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A Climate-Smart Forest Economy: How to Unleash the Full Climate Potential of Forests and Forest Products

Climate and Forests 2030

AUTHORS
Jamie Lawrence, Rod Taylor, Mark Wishnie, Daniel Zimmer

EXPERT REVIEWERS
Tasso Azevedo, Mokena Makeka, Jo O'Hara, Ralph C. Schmidt

Background

The Climate and Land Use Alliance (CLUA), with the support of Meridian Institute, is exploring the integration of climate and land use with justice, equity, health, and economic recovery through Climate and Forests 2030: Resources for Funders. This focus is intended to inspire innovation and investment in integrated work on forests, rights, and sustainable land use and will inform a new strategic plan for CLUA for the period 2021 to 2030.

To inform the thinking, CLUA commissioned a series of "thought pieces" to provide diverse inputs into developing a more integrated approach for forests and land use. These are meant to stimulate discussion and debate and are not intended to reflect the views of CLUA, its member foundations, or Meridian Institute. The views expressed in this paper are those of the authors. They have been informed by commentary and input by a range of other experts.

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Forward

Unleashing the Full Climate Potential of Forests

By Jamie Lawrence, Senior Advisor, Forest Economy Program Lead — Good Energies Foundation

The Earth is engulfed by the twin catastrophes of biodiversity loss and a climate crisis. For some time now, little preamble is needed, nor dispute required on that point, and yet as we write, humanity is suffering the consequences of a zoonotic disease pandemic linked to the destruction of natural habitats. It has become painfully obvious that better land stewardship is essential to achieving a 1.5°C world whereby greenhouse gas emissions from the destruction of ecosystems must be quickly reduced and the potential for additional land carbon storage significantly increased. The big question is how.

The 2015 Paris Agreement[1] on climate change saw many countries moving to include land-based solutions in their Nationally Determined Contributions (NDCs); a move that would catalyse a necessary shift from our current situation in which Natural Climate Solutions (NCS) form a mere 3% of climate funding and less than 10% of the conversation.[2] In the next decade, nature can provide a third of the solution to climate change. One of the landmark studies[3] on the topic, published in 2017, synthesized and clarified the potential activities, scale, and geographies for the Agriculture, Forestry, and Other Land Use (AFOLU) sector's climate mitigation potential. Griscom *et al.* (2017) demonstrate that NCSs can be configured to not only reduce and reverse AFOLU sector emissions but also provide over one third of the climate mitigation needed by 2030. Since then, many scientific papers have been published supporting the idea of reforestation *en masse*; the debate around where and in which way is the order of the day.[4] There has perhaps been a lot less debate and certainly not enough focus on the "how."

Among the NCS pathways, forests are the largest land use sector contribution. Avoided deforestation, improved forest management, and (the lion's share) reforestation would all contribute to a massive reduction in emissions and a huge drawdown of atmospheric carbon. But who would pay for such measures? Whilst NCSs such as reforestation are frequently touted as the most cost-effective climate solution (when compared with investments in decarbonization, for example), they remain costly especially when considered via financial measures of rates of return.

To date, any large-scale reforestation has been mainly achieved by i) land abandonment; ii) forest regeneration in de-militarized zones — e.g., between North and South Korea; and iii) sustained large scale rural policy — e.g., China's "Grain for

[1] *Text available here: https://unfccc.int/sites/default/files/english_paris_agreement.pdf*

[2] *www.nature4climate.org*

[3] *Griscom BW* et al. *2017. Natural climate solutions. Proc. Natl Acad. Sci. USA 114, 11 645-11 650*

[4] *Bastin JF, Finegold Y, Garcia C, Mollicone D, Rezende M, Routh D, Zohner CM, Crowther TW: The global tree restoration potential, Science, 5 July 2019.*

Green" program. Most of the funding for reforestation comes from government agencies or international donor programs. Yet, a 100% delivery of reforestation NCS pathways — referenced by Griscom *et al.* (2017) — would imply the creation of a new forest area the size of France, Spain, Norway, Germany, and Italy combined before 2030 (200+ million hectares). Therefore, when we focus on the scale needed, it becomes clear that, in order to deploy NCSs to their full potential, we will need a way of tapping into the "real" economy: the market economy. By way of an illustration, in 2019, forest carbon offset sales in the U.S. totalled 0.47 billion USD,[5] the USDA's Forest Service Budget totalled 6.1 billion USD,[6] and environmental philanthropy amounted to 12.7 billion USD[7] — all of which is dwarfed by the size of the U.S. timber & forest product sales, which totalled 366 billion USD[8] in 2019.

Land use change is about incentives. Markets send signals to land use actors. This much is clear.

So, by tapping in to the "real" economy, we might find a way to finance NCSs at scale. When this train of thought is applied, it subsequently leads to the question of what the climate impacts of such market activity might be. For example, if society increases the use of forest products to help pay for improved forest management and reforestation — what might be the impact? Answering this question leads to an investigation into the different climate functions of forests (carbon sinks or sequestration) and forests products (storage and substitution). Here, research[9] has shown that wood products store carbon; the longer they are used for, the longer said carbon is stored. It has also been shown that forests can be managed to retain a carbon balance[10] where harvesting is applied sensitively and silvicultural techniques enhance soil carbon. Additionally, it has been shown that reforestation harbors huge potential as an NCS pathway, and that the substitution of carbon intensive materials is an urgent necessity in the decarbonization journey.

By combining climate functions, we are therefore presented with a tantalizing opportunity to maximize the climate benefits of forests via a systemic approach to unlock the full climate potential of both forests and forest products.

The need for a systemic approach — a redesign of our system — builds towards what might be termed a "Climate-Smart Forest Economy." A Climate-Smart Forest

[5] *Includes all California ARB offsets issued in 2019 (source: ARB Offset Credit Issuance Table, through May 26, 2020, https://ww3.arb.ca.gov/cc/capandtrade/offsets/issuance/issuance.htm, accessed on 5/29/2020 at a weighted average price of $14.13 / tCO_2e (Source: World Bank Group, State and Trends of Carbon Pricing 2020) and global total voluntary forest offset sales in 2018 (Source: Ecosystem Marketplace, State of the Voluntary Carbon Markets, 2019*

[6] *Congressional Research Service, In Focus, Forest Service: FY2019 Appropriations and FY2020 Request. 2 pages. April 4, 2019*

[7] *Giving USA 2019, www. https://givingusa.org/giving-usa-2019-americans-gave-427-71-billion-to-charity-in-2018-amid-complex-year-for-charitable-giving/, accessed on 5/29/2020*

[8] *Value for all timber sales and manufacturing shipments, 2016 data, source: Forest2Market "The Economic Impact of Privately-Owned Forests in the 32 Major Forested States", April 4, 2019; (2) Giving USA 2019, www. https://givingusa.org/giving-usa-2019-americans-gave-427-71-billion-to-charity-in-2018-amid-complex-year-for-charitable-giving/, accessed on 5/29/2020*

[9] *"Substitution Effects of Wood-based Products in Climate Change Mitigation," Leskin et. Al, 2018, TIG Analysis*

[10] *Gert-Jan Nabuurs, Pieter Johannes Verkerk, Mart-Jan Schelhaas, José Ramón González Olabarria, Antoni Trasobares and Emil Cienciala. 2018. Climate-Smart Forestry: mitigation impacts in three European regions. From Science to Policy 6. European Forest Institute.*

Economy refers to the usage of forest products in circumstances where this provides net climate benefits while meeting social and ecological safeguards. Building a Climate-Smart Forest Economy could protect, maintain, and manage forests, while assigning greater value to forests, creating further incentives for restoration and reforestation. It offers an opportunity to decarbonize sectors that interface with forests through their value chains, such as construction. In addition to positive climate outcomes, this can result in substantial social and economic benefits.

In order for this to be achieved, such a systemic shift will require:

1. open dialogue to understand and solve fracture lines;
2. research to complete our gaps in knowledge;
3. consensus around carbon calculations across all the climate functions of forests and forest products;
4. significant outreach to rally the market forces and educate them in the right way of engaging forests responsibly; and,
5. an increase in commitment by all.

It will also require a way of showing what such a future could look like: real-life tangible demonstrations of projects (e.g., in the built environment) capable of unlocking the full climate potential of forests and sustainable forest products in a catalytic and replicable manner.

This article attempts to describe a pathway for a future in which bio-based materials incentivize the protection, maintenance, restoration, and improved stewardship of forests. The authors have chosen to use the built environment and construction as a tangible example of how a Climate-Smart Forest Economy might work in practice and what the challenges and opportunities specific to that sector are. The construction sector is huge, growing fast, and generates more emissions than transportation or industry. Globally, it is 14 times the size of the forest industry and drives activity in every municipality across the globe. Most importantly — as global floor area is projected to double by 2050[11] — it is a sector that is in urgent need of decarbonization as buildings make up 39% of global emissions. As a sector where a "do nothing" strategy or incremental decarbonization of materials are simply not viable options, construction offers us a perfect point of departure to imagine what a Climate-Smart Forest Economy might be capable of achieving.

[11] Global Alliance for Buildings and Construction, International Energy Agency, and United Nations Environment Programme, 2019. Global status report for buildings and construction: Towards a zero-emission, efficient and resilient buildings and construction sector"

Imagining a Climate-Smart Forest Economy

As the global population increases, particularly in cities, the pressure on the world's resources is accelerating exponentially. In fact, each week another 1.5 million people move to urban areas. Because all of them will require places to live and work, it is projected we will need the equivalent of another New York City every 34 days for the next 40 years.[12]

The assumption that economic and population growth inevitably lead to environmental and social degradation has certainly been widely accepted. But what if we were to turn that narrative around?

What if (counter-intuitive as it may seem), instead of contributing to the degradation and loss of forests and biodiversity, the surging demand for new and retrofitted buildings *accelerated* natural climate solutions, including tree planting and reforestation, and led to an increase in the world's forest cover? What if buildings, towns, and even sprawling cities drove demand for timber sourced from sustainably-managed forests that absorb and store carbon, help to stabilize and improve soils, and provide clean water and jobs for rural communities? What if these new buildings could replace carbon-intensive concrete and steel skyscrapers, enabling those buildings — and entire cities — to store[13] carbon rather than emit greenhouse gasses into our atmosphere?

A Tangible Example: Buildings as Global Carbon Sinks

There is a future in which forests can support cities and, in return, cities can support forests: a future of leafy city streets, vibrant forest communities, and beautifully designed buildings made from wood — which are designed to be lighter, stronger, and even fire and earthquake resistant.

Realizing this vision is not only theoretically plausible but could also be one of the most immediately accessible ways of mitigating the worst impacts of climate change. Within this decade, we have the ability to create a Climate-Smart Forest Future,[14] one where forests, forest products, and buildings help to avert a full-scale climate emergency — a climate-smart future in which, as Sir David Attenborough so inspiringly put it, we "have more forests than any of us have ever known."

Cities remain our best bet for realizing human potential; and inevitably, that comes with a host of adjoining responsibilities around environmental stewardship. The time to reimagine our cities for the next century and beyond is here. Along with its climate benefits, a Climate-Smart Forest Economy could drive significant investment in sustainable forestry, job creation, and rural community development.

With a carefully conceived, systems-driven strategy — one grounded in rigorous science, and one designed to shape policy and drive investment and market demand for the development and testing of alternative materials and pilot projects — this climate solution could well be in plain sight.

Imagine that a new neighborhood was built using today's typical construction methods and materials (namely concrete and steel) and that this neighborhood was replicated across the world, adding an urban area the size of Paris every week.

Now, imagine instead a new neighborhood built out of wood sourced from a local forest that upholds the highest environmental and social standards — and its carbon storage capacity remains unimpaired after careful harvesting. Imagine that...

- ...the architect, construction firm, and local authority involved with the project's development deployed funds towards reforestation and agroforestry projects locally and around the world.
- ...the neighborhood underwent significant greening as part of the development

[12] *"Global Status Report 2017 - World Green Building Council." Accessed January 12, 2021. https://www.worldgbc.org/sites/default/files/UNEP%20188_GABC_en%20%28web%29.pdf*

[13] *Churkina, G., Organschi, A., Reyer, C.P.O.* et al. *Buildings as a global carbon sink. Nat Sustain 3, 269–276 (2020). https://doi.org/10.1038/s41893-019-0462-4*

[14] *A review of greenhouse gas mitigation in Europe's forests and forest products: The Forest Economy and Climate Change – J Lawrence & G Lomax (TNC)*

commitments, and that the timber used in the building replaced what was originally specified as steel or concrete.

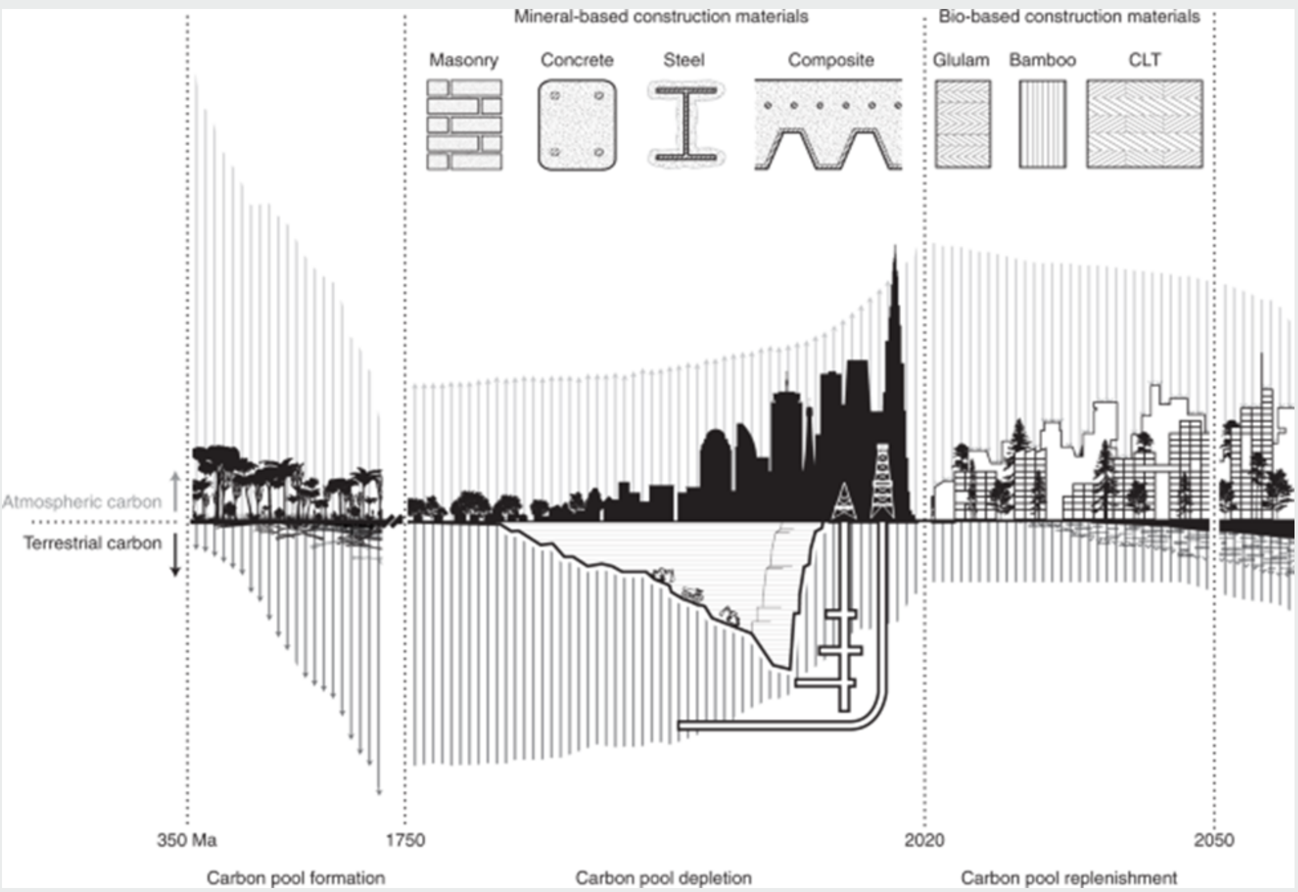
- ...the buildings were specified to remain standing for more than 100 years — storing carbon for over a lifetime — and designed to eventually be de-constructed so that their component parts (beams and frames) could be used in other buildings or products.

Now, isn't that a vision worth chasing?

Transitioning to a Climate-Smart Forest Economy: The 3-S Framework

Transitioning to such a Climate-Smart Forest Economy will require comprehensive policy change based on sound science to drive market demand and investment. The transition will require a holistic understanding of the way carbon is sequestered from the atmosphere and stored. It will require a new way of thinking and a change in the narrative about forests and our built environment. Instead of regarding forests as a zero-sum game, and forestry

FIGURE 1
People have traditionally relied on and depleted carbon reserves (sinks), both above and below ground, to expand our built environment. Yet, we have an opportunity to restore above ground carbon sinks (e.g., via reforestation) and, at the same time, create a carbon sink in our built environment (wood storing carbon in buildings).



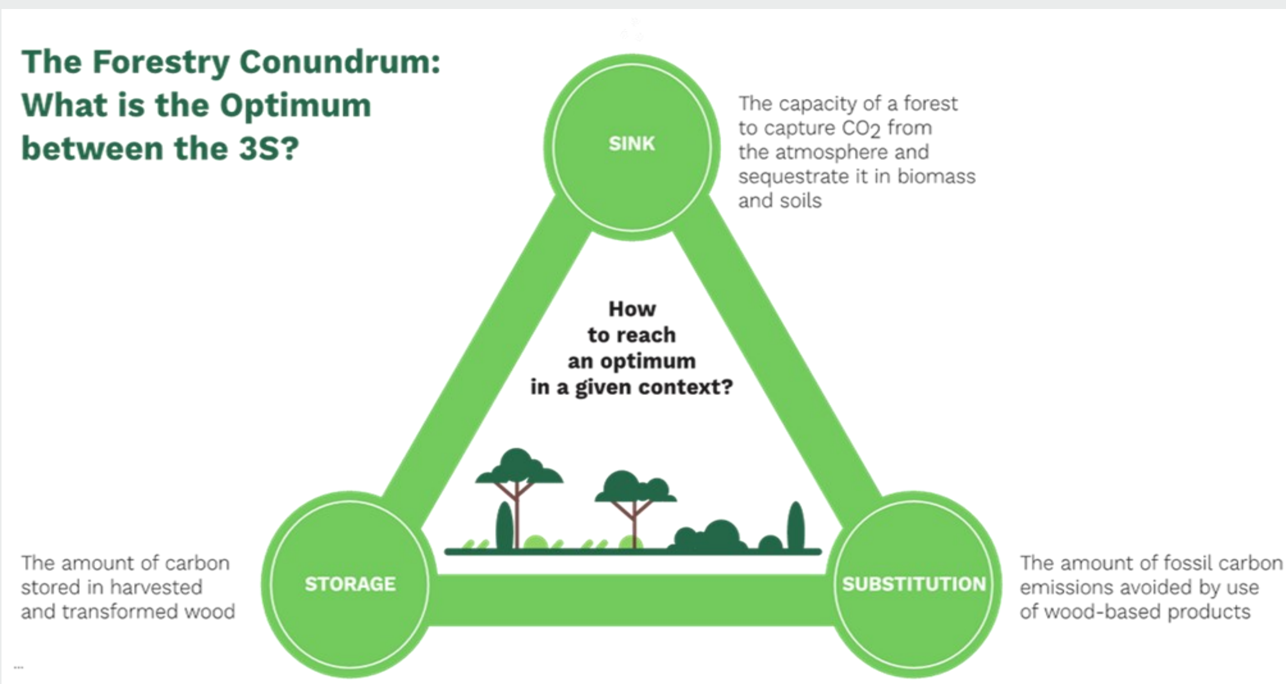
Source: Galina Churkina, "Buildings as Global Carbon Sink" Nature, January 27, 2020 https://www.nature.com/articles/s41893-019-0462-4 and construction as simply extractive, forest regeneration would be driven through market demand so that all aspects of forest management and construction value chains — from sapling to finished products — are complementary, and funding is synergistic, rather than siloed.

Integrating the various aspects of the value chain—particularly when it comes to the building and construction industries — and encouraging a synergistic rather than siloed approach to forest management, material choices, policy-making, and investment could have profound results, unlocking the true value of forests in the fight to avert a climate emergency.

Why building and construction specifically? Because together they are responsible for 39% of all carbon emissions globally — more than the entire transportation sector — with operational emissions (from energy used to heat, cool, and light buildings) accounting for 28%. The remaining 11% comes from embodied carbon emissions associated with materials and construction processes throughout the whole building lifecycle.[15] Incredibly, the world has added over 50 billion square meters of new floor area over the last decade. To put this into perspective, this is the equivalent of adding eleven Roman Colosseums every half hour. By 2050, this total floor space will increase by 70%, most of it in Asia and Africa.[16]

To support the transition, a so-called **"3-S" Framework** would be a useful conceptual tool for clarifying the various aspects of the Climate-Smart Forest Economy — from the management of land to the use of products and services. The tool would provide a comprehensive and integrated way of considering the various aspects of the carbon cycle: **<u>s</u>equestration** (pulling gasses from the atmosphere), **<u>s</u>torage** (the sink capacity of forests and materials), and **<u>s</u>ubstitution** (low-impact alternative materials).

FIGURE 2
A diagrammatic representation of the three carbon functions of forests and forest products and determination of optimum balance. See also: Appendix A.



Source: Daniel Zimmer

[15] *"Bringing Embodied Carbon Upfront." https://www.worldgbc.org/bringing-embodied-carbon-upfront-report-webform*
[16] *"Global Status Report 2017 - World Green Building Council." Accessed January 12, 2021. https://www.worldgbc.org/sites/default/files/UNEP%20188_GABC_en%20%28web%29.pdf*

The 3-S Framework would help decision makers understand how to individually and collectively identify how to maximize the role of the forests and their associated products on climate change. For example, builders, communities, city planners, and policymakers would be better able to understand and test how their actions and decisions contributed to the protection, management, and restoration of forests. They would have more insight and access to reliable information on carbon stocks in forests and be able to estimate how an increase or decrease in demand for forest products might affect that carbon stock, as well as how the choice of materials would affect carbon storage and the emissions associated with materials production. Policymakers could confidently incentivize the use of wood because the 3-S Framework would provide clear insight into the impact of those sourcing decisions on the building site as well as the forest. End users would be able to make decisions regarding materials with a more comprehensive understanding of the carbon performance of the materials they use and of how their choices impacted land management.

The Need for Scientific Research

Challenges:

The 3-S Framework needs to be informed by rigorous scientific research to provide a more comprehensive understanding of the carbon sequestration and storage potential of forests and wood materials as well as the comparative benefits of alternative materials. Much of the science around the carbon cycle is incomplete because most models have been developed to evaluate individual aspects of the cycle rather than considering the cycle as an integrated system. Moreover, because it is enormously complicated to track the factors that impact the system and to estimate the impact of a marginal change in demand for forest products on forest management and forest carbon stock, our current ability to make accurate assessments is limited. In other words, we don't have the comprehensive information necessary to balance the sequestration and storage functions of the forests with the storage opportunities and costs that material substitution could provide.

Opportunities:

Greater investment in scientific research will enable decision-makers to better determine which forests to protect, harvest, reforest, or afforest. We can determine how to optimize the sink or storage function of forests and to minimize carbon emissions during harvest. We can provide forest owners and managers with the information they need to minimize risks associated with climate change. Additionally, we can determine how to maximize the storage capacity of buildings and other wood products.

The Need for Better Forest Management

Challenge:

Whether forests are protected or harvested, as the recent fires that have ravaged great swathes of the Western U.S. and Australia demonstrate, we desperately need more effective management in many forests to restore health and increase resiliency. Yet, despite widespread political calls for better management, many forests are not currently managed to anticipate, adapt to, and avert the impacts of climate change or the loss of biodiversity, a problem as acute as climate change. That is because forest stewards often lack the market or public policy signals to incentivize sustainable land management.

Without the economic and political incentives for multi-functional sustainable management, forest managers don't have the tools, technology, knowledge, or resources needed to inform their decision-making — particularly given the rapidly-evolving conditions of our natural environment. Whether we encourage the use of more timber for construction or not, we need to manage existing forests more effectively while increasing the acreage of healthy, sustainable, multi-functional forests. In order to do so, we need to create market incentives in order to unlock the potential of the 3-Ss — sequestration, storage, and substitution (See Appendix B).

Furthermore, as we drive demand for forest products — particularly for construction — we need to have effective systems and mechanisms in place to ensure that the demand for wood does not lead to opportunistic exploitation, the conversion of natural ecosystems, the destruction of biodiversity, or other forms of unsustainable management. In other words, we need to ensure that increasing the demand for wood products drives more responsible forest management.

Opportunity:

Halting the loss and degradation of forests and promoting their restoration has the potential to contribute over one third of the total climate change mitigation required by 2030 to meet the objectives of the Paris Agreement. We have an opportunity to optimize the sequestration and sink capacity of forests through better and more scientifically–rigorous management. There is also an opportunity to balance this climate function with the benefits that can be gained from carbon storage in long-lived products and the substitution gain from avoiding the deployment of carbon-intensive materials in the first place. A core question is: What is the optimal balance between all 3-S climate functions? (See Appendix A).

While we need to protect intact old-growth forests, we also need to equip forest owners and managers with the tools, information, and resources needed to ensure their lands sequester as much carbon as possible. Although the obvious nature-based solution may be to simply limit harvesting and increase reforestation, we need to drive market demand to pay for that reforestation. Wisely managed forests and plantations — where certain species of rapidly growing trees are planted for use in mass timber and other engineered building materials — can arguably sequester even more carbon than slow-growing mature trees. At the same time, it is the old growth forests that store more carbon and provide other environmental, social, and economic benefits. However, the carbon benefit of trees is not limited to just what happens in the forest. The opportunity, then, is to manage forests for their carbon sequestration capacity and also as a source for wood-based materials that store carbon throughout their life cycles — and to balance the needs for both. The 3-S Framework takes multi-functional forest management to a new level by enabling the calculation of the storage and substitution benefits that trees provide.

Creating Demand for Climate-Positive Forest Products

Challenge:

While the focus on forest management tends to be on forests and forestry, the construction industry is 14 times the size of the forestry industry and generates even more emissions than transportation. That is why decarbonizing the construction industry and the built environment is essential if we are to meet the goals of the Paris Agreement — especially in light of current UN projections that humans will construct the equivalent of a new city of Paris every week for the next 40 years. In other words, the climate impact of this building boom could be catastrophic.[17]

Opportunity:

If more and more new buildings and construction products are made from wood — particularly engineered wood, including mass timber — we have the opportunity to accelerate the natural climate solutions provided by forests through the increased demand of wood, while, at the same time, creating buildings that store rather than emit carbon. In this way, the carbon that is sequestered and stored in trees remains locked in their wood products.

While it is true that a forest left alone would continue to sequester and store carbon, by ensuring sustainable forest management and driving demand for the right kinds of climate-positive forest products, we can deliver greater climate benefits than the standing forest might deliver on its own.

Mass timber — made by layering and pressing together large wood pieces to form panels as rigid and durable as steel — not only has great potential to drive reforestation and responsible forest management, but the materials themselves are stronger, lighter, more attractive, and even more fire-resistant than carbon and steel. Moreover, buildings made from mass timber store emissions, unlike carbon and steel buildings. If a typical steel and concrete building has an emissions profile of 2,000 metric tons of CO_2, mass timber can store at least an equal amount of carbon.[18]

[17] *"Global Status Report 2017 - World Green Building Council." Accessed January 12, 2021.* https://www.worldgbc.org/sites/default/files/UNEP%20188_GABC_en%20%28web%29.pdf
[18] *"As Mass Timber Takes Off, How Green Is This New Building Material?" Yale E360,* https://e360.yale.edu/features/as-mass-timber-takes-off-how-green-is-this-new-building-material

In sum, demand for wood products from sustainably-managed forests can help to revitalize working forests and put people back to work.

Shaping Climate-Smart Policy

Challenge:

In most places, government ministries and departments are siloed by sector: industry, agriculture, and forestry. Therefore, policies that could potentially drive a Climate-Smart Forest Economy by addressing the 3-S benefits — sequestration, storage, and substitution — can be difficult to holistically unlock.

While in some places, codes that guide building heights and materials are starting to change in favor of mass timber, too much of the bureaucratic red tape that guides construction policy is outmoded and continues to favor concrete and steel, focusing on the materials themselves rather than properties such as embodied carbon. Without new regulations, tax incentives, and revised building codes that actually encourage the use of mass timber, investment is stymied as is progress at scale.

Meanwhile, because the public generally associates forestry with forest overuse, abuse, and deforestation, policymakers tend to be hesitant about encouraging increased wood use for fear that they'll be judged as anti-environmentalists by their constituents.

Policy, then, is hindered by a lack of general awareness of the benefits of wood as a means to mitigate climate change. While in Asia, the U.S., and Europe policies are starting to shift to permit the construction of mass-timber buildings, policy-makers everywhere need guidance around the benefits associated with not only mass-timber, but forests in general, including those with high biodiversity, cultural significance, or that are or should be protected.

Opportunity:

Policy-makers have the opportunity to modernize and harmonize regulation in favor of a Climate-Smart Forest Economy generally, and mass timber construction in particular, to spur investment locally, nationally, regionally, and globally. This is happening in France, for example, where new buildings need to contain at least 50% wood, and in Paris, the government has pledged that all new buildings higher than eight stories to be constructed for the 2024 Olympics will be made entirely of timber. In fact, interest in mass timber projects is taking off globally, bolstered by high-profile projects around the U.S., Europe, Asia, and Africa.

Creating the Conditions for Investment

Challenge:

Without sufficient awareness and policy to drive investment, the market for mass timber and other steel and concrete substitutions, while promising and growing, is nascent. Although mass timber can be less expensive than concrete and steel — depending on where it's sourced and how far it needs to travel — production has not yet generated significant economies of scale to make design, permitting, and construction less expensive than concrete and steel in most of the world.

Opportunity:

While there is still insufficient demand for mass timber and other substitute products to drive economies of scale, because these alternative construction components are prefabricated off-site, mass-timber buildings can be constructed relatively quickly, are less disruptive on site, and generate considerably less waste. For example, when the University of Denver needed a new modular testing center for Covid-19, one was built off-site in Bakersfield, California and put up within ten days. Meanwhile, mass timber modular hospitals were built in Wuhan, China, in less than two weeks.

So, while mass wood materials may still be marginally more expensive than carbon and steel, savings can accrue in labor if not material and transportation costs. Because of the efficiency in production, the consulting firm McKinsey has estimated that modular construction could grow into a 130 billion USD industry in the United States and Europe by 2030.[19]

To realize the potential of mass timber, modular

[19] *"Modular construction: From Projects to Products" McKinsey & Company,* *https://www.mckinsey.com/~/media/mckinsey/business%20functions/operations/our%20insights/modular%20construction%20from%20projects%20to%20products%20new/modular-construction-from-projects-to-products-full-report-new.pdf*

factories need to be rolled out at scale to significantly increase production. The digitization of specifications for architecture and construction could help further increase efficiencies of modular timber building components. Furthermore, vertically integrated investment portfolios across the value chain — from forest management to manufacturing and construction — could drive new opportunities.

If we want large-scale capital to flow into climate-positive investments that support forest landscapes and natural climate solutions at scale, the end markets for products of sustainable forestry will be a key lever; they are far larger, and far more investable by large institutions than typical forestry projects.

Lessons about the key levers for scaling investment in climate solutions can be derived from the past. While the first solar panel was built in 1883 and the first electricity producing wind turbine in 1888, the adoption of both technologies was painfully slow until the mid-1990s, when governments in Germany, Denmark, and elsewhere began taking aggressive policy action — through renewable energy portfolio standards, tax credits, and subsidies — to spur investment in renewable energy. With greater investment, costs of production dropped significantly and production increased exponentially so that today renewable energy outcompetes fossil fuels in many parts of the world.

Similar policy action is needed to spur investment in driving mass timber to scale. That is why creating the social license to advance sustainable forestry and a robust analytical/decision-making 3-S Framework are critical to enable policymakers to act. Such policies could then encourage the corporations and institutional investors who have made massive commitments to climate mitigation in the last few years to invest in Climate-Smart Forestry solutions. For example, the UN-convened Net Zero Asset Alliance — which includes thirty of the world's largest investors with 5 trillion USD in assets under management — has collectively agreed on portfolio decarbonization targets that follow the Intergovernmental Panel on Climate Change 1.5°C scenario for the next five years.

While 5 trillion USD would far exceed the institutionally-investable opportunity in forestry (current private investment in timberland is estimated at 60-100 billion USD globally), if we combine land-based climate solutions with decarbonization of the built environment (approx. 3.5 trillion USD is invested in real estate investment trusts in the U.S. alone) we can achieve two climate outcomes through a single, holistic action and tap into a larger proportion of the 5 trillion USD commitment (See Appendix C).

Donor Recommendations

- Convene stakeholders and create a dialogue with the goal of creating shared visions, ambitions, and finding the optimal balance between nature and bioeconomy.
- Fund the development of the 3-S Framework as a decision-making tool that integrates forest carbon models, economic/behavioral decision-making models, and life-cycle assessments.
- Fund pilot and demonstration projects to deepen an understanding of the issues underlying the 3-S Framework.
- Educate investors, the public, and policymakers with the goal of generating social capital, destigmatizing forestry and wood use, and encouraging carbon-smart investments (See Appendix C).
- Build portfolios through venture philanthropy and incentivize industry, governments, foresters, and financial institutions to invest in sustainable forest products.
- Push for bold, unreasonable commitments that create additionality when engaging market drivers as incentives for natural climate solutions. Anything less will not ensure all 3-Ss are unlocked, nor offer a path towards tomorrow's world as we want to see it.

Appendix A

Balancing the S-3 Functions

By Daniel Zimmer

1. Maximizing forests' role in addressing climate change requires finding an optimum equilibrium between the carbon sink function of the forest and the carbon storage and substitution functions of the wood (the 3-Ss). How much wood can be harvested without harm to the sink function? If harvested, how much carbon can be stored in wood products and for how long? Moreover, how much fossil-carbon-based products can the wood substitute and for what benefits?

2. There is an important divide between the different forest/wood functions, and particularly between the sink and the storage-substitution capacities. Very often, experts privileging the sink function consider wood harvest through its consequences on the carbon debt (i.e., the lack of carbon absorption by the harvested trees). Those developing wood products simply compare the storage and substitution effects of wood, as compared to other non-wood products. Nowhere are the three functions analyzed conjunctively.[20]

3. One of the reasons for this gap is that the issue is highly complex. It involves an important parameter: time. The duration of the carbon storage in wood products is quite variable and can span from a few days or weeks to more than a century. With circular economy approaches, this duration is likely to — and should — increase in the future. Similarly, the substitution effects evolve regularly because all sectors are trying to reduce their carbon footprints. If cement or steel manage to become carbon neutral in the future, the substitution benefits will even disappear. Finally, the sink function itself is evolving and is likely to decline in the future without proper and active management of the forests: ageing trees are less efficient in their carbon absorption, and — as climate change advances — fire, disease, or pest outbreak risks will increase in many places and the trees themselves will be less adapted to the climate.

4. This time dimension is critical when prominent actors across the globe are looking at forests as a key recipe to the climate change issue. In a globalized world, more demand for wood is likely to increase imports of wood that may originate from either pristine or poorly managed forests. More demand for carbon sink protection may have the same result.

5. This complexity is reinforced by the fact that the orders of magnitude of the 3-S functions (in CO_2 equivalent) are similar. The amount of carbon that can potentially be stored in wood products is proportional to the carbon that has been absorbed from the atmosphere by the tree over its entire life. The quantity of fossil-

[20] *Austin Himes and Gwen Busby, "Wood Buildings as a Climate Solution," Science Direct 4 (November 2020), https://www.sciencedirect.com/science/article/pii/S2666165920300260#bib43.*

carbon emissions that are avoided are also proportional to the bio-carbon utilized: a recent EFI global review found that each kilogram of wood-carbon utilized in products (excluding bioenergy) avoid the emissions of 1.2kg of fossil-carbon. This similarity in the orders of magnitude means that the carbon balance between sink and storage/substitution is not easy to predict.

6. To address this complexity, a holistic approach is needed. New inclusive tools are needed that specify precisely the scenarios to be compared. In particular, comparing Life-Cycle Assessments of products or buildings without taking into account the carbon debt associated with the tree harvest is not enough. There will not be a unique approach to maximize the climate impact of wood and forests because of the diversity of situations and challenges beyond climate that must be addressed — biodiversity, water quality, local economy, other functions of the forests, and other land uses (agriculture in particular) are also part of the equation.

7. A critical step to spur action is the introduction of a new mindset: instead of simply *analyzing the effects* of different parameters, it is critical to actively promote those approaches that aim to maximize the benefits. For instance, as much of the harvested wood as possible needs to be utilized in long lifespan products using circular economy approaches.

8. In any analysis, it is also crucial to define the boundaries of the system under consideration and to specify the assumptions utilized. As much as possible, unclear or average situations (e.g., a generic forest not described precisely or for which the harvesting technique is not specified) should not be used to draw practical conclusions. In many instances, considering an isolated forest alone is too restrictive. For instance, the carbon debt of a forest harvest could be “compensated” by an afforestation project elsewhere. Such an approach could generate a virtuous cycle by creating incentives for potential investors or companies willing to compensate their carbon emissions.

CLIMATE AND FORESTS 2030: RESOURCES FOR FUNDERS

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Thought Piece: A Climate-Smart Forest Economy: How to Unleash the Full Climate Potential of Forests and Forest Products

Jamie Lawrence, Rod Taylor, Mark Wishnie, Daniel Zimmer