known techniques used in strategic foresight. They are written in compelling, accessible language, often as if the events have come to pass. There are many approaches to developing scenarios, including the well-used 2 × 2 matrix approach and Aspirational Scenarios.</p> <p>Scenarios offer strengths missing from other tools to extrapolate about the future, such as forecasting. Forecasting takes existing data and trends and calculates from them to a single future. Scenarios, on the other hand, support strategic foresight’s focus on the many possible futures by developing alternate possible futures.</p>	<a href="#">Scenarios and Decisionmaking for Complex Environmental Systems</a> <a href="#">Millennium Ecosystem Assessment</a> <a href="#">Aspirational Scenarios</a>
<b>Scenario planning</b>	A specific application of scenarios, used to guide decisions in the near term. Scenario planning aims to achieve the preferable future outcomes identified through the scenario process. Multiple scenarios depicting possible future outcomes are developed to guide planning efforts.	<a href="#">Scenarios to Provide Context for Horizon Scanning: Backcasting North American Forest Futures from 2090 to 2035</a>
<b>Horizon scanning</b>	A process to gather early signals of change—weak or strong—in the area of concern. Horizon scanning is a foundational method in strategic foresight. The signals of change serve as a guide to what the future may hold, can facilitate effective planning, may reduce surprises, and are used as input into other futures methods.	<a href="#">The Forest Futures Horizon Scanning Project</a> <a href="#">Setting up a Horizon Scanning System: A U.S. Federal Agency Example</a>

disturbance, invasive species, fire, and water. The compilers of this report reached out to both technical experts and futurists to write short papers about each driver and to provide broad perspectives on how these drivers may influence forests and forestry in the coming 20 years. This report contains essays on eight drivers. We anticipate continuing this effort with updates and new drivers reports to be produced as Research Notes.

The first driver of change in this report is an environmental driver: climate change. This driver is arguably one of the most important environmental influences expected for forests over the next 20 years (see Intergovernmental Panel on Climate Change 2014). In “Climate as a Driver of Change in U.S. Forests,” Leslie Brandt shows how climate change has the potential to cause changes in forest productivity, distribution, composition, and structure. She explains that future climate impacts are anticipated to vary regionally and influence hydrology, flooding, and drought; invasive species; forest insect and disease outbreaks; and fire regimes. She also explains how climate change could affect forest management operations, options, and goals. This paper provides a concise treatment of the complex environmental and management challenges anticipated for forests and the forest management sector and identifies key uncertainties about what climate change could bring in the coming decades.

The next several drivers of change in this report—economic growth, forest products, and emerging changes in technology—can be considered economic drivers. In “An Uncertain Economic Future for the United States,” Robert Olson approaches the uncertainties of forecasting economic growth futures by describing four possible economic scenarios: higher growth, slow growth, techno-economic acceleration, and hard times. He describes how these different economic scenarios could influence forest sector employment, natural resource management, research and

development, and demand for forest resources. Omar Espinosa explores the importance of the U.S. forest products sector in his paper, “Trends in the U.S. Forest Products Sector, Markets, and Technologies.” He first describes the negative trends the forest products sector has exhibited over the past several decades and then describes many promising opportunities for new technologies and products with the potential to transform the industry. This paper contains many useful graphs and charts that illustrate major trends affecting the forest products industry. The paper finishes with a look ahead to how the forest products industry will continue to play a critical role in the economic, social, and environmental development of the United States during the next two decades and beyond. Last in the set of papers that consider economic drivers is George Kubik’s “Technology as a Driver of Future Change in the Forest Sector: Projected Roles for Disruptive and Emergent Technologies.” Kubik highlights eight technologies that have the potential to influence forestry futures and their implications: artificial intelligence, autonomous vehicles, electronic performance enhancement systems, genomics and synthetic biology, the Internet of Things, materials science, nanotechnology, and robotics.

The next papers focus on social drivers of change and potential implications for forest futures. In “Demographics as a Driver of Change in the U.S. Forest Sector,” Robert Olson shows how demographic shifts could require different forest management responses to address land use changes, an aging population, and increasing cultural diversity. He describes how forestry may be more effective through coordination between rural and urban forest management. He examines the potential need for greater accessibility of forest amenities to an aging population and the need for fire management to account for more people living in the wildland-urban interface. Also explored is the need to address how the quickly growing communities of racial and ethnic

minorities use forests and how they ascribe values to forests. David Bengston's paper, "Shifting Forest Values as a Driver of Change," provides a framework for understanding the important and unexpected ways that people's values change in relation to forests and natural resources. He sketches out three scenarios for how values could unfold and affect forestry and society in the coming decades: ecotopia, back to the utilitarian future, and growing apathy and disengagement. In the last paper of this section, "Indigenous Rights and Empowerment in Natural Resource Management and Decision Making as a Driver of Change in U.S. Forestry," Michael Dockry explores how Indigenous communities have been organizing and using their inherent sovereignty to influence major environmental issues such as climate change, fossil fuel extraction and transport, timber harvesting, and water management. The paper concludes with four possible scenarios of how Indigenous empowerment could unfold: increased collaboration and comanagement, increased litigation, increased conflict and protest, or a continuation of the current situation that includes a combination of all three scenarios, each applicable at different places and times. Finally, in "Education as a Driver of Change in U.S. Forests and the Forest Sector," Terry Sharik and co-authors outline the changing trends in general education and then take a deep look at the specifics of the future of forestry and natural resource education. They show how new educational paradigms will focus more on knowledge generation, interdisciplinary learning, communication technology, student engagement, and lifelong learning. They then explain how these changes could be incorporated into forestry education. Specifically, they illustrate

how forestry education will most likely shift to focus on social and environmental sustainability, field-based learning, distance learning for nontraditional students, and broad interdisciplinary undergraduate degrees with disciplinary-specific master's degrees and technically specific associate degrees. They also characterize forestry education as increasing among the public and discuss the importance of increased racial and ethnic diversity among those pursuing this field.

These papers are intended to be a baseline for research by the Forest Service and others working on natural resource foresight. They lay the groundwork for integration of strategic foresight research and practice with the ultimate goal of improved forest management, decision making, and broad interdisciplinary planning for change. The report is not intended to be comprehensive but to provide information about important drivers of change for use by policymakers and decision makers and as part of a comprehensive Forest Service forest futures research portfolio. As the future unfolds, these drivers could be updated with new information, edited to incorporate new ideas, and expanded to include additional drivers. We hope that this collection is useful in raising awareness of some key drivers of change that are likely to influence forests and forestry over the next 20 years. We are thankful for the contributions of the authors, editors, and reviewers, each of whom improved this compilation in substantive ways. Though this report does not cover every possible driver of change for forests and forestry, we believe that it provides a range of papers that will be useful for foresters, land managers, and others interested in the future of forests and natural resource management.

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