



forests of innovation

Models for Reimagining
the Future of Forests

Vincent Caruso
Lisa Hagerman
Nancy Pfund
DECEMBER 2020
DBL PARTNERS

CONTENTS

Introduction: Forests of Innovation 4

Innovating How We Invest: Emerging Financial Models 8

Clearing a Path for Increased Private Investment in Forests 9

Public-Private Partnerships in Forest Restoration Finance 10

Innovating What We Invest In: Forest Services and Products 12

Death Care, Legacy Care, and Eternity Management 13

Recreation 15

Carbon Markets 16

Forest Products 18

Construction 19

Partnerships Advancing the Monetization of Forests 20

The Way Forward 24

Appendix List of Interviewees 27

References 28



ABOUT THE AUTHORS

Vincent Caruso

Vinnie is an Associate at DBL Partners, which he joined in 2019. Vinnie sources and performs diligence on investment opportunities, supports portfolio company management, and helps portfolio companies implement their double bottom line practices. Vinnie received his B.A. in economics and international studies from the University of Michigan and his MBA from the Yale School of Management.

Lisa Hagerman

Lisa Hagerman, Ph.D., is the Director of Programs at DBL Partners, which she joined in 2011. Lisa leads the strategy and implementation of double bottom line practices working with DBL's portfolio companies across public policy and regulatory initiatives, environmental stewardship, and workforce development. Lisa received her B.A. from Bucknell University, her M.A. in political science from the University of North Carolina at Chapel Hill, and a Ph.D. in economic geography from Oxford University.

Nancy Pfund

Nancy Pfund is Founder and Managing Partner of DBL Partners and writes frequently about conservation and public lands policy and opportunity. As the pioneer impact venture capital firm in the United States, DBL's goal is to combine top-tier financial returns with meaningful social, economic, and environmental returns in the regions and sectors in which it invests. Nancy was featured as #17 on the 2014 *FORTUNE* Inaugural World's Top 25 Eco-Innovators list; appeared on *Fast Company's* 2016 list of Most Creative People in Business; and was named to the 2020 Forbes Impact 50 list of the most notable impact investors. Nancy is a Trustee of the National Geographic Society and the Founding Co-Chair of the Conservation for Economic Growth Coalition, an organization dedicated to bringing the entrepreneurial voice to conservation and public lands issues. Nancy received her B.A. and M.A. in anthropology from Stanford University, and her MBA from the Yale School of Management.

ACKNOWLEDGMENTS

The authors wish to thank **Carla Orrego** (UC Berkeley Haas MBA '20) and **Peter Kossar** (UC Berkeley Haas MBA '21) of the UC Berkeley Haas *Impact Investing Practicum* program for their extensive research and significant contributions to this paper. We also wish to thank the practitioners and academics listed in the interviewee list for their time and willingness to share their valuable insights and expertise. **Madeline Reeves, DBL Summer Associate 2020** (Kellogg School of Management MBA '20; Harvard Kennedy School MPP '21) and **Jake Harris, Associate, DBL Partners** also contributed. None of these individuals should be held accountable for the views expressed, errors, or omissions.

introduction



Forests of Innovation

The impacts of our changing climate are a central concern for leaders across nearly every sector of society, including government, business, civil society, and public health. This is increasingly true for the general population, too. A recent study found that 73% of Americans now believe global warming is happening, up from 53% in 2013,¹ and 52% of Americans now believe addressing climate change should be a top legislative priority.² This shift in opinion is urgently welcomed, as near-term reductions in carbon emissions will need to be accompanied by large-scale carbon sequestration to meet targets set by the Paris Agreement and avoid the worst impacts of climate change.³ Recent evidence suggests forests will play a critical role in achieving these goals, through reductions in emissions from fires and deforestation, and through land management techniques that capture and store carbon, known as “Natural Climate Solutions.”⁴ While growing consensus for climate action and nature’s mitigation potential offer reasons for optimism, the consequences of a global response that has been neither swift nor powerful enough are already beginning to emerge.

The repercussions for the world’s forests have been particularly alarming. In California, the October 2019 Kincade Fire in Sonoma County burned 78,000 acres, causing Pacific Gas & Electric (PG&E), the California utility, to turn off electricity for 48,000 customers to prevent a powerline spark from causing another major fire.⁵ This unprecedented series of events came on the heels of what were then the two most destructive wildfire seasons in California’s history in 2017 and 2018.⁶ This trend shows no sign of slowing. In 2020, record-breaking fires

spread across the U.S. West. California was under a constant state of emergency as fires throughout August, September, and October caused widespread evacuations, record levels of air pollution, and power shutoffs for hundreds of thousands of PG&E customers.⁷ The California fires alone burned over four million acres, by far the most devastating wildfire season in state history.⁸

These fires have serious ramifications for communities and wildlife. They impair air quality, destroy property and natural habitat that is crucial to biodiversity, and exacerbate climate change by emitting large amounts of carbon into the atmosphere.⁹ They have also been shown to pose disproportionate risk to communities of color, with census tracts comprised of majority Black, Hispanic, and Native American populations facing 50% greater wildfire vulnerability on average, according to one 2018 study.¹⁰

Unfortunately, the frequency and severity of wildfires is increasing globally, from Brazil to Australia to the Arctic, due to hotter and drier conditions linked to climate change.¹¹ These developments, coupled with widely documented increases in global deforestation,¹² are

among the most visible signs that forests, and the planet as a whole, need help fast.

Recently, turbulent climactic events have often been overshadowed as the global economy has grappled with the COVID-19 public health crisis. At the same time, the varying degrees of economic closure implemented to slow the spread of the virus have led to steep reductions in air pollution and carbon emissions,¹³ offering glimpses into the numerous benefits transitioning to a cleaner economy could bring in the future. Data provided by Planet,^a a company that operates a network of nanosatellites to capture daily images of the Earth’s surface, has been used by the media to document lower levels of heavy industrial activity, reductions in travel, and the cleaner air and waterways that have resulted around the world.¹⁴

Regardless of the varying political views that surround climate change and the policy measures needed to stabilize a shaken global economy, there is no escaping the reality that escalating disruptions induced by climate change are becoming a regular part of everyday life. It is also increasingly clear that forests, and the communities

Emerging research, technology, and financial mechanisms demonstrate that forests need not be passive victims of climate change. Innovation applied to forests has the potential to uproot legacy business models, increase climate resilience, and sequester significant amounts of carbon.

a. Planet is a DBL Partners portfolio company.

that surround and depend upon them, are extremely vulnerable to these impacts.¹⁵ On the positive side, emerging research, technology, entrepreneurship, and financial mechanisms discussed throughout this paper demonstrate that forests need not be passive victims of climate change. Rather, innovation applied to forests has the potential to replace legacy business models with low-carbon alternatives, increase climate resilience, promote biodiversity, and sequester significant amounts of carbon from the atmosphere.

Every crisis offers an opportunity to reevaluate and make changes that would be difficult to implement under ordinary circumstances. As the economy ramps back up, and pollution levels inevitably rise once more, the temporary improvements to the environment offer a source of inspiration. What might be achieved if greater levels of investment are directed toward decarbonization solutions? What if these same investments also improved the health of existing forests and reforested areas where trees have been lost while helping to prevent emissions from fires? For example, the same Planet images used to track economic activity during

COVID-19 are being used by Salo Sciences, a conservation technology company, to create a detailed map of fire risk and fuel loads across California forests. This platform, known as the California Forest Observatory, combines Planet’s satellite imagery with Salo’s AI-powered ecological modeling to provide high-resolution data to improve forest management in the face of increased wildfire risk,¹⁶ a topic detailed in this report.

This paper will highlight several examples in which entrepreneurship, technology, and partnerships are being harnessed to deliver commercially viable innovation that directly benefits forests. The upshot for the Earth is enormous. Trees provide habitat for wildlife, are critical to watershed health, and prevent soil erosion.¹⁷ For humans, they are a source of economic livelihood,¹⁸ physical and mental health benefits,¹⁹ and recreation. While forests alone cannot tackle climate change, they have the potential to play a tremendous role in its mitigation. A 2017 study by The Nature Conservancy and others found that the aforementioned “natural climate solutions” could contribute up to 37% of CO2 emission reductions required by 2030 to meet

the targets of the 2016 Paris Climate Agreement.²⁰ Among the varied nature-based solutions identified in the study, forests currently show the greatest capacity to capture and store carbon, primarily through reforestation (replanting trees in deforested areas), avoided forest conversions (preventing further tree cover loss), and improved forest management practices.²¹ Advisers to the Biden administration have signaled an intention to take advantage of this potential by identifying key recommendations for the US Department of Agriculture including working with farmers and forest owners to advance natural climate solutions, establishing a Carbon Bank to finance climate-friendly land management practices, and prioritizing federal investment in forest restoration and wildfire prevention.^b

Applying market-based innovation to forests is an international approach that spans industries, sectors, and continents. While these international efforts are crucial, this paper maintains a narrower lens, focusing on the United States. Many of the featured organizations are early adopters of a new conservation-oriented approach. In fact, the application of business models that

VENICE GRAND CANAL

Before Covid-19



March 2020



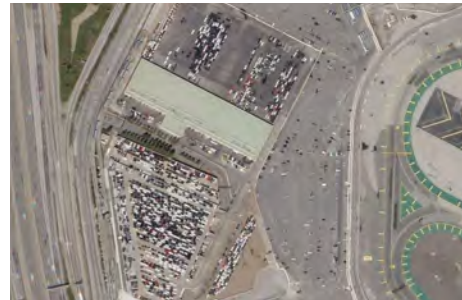
Source: Planet

SFO PARKING

Before COVID-19



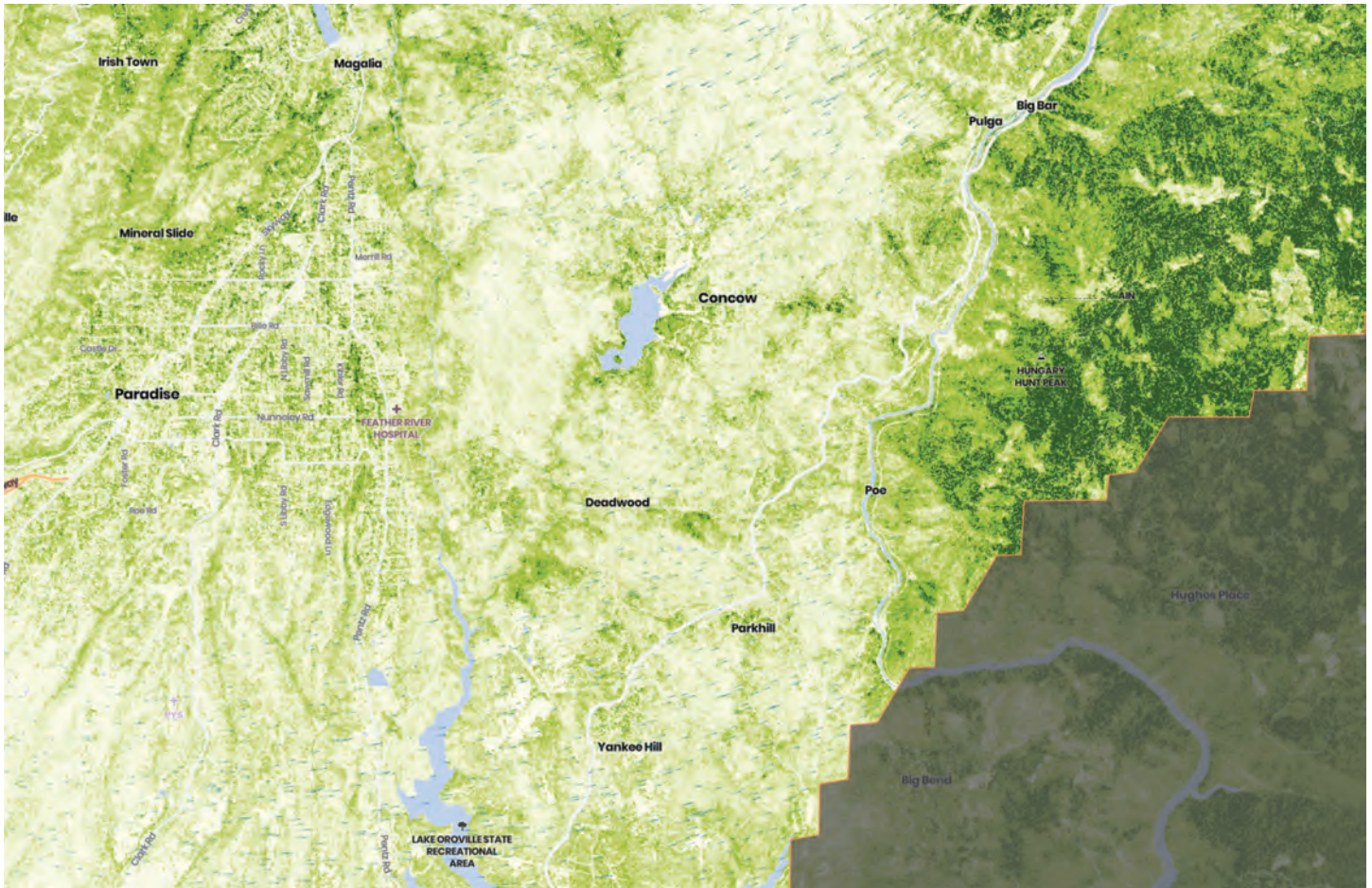
March 2020



Planet satellite imagery helped visualize the economic impact of COVID-19

b. These priorities were articulated in a memo authored by advisers to the Biden transition team in November 2020. Climate 21 Project. “Department of Agriculture Transition Memo.” November 2020. Retrieved from https://climate21.org/documents/C21_USDA.pdf.

The same Planet imagery is also being used by Salo Sciences to build the California Forest Observatory, a monitoring tool for California forests



This image, taken from the California Forest Observatory on September 10, 2020, shows the North Complex Fire approaching the town of Paradise, CA, where scars from the 2018 Camp Fire are still visible in the area of low canopy heights to the East of the town.



Source: California Forest Observatory. Salo Sciences. September 2020. Retrieved from <https://forestobservatory.com/>

promote conservation, including those based on forests, is still embryonic across most sectors. This is in contrast to more developed fields DBL has addressed in past thought papers, including renewable energy, organic agriculture, and energy policy.^c As a result, the data and examples derive from a relatively small pool of interviews and touch upon a variety of themes and industries. They include nonprofits, government agencies, and fast-growing technology companies. In all cases, their work underscores the important role that forests can play in a

low-carbon future, and the opportunities such initiatives may offer to a wide range of investors.

The remainder of this paper explores these topics through three major organizational sections. “Innovating How We Invest” examines public-private partnerships as a case study for how new financial models can attract greater diversity and amounts of capital toward projects to promote forest health. “Innovating What We Invest In” focuses on startups offering forest-based services

and products that have the potential to replace carbon-intensive businesses with low-carbon alternatives, improve access to forests, increase conservation incentives, and complement policy efforts to mitigate greenhouse gas (GHG) emissions. Finally, “Partnerships Advancing the Monetization of Forests” describes growing cooperation across the nonprofit, government, and for-profit sectors that is amplifying the varied examples highlighted throughout this report.

c. Previous DBL white papers can be found at <http://www.dblpartners.vc/resources-reports/>.

An aerial photograph of a dense, lush green forest, likely a coniferous forest, viewed from above. The trees are packed closely together, creating a textured, green canopy. The lighting is bright, highlighting the various shades of green. The text is overlaid on the upper portion of the image.

•
innovating
how we
•
invest

Emerging Financial Models

The idea that financial capital can contribute to managing, protecting, and restoring natural ecosystems, including forests, is older than many of the trees in the United States.²² What is new is the use of novel financial instruments and innovative partnerships to expand the boundaries of forest investments, creating a path for a broader array of investors to contribute to forest conservation efforts. This section provides an abbreviated overview of conservation finance and highlights two examples of new financial models that leverage public-private partnerships to attract private capital to fund needed forest restoration work on public lands.

CLEARING A PATH FOR INCREASED PRIVATE INVESTMENT IN FORESTS

From its origins in 1634, when Boston Common became America's first public park, the field of conservation finance (also called conservation investment and natural capital) has grown tremendously, surpassing \$50 billion globally in 2012.²³ This capital represents funds raised and managed to support land, water, and natural resource conservation.²⁴ Over this vast period, an abundance of models has emerged that deploy financial resources to safeguard and enhance the environmental benefits provided by forests. The list includes conservation easements, payments for ecosystem services (PES), green bonds, and many others.^d

Historically, these and other investment vehicles that incorporated forest health or other conservation goals primarily attracted funding from public and philanthropic sources. These capital sources have been better suited to conservation projects due to the long investment horizons, high risk, and low rates of return that characterize these kinds of investments.²⁵ More recently, greater levels of private capital have flowed into the sector as some investment vehicles have emerged that provide risk-adjusted returns better suited to the expectations of private investors. Estimates of private capital allocated to conservation expanded from \$200 million in 2004 to \$2 billion in 2015.²⁶ This growth stemmed primarily from investments in sustainable food and fiber production (\$1.6 billion) and real assets (\$620 million),²⁷ which includes the acquisition of forest land for habitat protection.

Boston Common: The First Conservation Finance Investment in 1634



Photo: Aerial Photography of Boston Common by Marco Verch under Creative Commons 2.0

Recently, large corporations, especially in the technology sector, have paved the way for greater private capital participation. In August 2020, Google issued \$5.75 billion of sustainability bonds, funding that will be used for projects that generate environmental outcomes. The environmental and social aspects of the raise saved Google three to five basis points on interest rates compared to traditional bond rates, establishing a precedent for green financing that large companies across a variety of sectors are expected to follow.²⁸ Major corporations have also made ambitious

d. This paper does not attempt to provide a complete history of conservation finance, nor does it exhaustively catalogue existing conservation finance models related to forests. Several organizations define, catalogue, and provide case studies for this growing field, including the Conservation Finance Alliance (www.conservationfinancealliance.org), the Coalition for Private Investment in Conservation (<http://cpicfinance.com/>), and Conservation Finance Network (<https://www.conservationfinancenetwork.org/>).

climate commitments that will lead to greater levels of investment in conservation finance. For example, Microsoft’s commitment to become carbon negative by 2030 will utilize carbon offsets (a topic detailed later in this paper) generated from forest restoration, afforestation, and soil carbon sequestration.²⁹

The increased participation from private capital is a step in the right direction, but significant barriers still exist that hamper further growth. The majority of private conservation capital comes from a small handful of the largest investors,³⁰ and there is a dearth of large-scale, liquid investment opportunities necessary to attract new ones.³¹ These obstacles, coupled with practical constraints on the amount of public and philanthropic capital that can realistically be allocated to conservation, have resulted in a significant gap between current funding levels and those needed to safeguard global ecosystems and the rich biodiversity they sustain. One widely cited report, jointly authored by Credit Suisse, McKinsey, and the World Wildlife Foundation, estimated this gap to be \$250 to \$350 billion in 2016,³² while another estimate from a July 2020 National Geographic Society study suggests an annual gap of over \$110 billion.³³

This conservation funding shortfall represents a major challenge, but it also presents an opportunity for entrepreneurs that can create new financial products and business models that promote conservation. Ultimately, closing this gap will require a range of opportunities that provide returns across the full financial spectrum. The remainder of this section takes a closer look at one area, public-private partnerships, in which new models are clearing a path for greater amounts of capital, and a more diverse set of investors, to contribute to forest health.

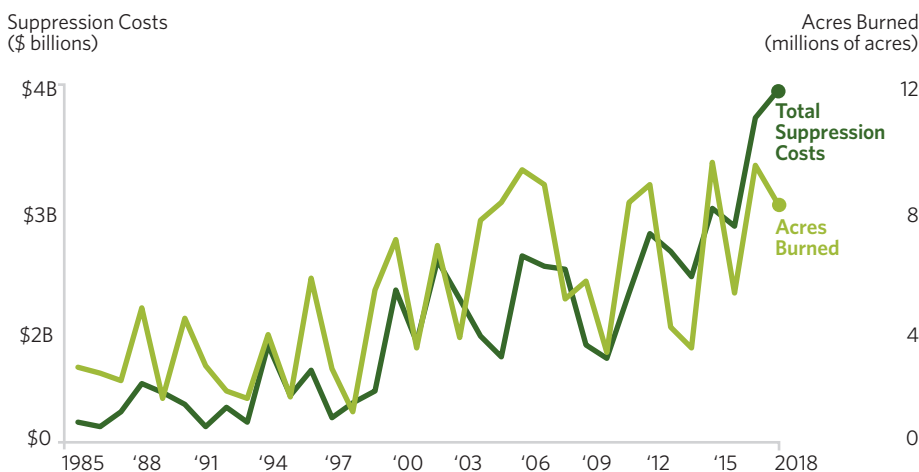
PUBLIC-PRIVATE PARTNERSHIPS IN FOREST RESTORATION FINANCE

Public-private partnerships, cooperation among public and private entities to provide services,³⁴ have been applied globally to a range of sectors, including infrastructure, energy, and public health. Recently, they have emerged as a promising tool to channel private capital toward improving the health of public forests, which comprise over 40% of U.S. forestland.³⁵ Two examples discussed in this section, Blue Forest Carbon and the Innovative Finance for National Forests Program, are utilizing public-private partnerships to increase funding for forest

restoration, which includes activities such as prescribed burns and small tree removal that can improve ecological function while helping to reduce the frequency and severity of wildfires.

Public forests, especially in the West, have become overgrown due to a century of policies that suppressed naturally occurring wildfires.³⁶ As mentioned previously, climate change has also created hotter and drier conditions in forests. These two trends, coupled with growing development at the borders of forests (called the “wildland urban interface”),³⁷ have contributed to dramatic increases in the frequency and intensity of wildfires,³⁸ as evidenced by the unprecedented 2020 fire season. Restoration has emerged as one promising solution to improve the resilience of public forests to wildfire, with studies showing that recent restoration in California provided a return on investment of \$1.90 to \$3.30 for each dollar spent.³⁹ Though restoration cannot completely mitigate the manifold drivers of forest fires, which include natural forces such as winds, lightning, and droughts in addition to human factors like population growth and development near forests,⁴⁰ it can contribute to making fires less likely and less severe.

U.S. Federal Wildfire Suppression Costs, 1985-2019



Source: National Interagency Fire Center, External Affairs Office



Source: U.S. Department of Interior, Office of Wildland Fire

The U.S. Forest Service (USFS), which manages 193 million acres of public land, allocates a portion of its budget to restoration each year. Historically, this was funded by the Reforestation Trust Fund, which appropriated \$30 million annually.⁴¹ The 2019 Reforestation Act increased this funding to \$60 million, but it had remained stagnant since 1980, resulting in a backlog of lands in need of restoration. By 2019, USFS estimated that 78 million of its acres (40%) were at risk from “uncharacteristically severe wildfires” and would benefit from restoration.⁴² One reason for this backlog is that the growing frequency and severity of fires has caused USFS fire suppression spending to rise dramatically, from \$367 million in 1995 (16% of its annual budget) to \$2.6 billion in 2018 (over 50%).⁴³ This led to consistent “fire borrowing,” in which USFS funded firefighting by pulling money from restoration.

Fortunately, recent legislative changes will curb fire borrowing going forward.⁴⁴ The Great American Outdoors Act, passed in August 2020, will allocate \$9 billion to public lands over the next 5 years through a new National Park and Public Lands Legacy Restoration Fund, some of which will address the forest restoration backlog. The act also allocated funding on a permanent basis for the first time to the existing Land and Water Conservation Fund at \$900 million annually, which also contributes some funds to forest restoration projects.⁴⁵ These legislative efforts provide needed increases in the level and stability of public funding for forest restoration. New public-private partnership models are showing that private capital can amplify these efforts to address the backlog of public forestland in need of restoration.

Blue Forest Conservation (BFC), a California nonprofit founded in 2015, is one organization creating investment vehicles for private capital to contribute to public forest restoration. The firm’s Forest Resilience Bond (FRB) brings a financial structure first used in social impact bonds

New public-private partnerships are showing that private capital can amplify existing efforts to address the backlog of U.S. forestland in need of restoration.

to the forestry sector, where it shows promise to expand restoration funding in the U.S. West.

Through the FRB, private investors provide upfront capital to finance forest restoration activities (e.g., prescribed burns and small tree removal) and organizations that benefit (“beneficiaries”) pay them back over time, with modest returns, as the work is completed. Typical beneficiaries might include the U.S. Forest Service (from reduced wildfire suppression costs), utilities (from protected water quality), and local governments (from improved environmental and social outcomes in their jurisdictions). BFC serves as the project developer, contracting with beneficiaries to identify a project and, alongside the World Resources Institute and local beneficiaries, determining the value of specific ecosystem services.

After partnering with the USFS in 2017, BFC launched the first FRB pilot in 2018, raising over \$4 million of financing from The Rockefeller Foundation, the Gordon & Betty Moore Foundation, Calvert Impact Capital, and CSAA Insurance Group. The goal of the pilot is to protect 15,000 acres of forest within the Yuba watershed in Tahoe National Forest. Along with state and federal funding, the finance package included a \$1.5 million cost-share contribution from the Yuba Water Agency, which stands to benefit from the protections to water quality that restoration will provide. The first restoration activities began in 2019 and are expected to continue through 2022. If all goes well with the pilot, BFC plans to finance larger, landscape-scale restoration projects with funding targets above \$50 million. This larger project size would enable participation from investors with a preference

for large capital allocations, such as pension funds and insurance agencies.

Products like the FRB demonstrate the potential for private capital to partner with government agencies to address critical needs across America’s public forests. This concept is gaining traction. A new collaboration between the National Forest Foundation, the U.S. Endowment for Forestry and Communities, and the USFS Conservation Finance Program aims to identify and scale new financing models that leverage private capital to support the National Forest System. Announced in 2019, the **Innovative Finance for National Forests (IFNF)** grant program awarded \$1.8 million in grant support, ranging from \$100,000 to \$500,000, to organizations developing financial mechanisms with potential to scale across the National Forest System.

The IFNF program received 48 project proposals in its initial year. The first grantees were announced in May of 2020 with a focus on watershed health and recreation infrastructure. The projects range from early design efforts, such as a new wildfire resilience insurance product, to models that are closer to implementation, like BFC’s Forest Resilience Bond. In addition to funding, the organizations benefit from partnerships with the participating organizations. The National Forest Foundation provides technical assistance for project implementation; the USFS offers access to staff and help navigating the agency; and the U.S. Endowment for Forestry and Community administers and monitors the grants. As the IFNF program takes shape, the collaborators aim to build a pipeline of projects that expand the use of conservation finance across U.S. National Forests.



innovating
what we
invest in

Forest Services and Products

At first glance, trees may not seem ripe with opportunities for innovation. They are familiar and ubiquitous in urban streets and rural hillsides, having been rooted in earth’s landscapes for more than 300 million years.⁴⁶ Recent developments suggest, however, that forests have untapped commercial potential that is just beginning to be discovered. Increasingly, forests are at the center of business model and technological innovation for startups across a wide range of industries. This section explores a subset of sectors, across both forest services (death care and eternity management, recreation, and carbon markets) and forest products, where forests are driving innovations that promote forest health and contribute to the decarbonization of industries with historically high levels of GHG emissions.

DEATH CARE AND ETERNITY MANAGEMENT

Looking out over the vast lawns of a typical American cemetery, it may not be clear how an industry focused on interring and honoring the dead could contribute to protecting the health and vibrancy of living forests. In fact, whether it is referred to as death care, legacy care, or eternity management, many of the practices that have underpinned the modern manifestation of this industry since the late 1800s⁴⁷ are unsustainable and amount to systematic environmental degradation that has historically gone unnoticed by the general public.

Each year in more than 100,000 cemeteries across the country, over 30 million board feet of hardwood coffins are lowered into the ground, along with a vast array of chemicals and carbon-intensive materials. These include 64,000 tons of steel, 1.6 million tons of concrete, 17,000 tons of copper and bronze, and 4.3 million gallons of embalming fluid, most prominently formaldehyde, a highly

toxic human carcinogen.⁴⁸ Over time, these materials leach into the earth, making cemeteries a major source of anthropogenic soil and groundwater contamination.⁴⁹

Today, several signs suggest these environmentally harmful practices are ripe for disruption. Over 50% of respondents to a 2019 study expressed interest in greener funeral options,⁵⁰ and cremation, which overtook burial as the preferred end-of-life option in 2015, is expected to be used in 80% of cases by 2035.⁵¹ While cremation does significantly less environmental harm, as it does not require the land, materials, or chemicals used in burial, it does have a carbon footprint, with common methods emitting 500 pounds of carbon per body (roughly equivalent to two gas tanks).⁵² As a result, several startups are designing low-carbon alternatives. One method known as “recomposition,” which is described in greater detail below, uses composting instead of burning.

Materials Used for Traditional Burials in the U.S. Each Year

MATERIAL	ANNUAL USE	EQUIVALENCY EACH YEAR
Concrete	1.6M tons	¼ of the concrete in the Hoover Dam
Wood	30M feet	Wood framing for 2,000 single family homes
Steel	64,000 tons	More steel than the Empire State Building (60,000 tons)
Metals (copper, bronze)	17,000 tons	Wire, plumbing, and hardware for 70,000 single family homes
Embalming Fluid (formaldehyde, methanol, etc.)	4.3M gallons	Would fill 6.5 Olympic swimming pools

Source: Annual use provided by Green Burial Council. Equivalencies calculated by DBL.

These upstream carbon reductions are complemented by sustainable innovation downstream, where companies are making it possible to scatter and memorialize the remains of loved ones in ways that also contribute to protecting and growing forests.

One example is **Better Place Forests (BPF)**^e, a company that is reimagining the relationship between one's final resting place and the natural world. As an alternative to traditional cemeteries, BPF has created America's first conservation memorial forests where families scatter the remains of loved ones beneath a tree of their choosing. In effect, these families purchase a living tree instead of a tombstone. BPF's forests are established on tracts of previously unprotected forestland. The company protects its forests in perpetuity by using a conservation easement, a tool commonly used to protect private land, to transfer development rights to a permanent land trust. BPF does not handle the cremation process, but it does neutralize the ashes and combine them with beneficial soil

“Better Place Forests is seeking aligned partnerships with land trusts because we share the goals of conserving cherished natural places and increasing communities’ connection with the land.”

Jake Young, Senior Manager of Land Acquisition and Land Trust Partnerships, Better Place Forests

prior to scattering. BPF also works to improve the health and resilience on its properties with ongoing maintenance, such as removing invasive species and clearing dense underbrush.

In addition to protecting existing forests, BPF has partnered with One Tree Planted, a Vermont-based nonprofit, to reforest fire-damaged areas across America. For each tree sold in one of its memorial forests, BPF works with One Tree Planted to plant 25 to 400 trees in areas impacted by forest fires or deforestation. To date, the partnership has planted more than 60,000 trees, which will help rebuild ecosystems and sequester, or capture, carbon as these trees mature.

BPF currently has two California conservation memorial forests in Point Arena and Santa Cruz, as well as forests in Flagstaff, Arizona and Scandia, Minnesota. It plans to expand to other states throughout the country. As the company grows, so too will the acres of forestland it puts under protection, helping the communities in which it operates to protect much-needed open space.

BPF offers one prominent example of how innovation can enable greener burial options and tap into changing consumer priorities. The company is not alone in this regard. Other startups such as **Capsula Mundi**⁵³ and **BioLife**⁵⁴ sell biodegradable urns designed to be planted beneath tree seedlings. As previously mentioned, other companies are providing sustainable alternatives to cremation upstream, which complement and enhance the benefits of choosing a greener spreading method. One such company, **Recompose**, has designed a process to convert human remains into soil, which it claims can sequester carbon and improve soil health.⁵⁵ In 2019, Washington became the first state to legalize this process, called “recomposition” or “human composting.”⁵⁶ This policy shift, along with the emergence of a wide range of companies seeking to reduce the environmental impact of traditional death care practices, suggests that this industry is becoming an unlikely exemplar of the potential for businesses built on sustainability to displace legacy models, satisfy changing consumer preferences, and address 21st century forest and climate challenges.

BPF Forest in Flagstaff, AZ



^e. Better Place Forests is a DBL Partners portfolio company.

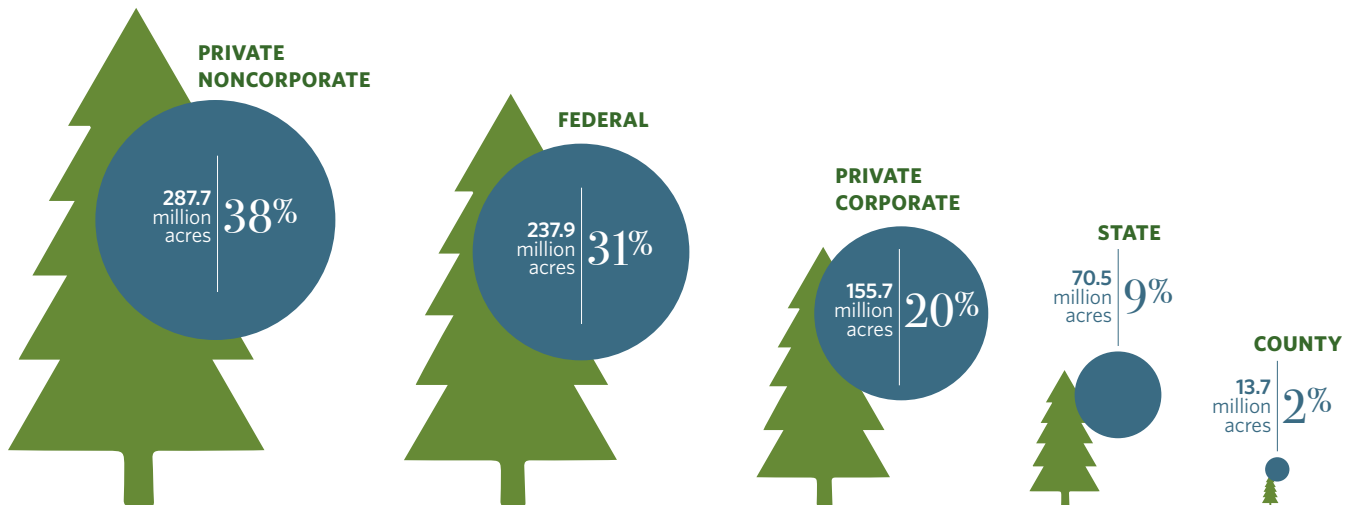
RECREATION

For many families, forests create happy memories: sunny adventures hiking on a trail or sitting by a campfire under the stars. In short, many individuals enjoy outdoor recreation and passionately incorporate it into their lifestyles. This passion also drives significant economic opportunity. Recreation generates \$887 billion per year in consumer spending and supports 7.6 million American jobs,⁵⁷ in addition to subtler economic benefits that are often overlooked. For example, a national survey conducted by The Muse^f, a workforce and career-building company, and the Conservation for Economic Growth Coalition (CEGC), an organization of venture capitalists and entrepreneurs, found that proximity to outdoor recreation helps companies attract and retain talented employees, particularly millennials.⁵⁸

The value generated by forest recreation extends far beyond the economy. Meaningful outdoor experiences, and the desire to allow future generations to share them, contribute to building the political and social will needed to drive climate action. A growing body of literature also shows that exposure to trees and forests can lead to a range of physical and mental health benefits, including improved respiratory health and reductions in stress and anxiety.⁵⁹ As our understanding of the numerous benefits provided by forest recreation continues to grow, so too do the number of businesses seeking to expand it. This section highlights emerging companies that are increasing access to forest recreation, attracting greater amounts of private investment into the sector, and providing forest owners with revenue opportunities that, unlike traditional development, result in the conservation of their land.

Though forest recreation is synonymous with national parks and other government-owned land, private landowners are by far the largest owners of forested areas in the U.S., including corporate (20%) and noncorporate (38%) private entities. These noncorporate private forests are controlled by more than ten million owners, including individuals, families, trusts, and estates scattered widely across the country. Historically, these non-corporate private owners have been the most likely to sell their forestlands for purposes that have resulted in development and deforestation. A study by the USFS predicts that by 2050, population growth and the resulting metropolitan development could lead to the deforestation of 50 million U.S. acres,⁶⁰ an area roughly the size of Nebraska.⁶¹ Development at this scale could also contribute to forest fragmentation, the breaking up of contiguous forests into disjointed patches, which is a primary threat to biodiversity.

Ownership of U.S. Forestland 766 million acres



"Private Noncorporate" ownership includes 36% owned by individuals, families, and family trusts/estates, with the remaining 2% owned by other private noncorporate organizations (including Native American tribes and conservation nonprofits). "Private Corporate" includes legally incorporated entities like forestry companies, timber investment management organizations, and real estate trusts.

Source: U.S. Endowment for Forestry and Communities. Who Owns America's Forests? Retrieved from: <https://bit.ly/3bQBJan>.

f. The Muse is a DBL Partners portfolio company.

This loss of forestland will likely be concentrated in and around cities, which is especially troubling due to the disparity of access to outdoor recreation sites in urban areas. A 2019 study published in *Landscape and Urban Planning* examined access to parks and wooded areas in ten U.S. metropolitan areas meant to represent a cross-section of American cities, from New York and Los Angeles to Indianapolis and St. Louis. The results show that Americans with lower income levels and educational attainment had fewer opportunities to access public green space and forested areas. Access to these spaces was also lower for racial and ethnic minority communities, especially in cities with higher populations.⁶²

A new crop of companies is aiming to increase the amount of land open to recreation, democratize its access through technology, and provide landowners with a stream of recreation revenues to incentivize them to keep forests intact rather than opt for development. Based on sharing-economy principles, these companies use digital technology to create recreation revenues by addressing barriers like marketing, customer acquisition, and accountability that might normally prevent widespread use of their land. For example, **Hipcamp**, a platform for campsite booking founded in 2013, aggregates private owners of two or more acres of undeveloped land and allows users to book visits through a mobile app, which currently lists more than 350,000 bookable sites.⁶³ Private landowners decide the best offerings for visitors, from treehouses and cabins to tent sites and RV hookups, and set their own prices, with Hipcamp receiving a 10% commission on sales.⁶⁴ Other companies have launched comparable offerings. **Tentr**, founded in 2015, targets higher-end “glamping” customers by curating a selection of private listings of over 15 acres, with amenities such as firepits and semi-permanent structures.⁶⁵ On the other end of the spectrum, **The Dyrt** operates a free, crowd-sourced camping database, with a premium subscription offering offline maps and discounts on reservation fees.⁶⁶

If extensive overcrowding in America’s public parks is any indication,⁶⁷ there is no shortage of demand for outdoor recreation, even as the threats of wildfire devastation and the resulting pollution hang in the air around us. The benefits of scaling up access for a greater number of people would improve public health, grow local economies, and focus more attention on conserving and protecting green space for the future enjoyment of local communities. Despite these benefits, today most privately-owned land is sitting on the sidelines. The proliferation of technology-enabled recreation is a promising trend with potential to increase the accessibility of the outdoors while incentivizing landowners to maintain forestland.

CARBON MARKETS

Business models that reduce GHG emissions and generate positive environmental outcomes, such as those described above, will be necessary to meet the Paris Agreement goals of limiting global temperature rise to 2°C, and ideally 1.5°C, above preindustrial levels. To achieve these targets and avoid the worst impacts of climate change, GHG reductions must also be accompanied by carbon sequestration to reach net-zero emissions by 2050.⁶⁸ Net-zero, also called carbon neutrality, implies a state in which all human-caused emissions are cancelled out, or “offset,” by removing an equivalent amount of carbon from the atmosphere.⁶⁹

Carbon markets are one market-based policy approach being used to meet these goals,⁸ and natural climate solutions like forests, which capture carbon as they grow, can play a crucial role in generating carbon offsets to meet growing demand in these markets. Though the cost, accuracy, and transparency of carbon measurement has inhibited growth of carbon offsets, new businesses are emerging that apply remote sensing technology to enable accurate, cost-effective measurement for forest carbon projects. This section provides a brief overview of carbon markets and natural climate solutions before highlighting a few emerging companies.

Background on Carbon Markets and Natural Climate Solutions

Carbon markets have two forms, compliance and voluntary, with carbon transacted either as a tradable, government-distributed allocation to emit, or as a credit stemming from an offset project that removes carbon from the atmosphere. In compliance markets, governments set an annual cap on GHG emissions that is lowered over time. The cap is divided into tradable allowances that polluting industry participants buy and sell to account for each ton of GHGs they produce. These carbon trading systems are in place globally, from Europe to Korea, with others in development.⁷⁰ In the United States, California’s Cap-and-Trade program is the fourth-largest in the world.⁷¹ The total value of carbon traded in global compliance markets reached \$215 billion in 2019, a 34% increase from 2018.⁷²

Compliance markets also allow regulated entities to “offset” a portion of their emissions by funding projects that sequester carbon. For example, the California Air Resources Board (CARB) Forest Offset Protocol granted nearly five million carbon credits for forest projects alone in 2019.⁷³ A voluntary market for carbon offsets also exists, which includes purchases by corporations and individuals to reduce their carbon footprint. The global market for offsets was \$600 million in 2019 and is expected to grow rapidly to \$200 billion by 2050 as carbon neutrality commitments from companies, cities, and countries expand.⁷⁴ As of 2019, over 5% of Fortune Global 500 companies had pledged to reach carbon neutrality by 2030, with several others pledging to do so by 2040.⁷⁵

While many carbon capture technologies are being developed to satisfy growing demand for offsets, research suggests “natural climate solutions” — land management techniques that increase the carbon stored in forests, grasslands, and wetlands — have significant near-term potential. These approaches have the added benefit of providing ecosystem services that improve air, water, and soil

g. On September 15, 2020 the Business Roundtable endorsed using a “market-based mechanism” to address climate change, signaling support for approaches like carbon markets that put a price on carbon to reduce emissions.

quality while also expanding wildlife habitat that supports biodiversity. The amount of carbon that trees ultimately capture will depend on several factors, including the prevailing carbon price, with higher prices leading to greater investment in forest offsets. At the uppermost range, one study estimates that in the U.S. alone, forests could sequester over 650 million metric tons by 2025, equivalent to annual U.S. GHG emission from agriculture (10% of the U.S. total).⁷⁶ Of course, this estimate is bounded by human needs for food, agriculture, and fiber land use, and it may be revised as agricultural, land use, and other strategies identify additional methods of reducing and sequestering carbon.

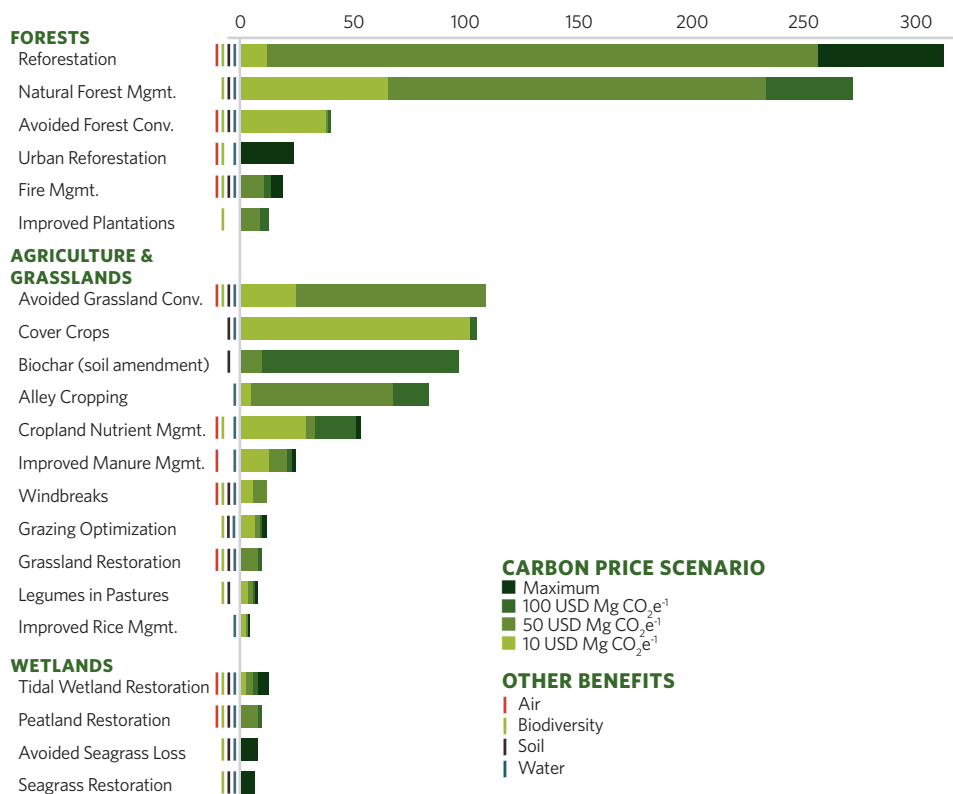
Improving Transparency in Carbon Markets with Technology

Forest carbon offset projects gained attention in April 2020 when Amazon announced that the first investment from its \$100 million Right Now Climate Fund would be a \$10 million grant to conserve forests and promote sustainable management in the Appalachian Mountains,⁷⁷ including \$7.3 million allocated to The Nature Conservancy's and American Forest Foundation's Family Forest Carbon Program.⁷⁸ This program will provide incentive payments to individual forest owners, who collectively own 36% of U.S. forests, to adopt practices that improve forest health and sequester additional carbon on their land. Simultaneously, the program will engage companies, such as Amazon, seeking to purchase large volumes of credits from small landowners.⁷⁹

This program demonstrates the potential of forest carbon projects to meet the growing demand for offsets, but some forest carbon projects have been limited by credibility concerns that their emission reductions may not be additional or permanent. A 2019 ProPublica investigation into carbon offset projects over the last two decades found that "carbon credits hadn't offset the amount of pollution they were supposed to, or they had bought gains that were quickly reversed or that couldn't be accurately measured to begin with."⁸⁰ One challenge

h. Planet is a DBL Partners portfolio company.

Climate Mitigation Potential of Natural Climate Solutions in the U.S. in 2025 (Teragrams of CO₂ Equivalent per Year)



Natural climate solutions in the U.S. could theoretically mitigate up to 21% of the country's net annual emission by 2025. The actual mitigation potential will depend on the price of carbon and costs of project implementation with higher carbon prices allowing for greater reductions. Current carbon prices are nearest to the \$10 per Mg CO₂e scenario.

Source: Reproduced with permission from Fargione et al. *Natural Climate Solutions for the United States*. *Science Advances*. November 2018.

is that the inventories necessary to meet rigorous accountability and transparency requirements can be expensive and time-consuming. For example, existing carbon inventory methodologies include hiring teams of foresters to physically measure individual trees within a given land parcel.⁸¹ In order for the use of offsets to grow, these concerns will need to be addressed.

Looking to the future, innovations in remote sensing, which include satellite imagery, drone technology, and other remote data gathering techniques, will play a significant role in improving carbon sequestration measurement. For example, Planet,^h the nanosatellite company, has begun democratizing access to high-resolution images of the earth's surface, which

can be used to verify nature-based carbon offset projects. In 2019, the company announced a partnership with Michael Bloomberg and the State of California to "develop new geospatial analytics that can directly enable conservation efforts for forests, coral reefs, and other natural resources."⁸² Increased access to improved geospatial data is enabling a new wave of startups to blossom.

Two Bay Area companies, **Pachama** and **SilviaTerra**, are applying remote sensing to forests. Pachama, which announced a partnership with Planet in April 2020,⁸³ uses satellite imagery and artificial intelligence to predict the amount of carbon stored within a given parcel of forestland. The company combines satellite images with LIDAR to create three-dimensional

maps that allow tracking of changes to forest cover, tree height, and carbon density. Pachama uses this information to build dashboards for carbon offset buyers to monitor the ongoing performance of projects from which they have purchased carbon credits. **SilviaTerra** also applies satellite imagery and artificial intelligence to forest measurement, which it uses to create a carbon rental market that allows landowners of all sizes to participate. In 2018, it partnered with Microsoft to create the SilviaTerra Basemap, the first “forest inventory for every acre in the continental United States,” including estimates of tree species, size, carbon sequestration, timber value, and wildlife habitat.⁸⁴

Incentivizing improved forest management and growth of the world’s forests stands to benefit all life on Earth. In addition to ecosystem services, these practices can sequester meaningful amounts of carbon in a cost-efficient manner to meet pressing climate goals. Companies like Pachama and SilviaTerra are showing that greater access to remote sensing data has the potential to efficiently build the trust necessary to spur growth in forest-based offset

projects. While the technology these startups are bringing to bear is an important piece of the puzzle, regulatory mandates and demand for climate action on the part of corporate actors and the public will continue to be pivotal for the continued growth of carbon offsets.

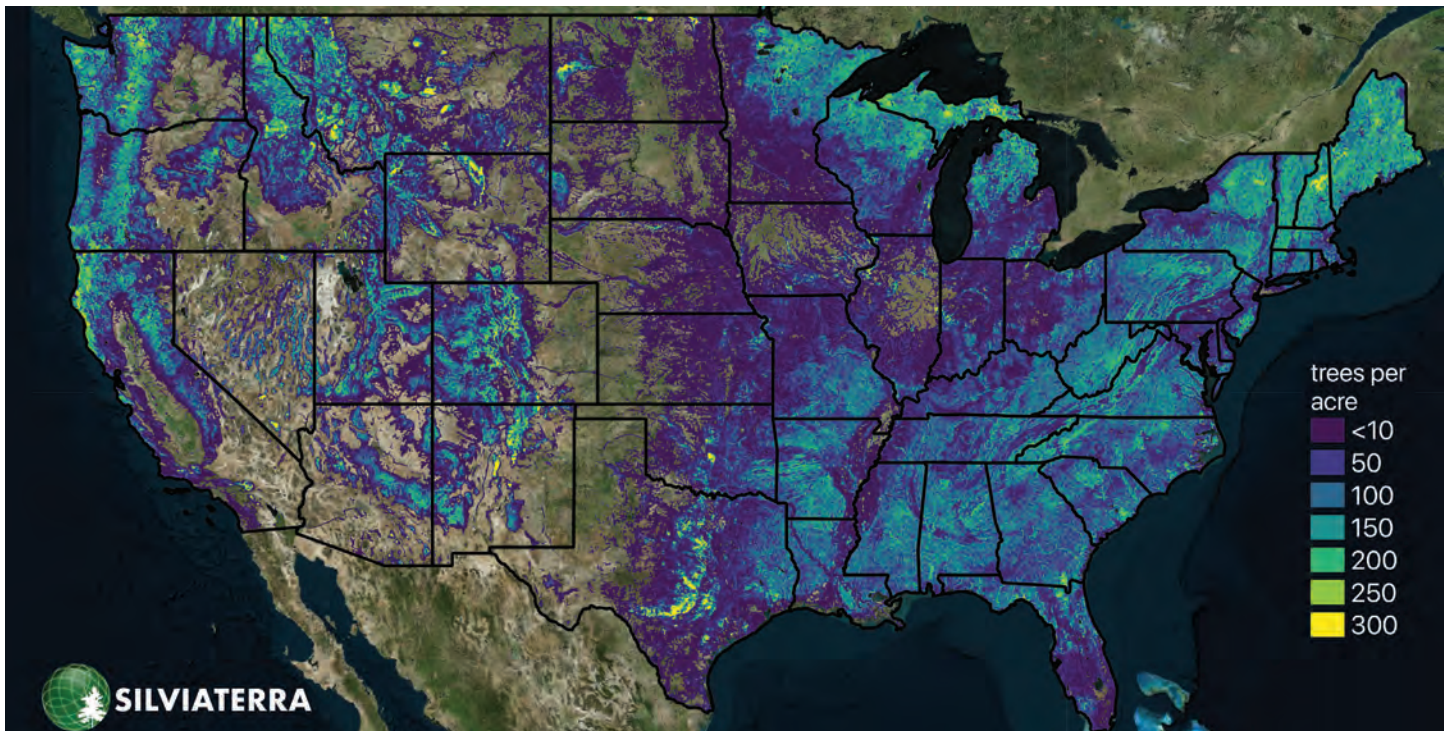
FOREST PRODUCTS

Traveling through forested areas, trucks stacked with logs are often seen navigating the roads, and moss-covered stumps can punctuate otherwise endless walls of trees. For many, these images conjure instinctual concerns of environmental damage from deforestation, habitat loss, or the release of stored carbon. Recently, these issues were brought to the fore when a toilet paper shortage prompted by the outbreak of COVID-19 drew attention to the fact that some brands are made from old-growth wood harvested in the Canadian boreal forest, carbon-dense woodlands home to hundreds of indigenous communities.⁸⁵ This example encapsulates the potential costs of using wood as an input. When sourced irresponsibly, it contributes to global deforestation.⁸⁶ But are there cases where harvesting trees can advance sustainability goals?

Growing evidence and new commercial offerings are showing that the answer is a qualified yes. Though counterintuitive, the use of some forest products can displace carbon-intensive materials with lower-carbon, biodegradable alternatives, act as “vaults” that store carbon captured by trees,⁸⁷ and provide forest owners with incentives to maintain forestry operations and the ecosystem services they generate.⁸⁸ To be clear, not all forest products lead to these outcomes. To ensure environmental benefit, they must be sourced from sustainably managed forests. The United Nations defines sustainable management as meeting “the social, economic, ecological, cultural and spiritual needs of present and future generations.”⁸⁹ Environmental benefits are also more likely when forest products are locally sourced to reduce transport,⁹⁰ reclaimed from discarded wood to create circular economies,⁹¹ or made from undesirable wood like small-diameter trimmings that are otherwise discarded.⁹²

Several independent certifications and ecolabels attempt to verify environmental claims and ensure products can be traced to sustainable forests.⁹³ The two leading certifications, Forest Stewardship

SilviaTerra Basemap of Tree Density Across the United States



Cutting Edge Mass Timber Construction Projects



UMass Amherst's Design Building adopts cutting edge timber engineering, utilizing a glulam frame, floor slabs made of composite, and exposed CLT. Its use of mass timber (as opposed to steel) removes 2,600 metric tons of carbon from the atmosphere.

Source: www.thinkwood.com/our-projects/umass-amherst-design-building



Vancouver's 18-storey Brock Commons tower, once the world's tallest timber building, was built cheaper, faster, and with less environmental impact than a comparable steel and concrete structure — offsetting an estimated 2,432 metric tons of carbon.

Source: www.theguardian.com/cities/2019/jul/22/canadian-cities-take-wooden-skyscrapers-to-new-heights

Council (FSC) and Programme for the Endorsement of Forest Certification (PEFC), have collectively certified 11% of global forests as sustainably managed, primarily in North America and Europe.⁹⁴ Others, like the Sustainable Forestry Initiative (SFI), intend to hold procurement officers to beneficial practices even when sourcing from uncertified forests.⁹⁵ These verification schemes are not perfect. They have certified only a small portion of global forests and wood consumption, and several certified companies have been exposed illegally smuggling unsustainable wood for their products.⁹⁶ Despite these flaws, certifications have been shown to improve management practices.⁹⁷ They offer one path toward channeling consumer demand for sustainability to unlock benefits that forest products can generate in industries like construction.

CONSTRUCTION

Construction is one major sector where the use of forest-based products could contribute to increased sustainability. In 2018, building and construction accounted for 39% of global carbon emissions, including 11% from the production of building materials like steel, cement, and glass.⁹⁸ Construction is also responsible for 160 million tons of waste in the United States each year, a quarter of the national total.⁹⁹ Recently, advanced materials engineered from

wood have gained traction in applications for residential, commercial, and industrial buildings, including pioneering designs that have created fully wooden structures.¹⁰⁰ Early momentum is beginning to emerge for increased use of “mass timber” buildings whose structural supports, normally fashioned from steel and concrete, are instead supported by solid or engineered wood.¹⁰¹

Construction products made from wood, including mass timber, can offer advantages over traditional concrete, masonry, and steel. If sustainably sourced, they can reduce emissions from construction projects and trap the carbon sequestered by trees within buildings, creating de facto “carbon banks.” A recent study in *Nature* estimates that designing mid-rise buildings with timber could store between 10 to 68 million tons of carbon in new buildings annually.¹⁰² If the materials are sourced from sustainable forests, the trees harvested in the process regrow, sequestering additional carbon. There are also potential economic benefits. Mass timber reduces construction time and labor requirements because building elements can be prefabricated, lighter to transport, and faster to assemble. They also perform better in some applications; for example, wooden window frames provide nearly 400 times more insulation than steel.¹⁰³

One of most widely used mass timber products is cross-laminated timber (CLT): large, prefabricated wooden panels that can support tall structures while remaining fire resistant.¹⁰⁴ Though CLT has caught on faster in Europe, the North American market reached \$80 million in 2019 and is expected to grow to \$228 million by 2025, aided by greater local production. One example is **SmartLam North America**, a Montana startup that received \$450,000 in grants from the U.S. Department of Agriculture and the State of Montana for its potential to create rural jobs and use wood being cleared from public lands by forest restoration activities meant to prevent wildfires.¹⁰⁵ SmartLam was the first producer of CLT in the U.S. and both the FSC and SFI have certified its products as sustainably sourced.

In the future, products derived from wood may also create substitutes for building material like siding and windows.¹⁰⁶ One early-stage company, **MOXY OI Technology Management**, claims to have developed a process to mineralize wood to create composite material that can be used to make products like roof tiles that are often made from glue, plastic, or cement.¹⁰⁷

The United Nations and International Energy Agency identified emissions reductions in construction as “critical to achieving the Paris Climate Agreement.”¹⁰⁸ Companies like SmartLam and MOXY are part of a broader trend toward integrating forest products into buildings to meet this target, which is also being supported by federal policy. The Timber Innovation Act, introduced in the 2018 Farm Bill, provides research funding, grant support, and technical assistance to advance innovation in the construction of tall wooden buildings. These policies will need to be combined with sustainable harvesting to maximize the environmental benefits that wood-based construction can provide. At the same time, sustainable innovations in wood-based construction will need to keep pace with parallel improvements in the sustainability of concrete and steel products, including improved rates of recycling and energy efficiency.¹⁰⁹



partnerships
advancing the
monetization
of forests

The Case for the Policy, Capital, and Innovation Trifecta

DBL has long characterized the climate investment opportunity as being driven by the trifecta of Policy, Capital, and Innovation, defined as the intersection of 1) Policy — legislation, regulation, and government incentives to support industry growth; 2) Capital — institutional dollars ready to invest; and 3) Innovation — entrepreneurs accelerating sustainable innovation cycles. The power of this trifecta is rapidly expanding to the conservation sector. The various forest innovation models highlighted throughout this paper face significant challenges, from access to growth capital and proof of scalability for early-stage organizations, to accuracy and trust in sustainability certification and carbon reporting. They also share a common recognition that the interdisciplinary nature of the forest sector, in terms of both financial and human capital, can be utilized as an asset. Each model uniquely aligns a market-driven approach with policy goals, setting the stage for strong partnerships across sectors and beneficial regulatory action.

The role of regulators is crucial to establishing many of the markets described in this paper. Within the death/eternity care industry, the regulatory environment is slowly addressing a need to open the market for creative, sustainable business models. The fact that the State of Washington has become the first in the nation to legalize human composting¹¹⁰ signals that policymakers are beginning to recognize changing consumer preferences. Younger populations are trending away from cemeteries, with groups like the “Order of the Good Death” now promoting “death positivity,” which rejects the environmental harm caused by current end-of-life practices.¹¹¹ In addition, trade associations such as the Green Burial Council are helping states navigate emerging sustainable death care standards and evolving cremation regulations.

In the evolving and complex carbon trading market, policy and regulatory

measures have long guided market development, creating financial incentives and serving as a catalyst for projects that reduce emissions and advance environmental justice, including forest projects. Though carbon trading has yet to gain traction at the federal level, state agencies have stepped in to regulate emissions, including the California Cap-and-Trade program, which is linked to Quebec’s program through the Western Climate Initiative,¹¹² and the Regional Greenhouse Gas Initiative on the East Coast.¹¹³ These programs also incentivize natural climate projects. In California, proceeds from carbon auctions are deposited in a “Greenhouse Gas Reduction Fund (GGRF).” The GGRF is appropriated by the state legislature as “California Climate Investments (CCI),”¹¹⁴ which are awarded to carbon reduction projects after being selected by more than 20 California state agencies.¹¹⁵ For example, as part of CCI, Cal Fire administers a “Forest Health Grant Program” designed to implement projects that restore forest health and conserve working forests.¹¹⁶ Since 2016, California has mandated that 35% of CCI funds must be allocated to projects that benefit disadvantaged and low-income communities.¹¹⁷ A May 2020 study showed that since California’s Cap-and-Trade launched in 2013, a statewide disparity of exposure to local air pollution narrowed by 20 to 30% between disadvantaged and other communities.¹¹⁸

“The Innovative Finance for National Forests program is advancing the Forest Service’s efforts to think outside the box when it comes to financing critical work to promote watershed health and sustainable recreation infrastructure.”

Jacqueline Emanuel, Director of U.S. Forest Service National Partnership Office

The California Cap-and-Trade program also includes a carbon offset component, for which CARB sets GHG offset protocols.¹¹⁹ CARB sets the proportion of the capped entities' GHG reductions that can be met with offsets, which is currently at 8% and will drop to 4% for 2021-2025. CARB's "Compliance Offset Protocol for U.S. Forest Projects" provides the requirements and methods for quantifying the net climate benefits of activities that sequester carbon on forestland.¹²⁰ An example of a forest carbon project for which CARB issued offset credits is The Nature Conservancy's private investment fund, the Cumberland Forest Project, which is implementing a sustainable forest strategy and has acquired 253,000 acres of working forestland across Virginia, Kentucky, and Tennessee. In 2019 alone, CARB issued 2.2 million tons of carbon offset credits to the fund.¹²¹

Approaches that utilize the CARB offset market and others like it could someday be applied to efforts in the death/eternity care and recreation sectors to scale their impact. For example, the forests replanted through the Better Place Forest partnership with One Tree Planted could be monitored and verified to generate carbon offsets, with proceeds donated to forest maintenance activities at state parks, public lands, or the spreading forests themselves.

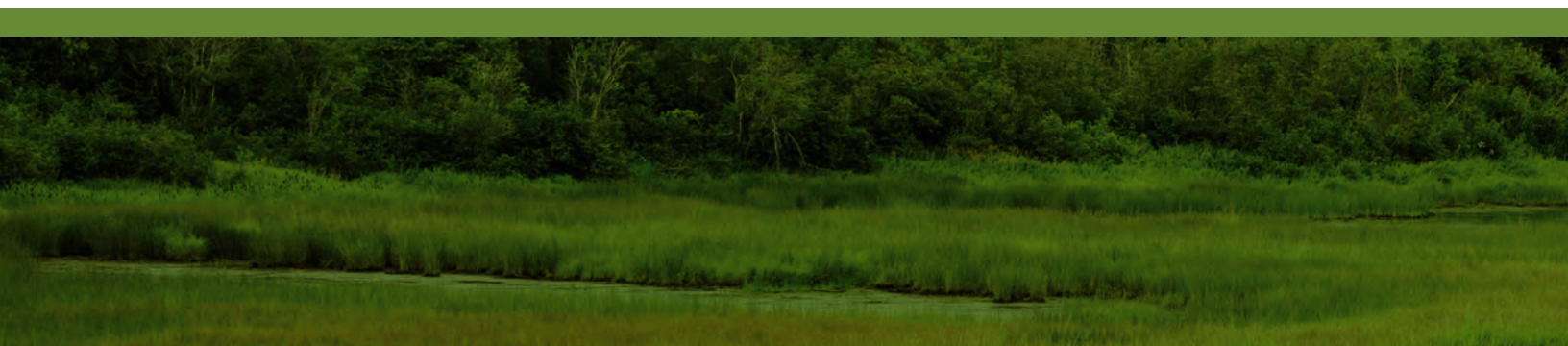
Nonprofit organizations are also playing a crucial role to spur the emerging forest innovations highlighted in this paper. Organizations like The Nature Conservancy¹²² have contributed vital research that has helped bring increased attention to the potential for forests and other natural lands to play a major role in climate change mitigation.¹²³ Nonprofits are also adding critical accountability

and building trust through their ability to offer credible third-party verification. For example, in the carbon trading market, nonprofits like the Gold Standard¹²⁴ and Verified Carbon Standard¹²⁵ verify accuracy in sequestration measurement by providing approved methodologies and reviewing the findings of third-party verifiers before issuing Verified Emissions Reductions (VER) credits. Other organizations like The Climate Registry design and operate voluntary and involuntary GHG reporting programs.¹²⁶ In the forest products sector, the Forest Stewardship Council and the Sustainable Forestry Initiative provide forest management certifications to improve sustainable forest management.

Other nonprofits are launching creative strategic partnerships with for-profit entities to enhance the positive benefits to forests through their

“The Nature Conservancy and the American Forest Foundation’s ‘Family Forest Carbon Program’ is an innovative nonprofit and private landowner program that helps small landowners, who represent 36% of all U.S. forestland, access carbon credit markets.”

Jacqueline Westley, Manager, Forestry Investments, The Nature Conservancy



conservation-oriented business models. As mentioned above, the partnership between One Tree Planted, a nonprofit, and Better Place Forests has resulted in the planting of over 60,000 trees, for example. These types of partnerships further the goals of both the nonprofit and for-profit entities. Even without a direct partnership, the work of nonprofits complements startups with sustainability built into their business models. For example, advocacy groups like The Wilderness Society support public land management policies to preserve wildlands, which benefits the outdoor recreation economy, including startups mentioned in this paper. Other nonprofits, such as the Sierra Club and Vote Solar, manage environmental justice programs that help integrate the social justice and environmental protection movements, strengthening companies aligned with their goals and promoting equitable access to parks and clean energy utilization in communities of color.

In many cases described in this paper, the interests of corporations, nonprofits, governments, and communities all overlap. Conservation-oriented companies must build trust with government agencies, locally engaged nonprofits, private landowners, and community members to credibly signal a commitment to protecting and preserving natural resources in the region. In the case of Better Place Forests, this

function is accomplished by the role of the “Forest Steward,” who combines knowledge of forest management with a deep understanding of local community priorities. Once credibility has been established, state and federal agencies, such as the U.S. Forest Service, and land trusts, such as the Mendocino Land Trust, can become key collaborators and even a source of grant funding. For example, the U.S. Department of Agriculture has a Natural Resources Conservation Service that provides grants to private companies as they acquire and maintain forestland, recognizing that they contribute to improving water quality and increasing wildlife habitat.

The models discussed throughout this paper offer plentiful opportunities to engage with forests through investment, and increasingly there are opportunities for every type of investor. For example, private or family foundations and other family offices can invest along the mission-investing spectrum, whether through grants, program-related investments (PRIs), or market-rate mission investments (MRIs). They can also provide valuable human capital to support promising organizations, helping them grow to a point where they can attract market-rate investment. In the case of Blue Forest Conservation’s Forest Resilience Bonds, the Gordon & Betty Moore Foundation provided early financial support and partnership, for example.

In the fixed income category, growth in sustainable and green bonds issuances is providing new avenues to fund projects with environmental benefit. For venture capitalists, a surge in sustainability minded entrepreneurship is offering early stage investment opportunity where conservation intersects with technology, among other burgeoning cross-sector sustainability approaches.

Partnerships are a common tool used across many of the examples highlighted in this paper. The incentives of stakeholders across the government, nonprofit, and private sectors are strongly aligned, offering plentiful opportunity to forge new collaborations to advance forest innovation. Whether the composition of the partnership is “public-private” (e.g., USFS and Blue Forest Carbon); “nonprofit-private” (e.g., One Tree Planted and Better Place Forests); “private-private” (e.g., Pachama and Planet); or collaborations among philanthropic organizations (e.g., CREO, Terra Silva¹²⁷), myriad actors can increasingly work together to amplify their collective impact.





the way
forward

“We must protect the forests for our children, grandchildren, and children yet to be born. We must protect the forests for those who can’t speak for themselves such as the birds, animals, fish, and trees.”

Qwatsinas (Hereditary Chief Edward Moody), Nuxalk Nation, British Columbia, Canada

Forests and the natural world have always offered economic opportunity, sustenance, and improved well-being to humanity. Today, their value is even more expansive. They are quickly becoming a source of innovation capable of generating financial returns, conserving habitat, and meeting urgent challenges posed by climate change.

Throughout history, perceptions of forests have constantly evolved. They were an enchanted home to monsters and fairies in folklore, a source of sublime inspiration to Romantics, and, more recently, a store of resources to be utilized, to name just a few.¹²⁸ Now, forests are once again being reinterpreted and gaining widespread attention. Expanding regulatory support and changing social mores are allowing new forest-based models to bloom. Entrepreneurs are harnessing the commercial and sustainability potential of forests to create novel financial instruments and business models across a diverse range of sectors. In public policy,

forests have inspired bipartisan action, including the August 2020 passage of the Great American Outdoors Act. Across each of these dimensions, a diverse set of stakeholders, including policymakers, non-profits, investors, and entrepreneurs, are working together to catalyze market-driven forest innovation.

Several actions would help to accelerate and build upon this momentum. Additional supportive policies to provide research funding and grant dollars would bolster emerging forest-based technologies and businesses. The continued proliferation of partnerships would strengthen and align efforts across sectors. Greater numbers of impact venture capitalists and institutional investors acknowledging opportunities presented by forests would lead to an influx of capital.

As the escalating global threats of wildfire and deforestation continue to pose multifaceted challenges to

human and environmental health, the immediate need to protect forests has never been clearer. Over the next decade, collaborative efforts described in this paper to accelerate forest innovation will be important tools to ensure that our planet not only survives and thrives but that future generations will have the opportunity to develop their own cultural identities around forests and working natural lands. Expanding beyond commonly held notions of what healthy forests can be is a critical step. Once the setting for fairy tales, forests are now becoming the subject of financing rounds, opening investment opportunities with a large tent that includes public and private sector partners, entrepreneurs, and investors working together. As these efforts advance, tomorrow’s forest stewards will modernize a rich heritage built over the ages, contributing to a world in which forests are not continually threatened but remain an essential and inspirational part of our past, present, and future.

“Once the setting for fairy tales, forests are now becoming the subject of financing rounds, creating investment opportunities with a large tent of public and private sector partners, entrepreneurs, and investors. As these efforts advance, tomorrow’s forest stewards will modernize a rich heritage built over the ages, contributing to a world in which forests remain an essential part of our past, present, and future.”

Appendix List of Interviewees

The authors extend a special thank you to everyone who contributed to this paper, including those who reviewed early drafts and engaged in brainstorming around specific themes. We are particularly grateful to the interviewees listed below, who were extremely generous with their time and insights. None of these individuals should be held accountable for any views expressed, errors, or omissions.

Nonprofits

- Peter Stangel, Chief Operating Officer, United States Endowment for Forestry and Communities
- Thomas Hodgman, Director of Conservation Transactions, The Nature Conservancy
- Jacqueline Westley, Manager of Forestry Investments, The Nature Conservancy

Academics

- Sara Nelson, Postdoctoral Research Fellow, University of British Columbia
- Patrick Bigger, Lecturer, Lancaster University

Foundations

- Dan Winterson, Program Officer, Gordon and Betty Moore Foundation
- Adam Connaker, Principal, The Rockefeller Foundation
- Belinda Morris, Principal, Morello Advisors & Former Program Officer, Packard Foundation

Government

- Tommie Herbert, National Conservation Finance Lead, U.S. Forest Service
- Nathalie Woolworth, Conservation Finance Program Manager, U.S. Forest Service

Investors and Investor Networks

- Zach Knight, Managing Partner, Blue Forest Conservation
- Phil Saksa, Director of Research, Blue Forest Conservation
- Maki Tazawa, CREO Syndicate
- Carl Palmer, Executive Director, LegacyWorks Group

Companies

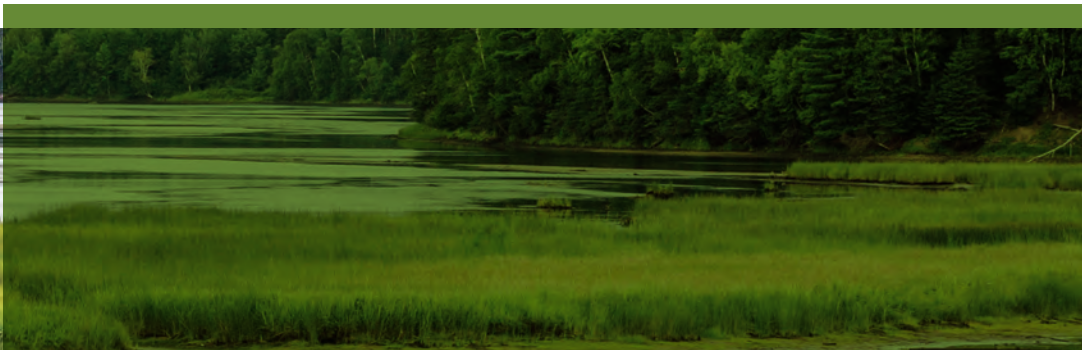
- Jake Young, Manager of Land Acquisition and Land Trust Partnerships, Better Place Forests
- Kyle Gertridge, Head of Business Development and Partnerships, Salo Sciences
- Max Nova, Founder, SilviaTerra



References

- ¹Leiserowitz et al. *Climate Change in the American Mind: April 2020*. Yale Program on Climate Change Communication. May 2020. Retrieved from <https://climatecommunication.yale.edu/publications/climate-change-in-the-american-mind-april-2020/>.
- ²"How Americans see climate change and the environment in 7 charts." Pew Research. April 2020. Retrieved from <https://www.pewresearch.org/fact-tank/2020/04/21/how-americans-see-climate-change-and-the-environment-in-7-charts/>.
- ³Intergovernmental Panel on Climate Change (IPCC). *Global Warming of 1.5 OC*. March 2020. Retrieved from: <https://www.ipcc.ch/sr15/download/#full>.
- ⁴Griscom et al., *Natural Climate Solutions*. Proceedings of the National Academy of Sciences of the United States of America. October 2017. Retrieved from <https://www.pnas.org/content/114/44/11645>.
- ⁵"PG&E shut off power to 48,200 customers in northern California because of wildfire risk." *CNN*. September 2019. Retrieved from <https://www.cnn.com/2019/09/24/us/california-power-outage-fire-threat/index.html>.
- ⁶Cal Fire. *2018 Incident Archive*. Retrieved from <https://www.fire.ca.gov/incidents/2018/>. And from Cal Fire. *2017 Incident Archive*. Retrieved from <https://www.fire.ca.gov/incidents/2017/>.
- ⁷"California Wildfires Force Evacuations in Sonoma and Napa Counties." *The New York Times*. August 2020. Retrieved from <https://www.nytimes.com/2020/08/19/us/california-governor-emergency-wildfires.html>. And from "Bay Area, California hit with some of the worst air quality in the world." *ABC7News*. September 2020. Retrieved from <https://abc7news.com/bay-area-air-quality-monday-california-worst-in-the-world-when-will-improve-oregon/6422415/>. And from "PG&E Turns Off Power for Safety to Approximately 172,000 Customers in 22 Counties in Sierra Foothills, Sacramento Valley, Northern Sierra and Elevated North Bay Terrain." *PG&E*. September 2020. Retrieved from https://www.pge.com/en/about/newsroom/newsdetails/index.page?title=20200908_pge_turns_off_power_for_safety_to_approximately_172000_customers_in_22_counties_in_sierra_foothills_sacramento_valley_northern_sierra_and_elevated_north_bay_terrain.
- ⁸Cal Fire. *Incidents Overview*. Retrieved from <https://www.fire.ca.gov/incidents/>.
- ⁹National Oceanic and Atmospheric Administration. *The Impact of Wildfires on Climate and Air Quality*. Retrieved from <https://www.esrl.noaa.gov/csl/factsheets/csdWildfiresFIREX.pdf>. And from Corelogic. 2019 *Wildfire Risk Report*. Retrieved from https://www.corelogic.com/downloadable-docs/wildfire-report_0919-01-screen.pdf.
- ¹⁰Davies et al. *The unequal vulnerability of communities of color to wildfire*. *PLoS One*. November 2018. Retrieved from <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0205825>.
- ¹¹Union of Concerned Scientists. *The Connection Between Climate Change and Wildfires*. March 2020. Retrieved from <https://www.ucsusa.org/resources/climate-change-and-wildfires>. And from "Intense Arctic Wildfires Set a Pollution Record." *The New York Times*. July 2020. Retrieved from <https://www.nytimes.com/2020/07/07/climate/climate-change-arctic-fires.html>.
- ¹²World Resources Institute. *Deforestation Is Accelerating, Despite Mounting Efforts to Protect Tropical Forests. What Are We Doing Wrong?* June 2018. Retrieved from <https://www.wri.org/blog/2018/06/deforestation-accelerating-despite-mounting-efforts-protect-tropical-forests>.
- ¹³National Aeronautics and Space Administration. *NASA Satellite Data Show 30 Percent Drop in Air Pollution Over Northeast U.S.* April 2020. Retrieved from <https://www.nasa.gov/feature/goddard/2020/drop-in-air-pollution-over-northeast>.
- ¹⁴Journalists Use Satellite Data to Track Pollution, Kim Jong-Un And More During COVID-19 Pandemic." *Planet*. May 2020. Retrieved from <https://www.planet.com/pulse/journalists-use-satellite-data-to-track-pollution-kim-jong-un-and-more-during-covid-19-pandemic/>.
- ¹⁵Food and Agriculture Organization of the United Nations. *Climate change vulnerability assessment of forests and forest-dependent people*. 2019. Retrieved from <http://www.fao.org/3/ca7064en/CA7064EN.pdf>.
- ¹⁶*Salo Sciences website*. Salo Sciences. Retrieved from <https://salo.ai/>.
- ¹⁷World Wildlife Fund. *We Need to Safeguard Our Forests*. Retrieved from https://wwf.panda.org/our_work/forests/importance_forests/.
- ¹⁸The World Bank. *Sustaining Forests and Livelihoods in a Changing World*. January 2013. Retrieved from <https://www.worldbank.org/en/news/feature/2013/01/29/sustaining-forests-livelihoods-changing-world>.
- ¹⁹Garbe, Paul. *Health Benefits of Forests Bibliography*. October 2019. Retrieved from <https://www.usendowment.org/wp-content/uploads/2020/04/health-benefits-of-forests-bibliography.pdf>.
- ²⁰Griscom et al., *Natural Climate Solutions*. Proceedings of the National Academy of Sciences of the United States of America. October 2017. Retrieved from <https://www.pnas.org/content/114/44/11645>.
- ²¹*Ibid.*
- ²²McFarland, Brian. *The Origins and History of Conservation Finance*. In: *Conservation of Tropical Rainforests*. Palgrave Studies in Environmental Policy and Regulation. November 2017. Retrieved from http://link.springer.com/443.webvpn.fjmu.edu.cn/chapter/10.1007%2F978-3-319-63236-0_6.
- ²³Credit Suisse, World Wildlife Fund, and McKinsey & Company. *Conservation Finance: Moving beyond donor funding toward an investor-driven approach*. January 2014. Retrieved from <https://www.cbd.int/financial/privatesector/g-private-wwf.pdf>.
- ²⁴Clark, Story. *A Field Guide to Conservation Finance*. Island Press, 2007.
- ²⁵McKinsey and Company. *Taking Conservation Finance to Scale*. November 2016. Retrieved from <https://www.mckinsey.com/business-functions/sustainability/our-insights/taking-conservation-finance-to-scale#>. And from "Impact Investing: How Does it Fit into the Broader Capital Markets?" Case Studies from the Forest Conservation Sector. Harvard Business School Private Capital Project. September 2020.
- ²⁶Ecosystem Marketplace. *State of Private Investment in Conservation 2016*. December 2016. Retrieved from https://www.forest-trends.org/wp-content/uploads/2017/03/2016SOPICReport_FINAL_Full-REV.pdf.
- ²⁷*Ibid.*
- ²⁸"Sustainable Finance Sees Big-Tech Boom After Record Google Deal." *Bloomberg*. August 2020. Retrieved from <https://www.bloomberg.com/news/articles/2020-08-07/sustainable-finance-sees-big-tech-boom-after-record-google-deal>.

- ²⁹Microsoft will be carbon negative by 2030." *Microsoft*. January 2020. Retrieved from <https://blogs.microsoft.com/blog/2020/01/16/microsoft-will-be-carbon-negative-by-2030/>.
- ³⁰Ecosystem Marketplace. *State of Private Investment in Conservation 2016*. December 2016. Retrieved from https://www.forest-trends.org/wp-content/uploads/2017/03/2016SOPICReport_FINAL_Full-REV.pdf.
- ³¹The Nature Conservancy and Environmental Finance. *Investing in Nature: Private finance for nature-based resilience*. November 2019. Retrieved from <https://www.environmental-finance.com/assets/files/reports/tnc-investing-in-nature.pdf>.
- ³²Credit Suisse, World Wildlife Fund, and McKinsey & Company. *Conservation Finance: Moving beyond donor funding toward an investor-driven approach*. January 2014. Retrieved from <https://www.cbd.int/financial/privatesector/g-private-wwf.pdf>. And from McKinsey and Company. *Taking Conservation Finance to Scale*. November 2016. Retrieved from <https://www.mckinsey.com/business-functions/sustainability/our-insights/taking-conservation-finance-to-scale#>.
- ³³Waldron et al. *Protecting 30% of the planet for nature: costs, benefits and economic implications*. University of Cambridge Conservation Research Institute. July 2020. Retrieved from https://www.conservation.cam.ac.uk/files/waldron_report_30_by_30_publish.pdf.
- ³⁴Roehrich et al. *Are public-private partnerships a healthy option? A systematic literature review*. Social Science & Medicine. July 2014. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0277953614002871?via%3Dihub>.
- ³⁵United States Department of Agriculture Forest Service. *Forest Inventory and Analysis National Program*. February 2019. Retrieved from <https://www.fia.fs.fed.us/nwos/>.
- ³⁶Little Hoover Commission. *Fire on the Mountain: Rethinking Forest Management in the Sierra Nevada*. February 2018. Retrieved from <https://lhca.gov/sites/lhca.gov/files/Reports/242/Report242.pdf>.
- ³⁷Ngu, Ash and Sahil Chinoy. "To Help Prevent the Next Big Wildfire, Let the Forest Burn." *The New York Times*. Retrieved from <https://www.nytimes.com/interactive/2018/11/29/opinion/sunday/california-wildfires-forest-management.html>. And from Wildland Urban Interface (WUI). *U.S. Fire Administration*. Retrieved from <https://www.usfa.fema.gov/wui/>.
- ³⁸Union of Concerned Scientists. *The Connection Between Climate Change and Wildfires*. March 2020. Retrieved from <https://www.ucsusa.org/resources/climate-change-and-wildfires>.
- ³⁹Huber, Kristiane. *Resilience Strategies for Wildfire*. Center for Climate and Energy Solutions. November 2018. Retrieved from <https://www.c2es.org/site/assets/uploads/2018/11/resilience-strategies-for-wildfire.pdf>.
- ⁴⁰"These Scientists Are Studying Why California Keeps Burning." *Bloomberg*. September 2020. Retrieved from <https://www.bloombergquint.com/onweb/these-scientists-are-studying-why-california-keeps-burning-kf57sxn>.
- ⁴¹Powell, David. *Fact Sheet: Forest Service Trust Funds*. United States Department of Agriculture Forest Service. February 2014. Retrieved from https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3794956.pdf.
- ⁴²United States Department of Agriculture Forest Service. *FY 2019 Budget Justification*. February 2018. Retrieved from <https://www.fs.usda.gov/sites/default/files/usfs-fy19-budget-justification.pdf>.
- ⁴³United States Department of Agriculture Forest Service. *Forest Service Report Highlights Restoration Progress Made Despite Growing Challenges*. November 2015. Retrieved from <https://www.fs.usda.gov/news/releases/forest-service-report-highlights-restoration-progress-made-despite-growing-challenges>. And from National Interagency Fire Center, External Affairs Office. *Federal Firefighting Costs (Suppression Only)*. March 2020. Retrieved from https://www.nifc.gov/fireInfo/fireInfo_documents/SuppCosts.pdf.
- ⁴⁴Washington Forest Protection Association. *Congress Ends the Practice of U.S. Forest Service 'Fire Borrowing'*. March 2018. Retrieved from <http://www.wfpa.org/news-resources/blog/congress-ends-practice-of-fire-borrowing/>.
- ⁴⁵"The biggest land conservation legislation in a generation." *The Harvard Gazette*. July 2020. Retrieved from <https://news.harvard.edu/gazette/story/2020/07/the-likely-impact-of-great-american-outdoors-act/>.
- ⁴⁶"How the first trees grew so large." *Nature*. October 2017. Retrieved from <https://www.nature.com/articles/d41586-017-04995-w>.
- ⁴⁷Brenner, Erich. *Human Body Preservation — old and new techniques*. *Journal of Anatomy*. January 2014. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3931544/>.
- ⁴⁸"Thinking About Having a 'Green' Funeral? Here's What to Know." *The New York Times*. March 2018. Retrieved from <https://www.nytimes.com/2018/03/22/smarter-living/green-funeral-burial-environment.html>. And from Green Burial Council. *Media Packet*. Retrieved from https://www.greenburialcouncil.org/media_packet.html. And from Agency for Toxic Substances & Disease Registry. *Toxic Substances Portal – Formaldehyde*. September 2008. Retrieved from <https://www.atsdr.cdc.gov/phs/phs.asp?id=218&tid=39>.
- ⁴⁹Zychowski, Jozef and Tomasz Bryndal. *Impact of cemeteries on groundwater contamination by bacteria and viruses — a review*. *Journal of Water & Health*. June 2015. Retrieved from <https://iwaponline.com/jwh/article/13/2/285/28303/Impact-of-cemeteries-on-groundwater-contamination>.
- ⁵⁰National Funeral Directors Association. *Consumers Moving Past Tradition for Funerals, Survey Says*. October 2019. Retrieved from <https://www.nfda.org/news/media-center/nfda-news-releases/id/4703/consumers-moving-past-tradition-for-funerals-survey-says>.
- ⁵¹National Funeral Directors Association. *Cremation on the Rise: NFDA Predicts the National Cremation Rate Will Climb by a Third Within 20 Years*. July 2018. Retrieved from <https://www.nfda.org/news/media-center/nfda-news-releases/id/3526/cremation-on-the-rise-nfda-predicts-the-national-cremation-rate-will-climb-by-a-third-within-20-years>. And from "The environmental toll of cremating the dead." *National Geographic*. November 2019. Retrieved from <https://www.nationalgeographic.com/science/2019/11/is-cremation-environmentally-friendly-heres-the-science/#close>.
- ⁵²Ibid.
- ⁵³*Capsula Mundi website*. Capsula Mundi. Retrieved from <https://www.capsulamundi.it/shop/>.
- ⁵⁴*The Living Urn website*. The Living Urn. Retrieved from <https://www.thelivingurn.com/pages/product>.
- ⁵⁵*Recompose website*. Recompose. Retrieved from <https://www.recompose.life/faq>.
- ⁵⁶"Washington becomes the first state to legalize composting of humans." *CNN*. May 2019. Retrieved from <https://www.cnn.com/2019/05/22/us/washington-human-composting-legal-trnd/index.html>.
- ⁵⁷Outdoor Industry Association. *The Outdoor Recreation Economy*. April 2017. Retrieved from https://outdoorindustry.org/wp-content/uploads/2017/04/OIA_RecEconomy_FINAL_Single.pdf.
- ⁵⁸Pfund, Nancy. "Public Lands Contribute to the Economic Prosperity of States." *Morning Consult*. Retrieved from <https://morningconsult.com/opinions/public-lands-contribute-economic-prosperity-states/>.
- ⁵⁹Garbe, Paul. *Health Benefits of Forests Bibliography*. October 2019. Retrieved from <https://www.usendowment.org/wp-content/uploads/2020/04/health-benefits-of-forests-bibliography.pdf>.
- ⁶⁰Alig et al. *Conversions of Forest Land: Trends, Determinants, Projections, and Policy Considerations*. United States Department of Agriculture, Forest Service, Pacific Northwest and Southern Research Stations. 2010. Retrieved from https://www.fs.fed.us/pnw/pubs/gtr802/Vol1/pnw_gtr802vol1_alig.pdf.



- ⁶¹Wikipedia. *List of U.S. states and territories by area*. August 2020. Retrieved from https://en.wikipedia.org/wiki/List_of_U.S._states_and_territories_by_area.
- ⁶²"The Inequality of America's Parks and Green Space." *Bloomberg CityLab*. March 2019. Retrieved from <https://www.citylab.com/equity/2019/03/inequality-parks-and-green-space-income-race-research/585166/>. And from Nesbitt et al. *Who has access to urban vegetation? A spatial analysis of distributional green equity in 10 US cities*. Landscape and Urban Planning. January 2019. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0169204618307710>.
- ⁶³*Hipcamp website*. Hipcamp. Retrieved from <https://support.hipcamp.com/hc/en-us>.
- ⁶⁴*Ibid*.
- ⁶⁵*Tentr website*. Tentr. Retrieved from <https://www.tentr.com/>.
- ⁶⁶The Dyrt website. *The Dyrt*. Retrieved from <https://thedyrt.com/pro>.
- ⁶⁷"Have 50 Years of Overcrowded Parks Taught Us Nothing?" *Outside*. March 2018. Retrieved from <https://www.outsideonline.com/2292951/have-50-years-overcrowded-parks-taught-us-nothing>.
- ⁶⁸IPCC. Special Report — Global Warming of 1.5 OC. Intergovernmental Panel on Climate Change (IPCC). March 2020. Retrieved from: <https://www.ipcc.ch/sr15/download/#full>.
- ⁶⁹"What Does "Net-Zero Emissions" Mean? 6 Common Questions, Answered." *World Resources Institute*. September 2019. Retrieved from <https://www.wri.org/blog/2019/09/what-does-net-zero-emissions-mean-6-common-questions-answered>.
- ⁷⁰Climate Policy Info Hub. *The Global Rise of Emissions Trading*. Retrieved from <https://climatepolicyinfohub.eu/global-rise-emissions-trading>.
- ⁷¹Center for Climate and Energy Solutions. *California Cap and Trade*. Retrieved from <https://www.c2es.org/content/california-cap-and-trade/>. And from California Air Resources Board. *Cap and Trade regulation instructional guidance*. February 2015. Retrieved from https://www3.arb.ca.gov/cc/capandtrade/guidance/guidance31a_corp_assn_feb_2015.pdf.
- ⁷²"World's carbon markets grow 34% in value to \$215 billion in 2019 -report." *Carbon Pulse*. September 2020. Retrieved from <https://carbonpulse.com/90631/>.
- ⁷³California Air Resources Board. *Compliance Offset Program*. Retrieved from <https://www2.arb.ca.gov/our-work/programs/compliance-offset-program>.
- ⁷⁴"Global carbon offsets market could be worth \$200 billion by 2050." *S&P Global*. May 2020. Retrieved from <https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/051320-global-carbon-offsets-market-could-be-worth-200-bil-by-2050-berenberg>.
- ⁷⁵Natural Capital Partners. *Deeds not Words: The Growth of Climate Action in The Corporate World*. September 2019. Retrieved from https://assets.naturalcapitalpartners.com/downloads/Deeds_Not_Words_-_The_Growth_Of_Climate_Action_In_The_Corporate_World.pdf.
- ⁷⁶Fargione et al. *Natural Climate Solutions for the United States*. Science Advances. November 2018. Retrieved from <https://advances.sciencemag.org/content/4/11/eaat1869>.
- ⁷⁷"As Part of Its Plan to be Net Zero Carbon by 2040, Amazon Commits \$10 Million to Restore and Conserve 4 Million Acres of Forest in the Appalachians and other U.S. Regions in Partnership with The Nature Conservancy." *Amazon*. April 2020. Retrieved from <https://press.aboutamazon.com/news-releases/news-release-details/part-its-plan-be-net-zero-carbon-2040-amazon-commits-10-million>.
- ⁷⁸"Corporate Partnerships in the Family Forest Carbon Program." *American Forest Foundation*. Retrieved from <https://www.forestfoundation.org/family-forest-carbon-program>.
- ⁷⁹"How Small Family Forests Can Help Meet the Climate Challenge." *Yale Environment 360*. June 2020. Retrieved from <https://e360.yale.edu/features/how-small-family-forests-can-help-meet-the-climate-challenge>.
- ⁸⁰Song, Lisa and Paul Moura. "An Even more inconvenient truth, why carbon credits for forest preservations may be worse than nothing." *ProPublica*. May 2019. Retrieved from <https://features.propublica.org/brazil-carbon-offsets/inconvenient-truth-carbon-credits-dont-work-deforestation-redd-acre-cambodia/>.
- ⁸¹"How drones and satellite images are measuring the forests used for carbon offsets." *Fast Company*. March 2019. Retrieved from <https://www.fastcompany.com/90319702/how-drones-and-satellite-images-are-measuring-the-forests-used-for-carbon-offsets>. "Family Forest Carbon Program Gets Go-Ahead on New Carbon Methodology Concept." *American Forest Foundation*. April 2020. Retrieved from <https://www.forestfoundation.org/fccp-methodology-approved>.
- ⁸²"Michael Bloomberg, State of California And Planet Partner to Deliver New Satellite Climate Data Solutions." *Planet*. September 2019. Retrieved from <https://www.planet.com/pulse/michael-bloomberg-state-of-california-and-planet-partner-to-deliver-new-satellite-climate-data-solutions/>.
- ⁸³"Pachama And Planet Partner to Protect and Restore Forests Globally." *Planet*. April 2020. Retrieved from <https://www.planet.com/pulse/pachama-and-planet-partner-to-protect-and-restore-forests-globally/>.
- ⁸⁴*SilviaTerra website*. SilviaTerra. Retrieved from silviaterra.com.
- ⁸⁵"Sustainable Toilet Paper Can Help Fix Our Shortage." *Natural Resources Defense Council*. April 2020. Retrieved from <https://www.nrdc.org/experts/shelley-vinyard/sustainable-toilet-paper-can-help-fix-our-shortage>. "The bad toilet paper from your office might be the sustainable answer to TP shortages." *Fast Company*. April 2020. Retrieved from <https://www.fastcompany.com/90494104/the-bad-toilet-paper-from-your-office-might-be-the-sustainable-answer-to-tp-shortages>.
- ⁸⁶Union of Concerned Scientists. *Wood Products*. January 2016. Retrieved from <https://www.ucsusa.org/resources/wood-products>.
- ⁸⁷Food and Agriculture Organization of the United Nations. *Forestry for a Low-Carbon Future*. 2016. Retrieved from <http://www.fao.org/3/a-i5857e.pdf>.
- ⁸⁸Forest2Market. *Historical Perspective on the Relationship between Demand and Forest Productivity in the US South*. July 2017. Retrieved from https://www.forest2market.com/hubfs/2016_Website/Documents/20170726_Forest2Market_Historical_Perspective_US_South.pdf.
- ⁸⁹United Nations Forum on Forests. *Sustainable consumption and production of forest products*. April 2018. Retrieved from https://www.un.org/esa/forests/wp-content/uploads/2018/04/UNFF13_BkgdStudy_ForestsSCP.pdf.
- ⁹⁰United States Environmental Protection Agency. *Sustainable Marketplace: Greener Products and Services*. Retrieved from <https://www.epa.gov/greenerproducts/identifying-greener-wood-products>.
- ⁹¹European Commission. *The Role of Forests in the Circular Economy*. February 2018. Retrieved from <http://www.cpfweb.org/47045-0af2dac64ae756ded88090d61802addbd.pdf>.
- ⁹²United States Department of Agriculture, Forest Service. *Small-Diameter Success Stories*. May 2004. Retrieved from https://www.fpl.fs.fed.us/documnts/fpmu/sd_success_stories.pdf.
- ⁹³United States Environmental Protection Agency. *Recommendations of Specifications, Standards, and Ecolabels for Federal Purchasing*. Retrieved from <https://www.epa.gov/greenerproducts/recommendations-specifications-standards-and-ecolabels-federal-purchasing#Recommendations>. And from Clark, Michael Rawson and Joelyn Sarrah Kozar. *Comparing Sustainable Forest Management Certifications Standards: A Meta-analysis*. Ecology and Society. 2011. Retrieved from <http://www.ecologyandsociety.org/vol16/iss1/art3/>.

- ⁹⁴United Nations Forum on Forests. *Sustainable consumption and production of forest products*. April 2018. Retrieved from https://www.un.org/esa/forests/wp-content/uploads/2018/04/UNFF13_BkgdStudy_ForestsSCP.pdf.
- ⁹⁵Sustainable Forestry Initiative. *SFI 2015-2019 (EXTENDED THROUGH DECEMBER 2021) STANDARDS*. Retrieved from <https://www.sfiprogram.org/standardguide2015-2019/>.
- ⁹⁶Conniff, Richard. "Greenwashed Timber: How Sustainable Forest Certification Has Failed." *Yale Environment 360*. April 2018. Retrieved from <https://e360.yale.edu/features/greenwashed-timber-how-sustainable-forest-certification-has-failed>.
- ⁹⁷Yale School of the Environment, Global Forest Atlas. *Forest Certification*. Retrieved from <https://globalforestatlas.yale.edu/conservation/forest-certification>.
- ⁹⁸International Energy Agency. *2019 Global Status Report for Building and Construction*. December 2019. Retrieved from https://webstore.iea.org/download/direct/2930?filename=2019_global_status_report_for_buildings_and_construction.pdf.
- ⁹⁹Wheeler, Andrew. "The Environmental Impact of Meeting Increasing Demand for Urban Infrastructure Construction Projects." *Engineering.com*. November 2017. Retrieved from <https://www.engineering.com/BIM/ArticleID/15915/The-Environmental-Impact-of-Meeting-Increasing-Demand-for-Urban-Infrastructure-Construction-Projects.aspx>.
- ¹⁰⁰"The Material Revolutionizing the Construction Industry? Wood." *Discover*. May 2020. Retrieved from <https://www.discovermagazine.com/the-sciences/the-material-revolutionizing-the-construction-industry-wood>.
- ¹⁰¹"Mass timber 101: Understanding the emerging building type." *ConstructionDive*. May 2017. Retrieved from <https://www.constructiondive.com/news/mass-timber-101-understanding-the-emerging-building-type/443476/>.
- ¹⁰²Churkina et al. *Buildings as a global carbon sink*. *Nature Sustainability*. January 2020. Retrieved from <https://www.nature.com/articles/s41893-019-0462-4>.
- ¹⁰³"Why more buildings should be made from wood." *The Economist*. January 2019. Retrieved from <https://www.economist.com/leaders/2019/01/05/why-more-buildings-should-be-made-of-wood>.
- ¹⁰⁴"Crosslam timber / CLT- Fire resistance and rating." *Greenspec*. Retrieved from <https://www.greenspec.co.uk/building-design/crosslam-timber-fire-resistance-and-rating/>.
- ¹⁰⁵"Montana Department of Commerce Announces Economic Development Grant Awards." *Montana Associated Technology Roundtables*. September 2012. Retrieved from <https://matr.net/news/montana-department-of-commerce-announces-economic-development-grant-awards-4/>. And from "SmartLam Receives \$250,000 Grant from USDA." *Flathead Beacon*. April 2015. Retrieved from <https://flatheadbeacon.com/2015/04/14/smartlam-receives-250000-grant-from-usda/>.
- ¹⁰⁶"The Material Revolutionizing the Construction Industry? Wood." *Discover*. May 2020. Retrieved from <https://www.discovermagazine.com/the-sciences/the-material-revolutionizing-the-construction-industry-wood>.
- ¹⁰⁷Moxy OID website. *Moxy OID*. Retrieved from <https://moxyoid.com/>.
- ¹⁰⁸Global Alliance for Buildings and Construction. *2019 Global Status Report for Buildings and Construction*. 2019. Retrieved from <http://wedocs.unep.org/bitstream/handle/20.500.11822/30950/2019GSR.pdf?sequence=1&isAllowed=y>.
- ¹⁰⁹"Why Steel." *The American Institute of Steel Construction*. Retrieved from <https://www.aisc.org/why-steel/sustainability/>. And from "Sustainability." *US Concrete*. Retrieved from <https://www.us-concrete.com/sustainability>.
- ¹¹⁰"Inslee signs bill to make Washington first state to legalize human composting." *The Hill*. May 2019. Retrieved from: <https://thehill.com/homenews/state-watch/444880-inslee-signs-bill-to-make-washington-1st-state-to-legalize-human>.
- ¹¹¹*The Order of the Good Death website*. The Order of the Good Death. Retrieved from <http://www.orderofthegooddeath.com/resources/death-positive-movement>.
- ¹¹²*Western Climate Initiative website*. Western Climate Initiative. Retrieved from <https://wci-inc.org/>.
- ¹¹³*The Regional Greenhouse Gas Initiative website*. The Regional Greenhouse Gas Initiative. Retrieved from <https://www.rggi.org/>.
- ¹¹⁴California Air Resources Board. *California Climate Investments*. Retrieved from <https://ww2.arb.ca.gov/our-work/programs/california-climate-investments>.
- ¹¹⁵California Air Resources Board. *California Climate Investments provided more than \$1 billion for underserved communities in 2019*. April 2020. Retrieved from <https://ww2.arb.ca.gov/news/california-climate-investments-provided-more-1-billion-underserved-communities-2019>.
- ¹¹⁶California Air Resources Board. *U.S. Forest Projects — November 14, 2014*. November 2014. Retrieved from <https://ww2.arb.ca.gov/our-work/programs/compliance-offset-program/compliance-offset-protocols/us-forest-projects/2014>.
- ¹¹⁷https://ww2.arb.ca.gov/sites/default/files/classic/cc/capandtrade/auctionproceeds/priority_targets_fy1920.pdf?_ga=2.49600998.1390909477.1600218613-1223666292.1593537421.
- ¹¹⁸Hernandez-Cortes, Danae and Kyle C. Meng. *Do Environmental Markets Cause Environmental Injustice? Evidence from California's Carbon Market*. The National Bureau of Economic Research. May 2020. Retrieved from <https://www.nber.org/papers/w27205>.
- ¹¹⁹California Air Resources Board. *Compliance Offset Program*. Retrieved from <https://ww2.arb.ca.gov/our-work/programs/compliance-offset-program>.
- ¹²⁰California Air Resources Board. *U.S. Forest Projects — November 14, 2014*. November 2014. Retrieved from <https://ww2.arb.ca.gov/our-work/programs/compliance-offset-program/compliance-offset-protocols/us-forest-projects/2014>.
- ¹²¹"Impact fund of the year: The Nature Conservancy's sustainable forestry fund." *Environmental Finance*. June 2020. Retrieved from <https://www.environmental-finance.com/content/awards/sustainable-investment-awards-2020/winners/impact-fund-of-the-year-the-nature-conservancys-sustainable-forestry-fund.html>.
- ¹²²"Family Forests: An Untapped Powerhouse in Climate Mitigation." *The Nature Conservancy*. April 28, 2020. Retrieved from <https://www.nature.org/en-us/what-we-do/our-insights/perspectives/family-forests-powerhouse-in-climate-mitigation/>.
- ¹²³*Natural Climate Solutions website*. The Nature Conservancy. Retrieved from <http://naturalclimatesolutions.org/>.
- ¹²⁴"The Gold Standard Impact Quantification." *Gold Standard*. Retrieved from <https://www.goldstandard.org/impact-quantification/impact-quantification>.
- ¹²⁵"Verra Standards and Programs." Verra. Retrieved from <https://verra.org/verra-standards-and-programs/>.
- ¹²⁶"General Reporting Protocol." *The Climate Registry*. Retrieved from <https://www.theclimateregistry.org/tools-resources/reporting-protocols/general-reporting-protocol/>.
- ¹²⁷Catalytic Capital Consortium. *Terra Silva: Tackling Climate Change with Catalytic Capital*. Retrieved from https://www.macfound.org/media/files/C3_Terra_Silva_Fact_Sheet_v5_102219.pdf.
- ¹²⁸Cox, Timothy R. "Americans and Their Forests: Romanticism, Progress, and Science in the Late Nineteenth Century." *Journal of Forest History*. October 1985. Retrieved from <https://www.jstor.org/stable/4004710>. And from Food and Agriculture Organization of the United Nations. *Forest and Tree Symbolism in Folklore*. Retrieved from <http://www.fao.org/tempref/docrep/fao/005/y9882e/y9882e07.pdf>.



DECEMBER 2020

DBL PARTNERS