INNOVATIVE WOOD PRODUCTS: PROMOTING RURAL ECONOMIES AND HEALTHY FORESTS

HEARING

BEFORE THE

SUBCOMMITTEE ON CONSERVATION AND FORESTRY

OF THE

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WITNESSES

INNOVATIVE WOOD PRODUCTS: PROMOTING RURAL ECONOMIES AND HEALTHY FORESTS

WEDNESDAY, FEBRUARY 26, 2020

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON CONSERVATION AND FORESTRY,
COMMITTEE ON AGRICULTURE,
Washington, D.C.

The Subcommittee met, pursuant to call, at 10:08 a.m., in Room 1300 of the Longworth House Office Building, Hon. Abigail Davis Spanberger [Chair of the Subcommittee] presiding.

Members present: Representatives Spanberger, O'Halleran, Pingree, Axne, Schrier, Peterson (*ex officio*), LaMalfa, and Allen.

Staff present: Prescott Martin III, Félix Muñiz, Jr., Alison Titus, Josh Maxwell, Ricki Schroeder, Patricia Straughn, Dana Sandman, and Justina Graff.

OPENING STATEMENT OF HON. ABIGAIL DAVIS SPANBERGER, A REPRESENTATIVE IN CONGRESS FROM VIRGINIA

The CHAIR. This hearing of the Subcommittee on Conservation and Forestry on innovative wood products: promoting rural economies and healthy forests, will come to order.

Good morning. Welcome and thank you for joining us here today to discuss a very important topic: innovation in the wood products industry, and what it means for rural prosperity and forest health.

America's forests are a pillar of our country's prosperity, delivering very important environmental, social, and economic benefits. Forests deliver ecosystem services that are irreplaceable: clean air and water, carbon storage, and biodiversity. They are favored places for families and recreation enthusiasts, and in rural areas, forests create jobs and underpin local economies.

My home Commonwealth of Virginia understands this very well. Across Virginia's 15 million acres of forested land, forest-related businesses contribute $17 billion annually to the Commonwealth's economy, and support more than 100,000 jobs.

At the national level, forestry-related businesses employ nearly three million men and women. As it relates to wood products, the industry accounts for approximately four percent of total manufacturing GDP, producing nearly $300 billion in products annually.

Yet, multiple factors complicate the health of the industry. As markets have changed and evolved, demand for traditional wood products have matured or declined. Plastic, steel, and other materials have replaced products previously made exclusively from wood. The rise of digital media has significantly depressed newsprint and sheet paper production, and new residential housing,

which drives strong wood markets, is now beginning to approach pre-crisis figures.

With markets facing economic stagnation, the forest sector is looking to innovation to reinvigorate the industry and the future is full possibilities. Innovative wood products have the potential to develop new markets and strengthen local economies. New markets can also provide incentives for land managers, public and private, to implement sustainable management practices that fully maximize forestry's social and environmental benefits.

Recent innovations in mass timber and fiber insulation for the construction of wood buildings are already underway. These inventive products offer faster construction schedules and lower emission profiles. Researchers are also discovering new ways to use wood materials, completely changing the course of materials science and engineering.

An area of active research is nanotechnology. Potential applications for the use of nanocellulose include additives to create food coatings, transparent, flexible electronics, biomedical applications, among many other novel uses. These products, and more like them, are benefitting from Federal research conducted by the Forest Products Laboratory. Innovative products that aren't even on our radar yet, will come from investment in product development through opportunities like the Wood Innovation Grant Program. These investments are vital if our nation's forests are to remain bountiful and productive for their full range of environmental, social, and economic benefits.

I am grateful to hear and learn from our witnesses today on the progress of the wood products industry, Federal support for these products, and to discuss the many benefits that innovation lends to forestry.

[The prepared statement of Ms. Spanberger follows:]

PREPARED STATEMENT OF HON. ABIGAIL DAVIS SPANBERGER, A REPRESENTATIVE IN CONGRESS FROM VIRGINIA

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- Plastic, steel, and other materials have replaced products previously made exclusively from wood;
- the rise of digital media has significantly depressed newsprint and sheet paper production; and
- new residential housing, which drives strong wood markets, is now only beginning to approach pre-crisis figures.

With markets facing economic stagnation, the forest sector is looking to innovation to reinvigorate the industry—and the future is full of possibilities.

Innovative wood products have the potential to develop new markets and strengthen local economies. New markets can also provide incentives for land managers, public and private, to implement sustainable management practices that fully maximize forestry's social and environmental benefits.

Recent innovations in mass timber and fiber insulation for the construction of wood buildings are already underway. These inventive products offer faster construction schedules and lower emission profiles.

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The CHAIR. In consultation with the Ranking Member and pursuant to the Rule XI(e), I want to make Members of the Subcommittee aware that other Members of the full Committee may join us today.

The chair would request that Members submit their opening statements for the record so witnesses may begin their testimony, and to ensure that there is ample time for questions.

PREPARED STATEMENT OF HON. DOUG LAMALFA, A REPRESENTATIVE IN CONGRESS FROM CALIFORNIA

Good morning, and welcome to today's Conservation and Forestry Subcommittee hearing.

Our nation's forests are a great natural resource, and today we will examine how innovative wood products can lead to healthy and productive forests and improve rural economies.

Forest lands—whether they are Federal, state, or private—are vitally important for many rural areas. Aside from the timber they produce, our forests also provide recreational opportunities and serve as economic drivers for the communities that surround them.

Once this timber is harvested, the forest products industry can use innovative approaches to create products including paper, packaging, construction material, and a variety of other items that we use on a daily basis.

The forest products industry directly employs over 900,000 people and accounts for about 4% of the total U.S. manufacturing GDP. Until recently, there was a decline in the amount of timber harvested on Federal lands. As timber harvest decreased, the number of jobs and local businesses connected to this natural resource also decreased.

I would be remiss if I didn't mention the work that we did in the 2018 Farm Bill to foster innovation within this industry and promote new markets for products. The 2018 Farm Bill included the Timber Innovation Act that established a research and development program to help advance tall wood building construction in the United States.

The 2018 Farm Bill also provided the Forest Service with tools to improve management of forest lands and allowed more partners to help with these activities; however, I believe we can do more to ensure we have healthy National Forests, and that they provide economic growth for our rural communities through innovative forest products.

One of the innovative wood products we will hear about today is mass timber—a large wood panel composed of smaller materials. While using mass timber may be a relatively new approach to building in the United States, Europe and Canada have been using mass timber for over 2 decades.

One example of mass timber that is proving to be effective is Cross-Laminated Timber (CLT). CLT and other mass timber products are sustainable, effective alternatives to traditional structural materials such as steel or concrete. In addition, mass timber projects can be built quicker and require less on-site labor than the use of traditional materials.

While there are several benefits to using mass timber, there remain some challenges including regulatory hurdles and a poor perception within the construction industry.

Another innovative wood product worth mentioning is biochar, a porous carbon substance that is created from burning wood in the absence of oxygen. Biochar has many uses including to improve soil health and reduce invasive species growth.

These are just a couple examples of the outstanding work the forest products industry is doing to bring jobs and economic growth to the rural areas of our nation.

We have a great panel of witnesses before us today, and I am looking forward to having a productive discussion and learning more about other examples of innovative products, including insulation and nanomaterials.

Thank you to the witnesses for taking time to be here, and to Chair Spanberger for calling this vitally important hearing.

I yield back.

The CHAIR. I would like to welcome our witnesses today. Thank you for being here.

It is my pleasure to introduce Mr. Michael Goergen, Vice President of Innovation and Director of P3Nano at the U.S. Endowment for Forestry and Communities. Michael joined the Endowment in 2013 and is currently focused on taking cellulosic nanotechnology from the lab to commercialization, advancing mass timber construction, and is bringing together partners in the public- and private-sectors. Prior to joining the Endowment, Michael served as the Executive Vice President and CEO of the Society of American Foresters.

Our next witness is Ms. Jennifer Cover. Ms. Cover serves as the President and CEO of WoodWorks, a nonprofit program focused on growing the market demand for wood products through project support and education. She is a California licensed professional engineer, and taught timber design at the University of California, San Diego, for 8 years. She holds a master's degree from the University of California Berkeley, and her experience includes business development, market analysis, project management, and structural design, all with an emphasis on wood construction.

I would now like to recognize the gentlewoman from Maine, Representative Chellie Pingree, to introduce our next and final witness.

Ms. PINGREE. Thank you very much, Madam Chair. Thank you so much for holding this hearing, particularly coming from the State of Maine, the most forested state in the nation, our state has been dealing with a lot of the challenges in the transition in this industry. We are really excited to have all of the panelists here today.

But, we are particularly excited to have someone from Maine, Joshua Henry, the President and Co-Founder of GO Lab, a building products company that is based in Belfast, Maine.

Prior to founding GO Lab, Mr. Henry served as a faculty member in the chemistry department of Bates College and the University of Maine. He is a part of producing a very exciting insulation product that we predict some day will be in every home and every commercial building across the country. You are all lucky to be in on the ground floor to hear more about it today.

But thank you so much for taking your time, Dr. Henry, to come spend some time with us here today, and we look forward to your testimony.

I yield back.

The CHAIR. We will now proceed with hearing from our witnesses. Each of you will have 5 minutes to present testimony. When the light turns yellow, that indicates there is 1 minute remaining to complete your testimony.

Mr. Goergen, please begin when you are ready.

STATEMENT OF MICHAEL T. GOERGEN, JR., VICE PRESIDENT, INNOVATION AND DIRECTOR P3NANO, U.S. ENDOWMENT FOR FORESTRY AND COMMUNITIES, BETHESDA, MD

Mr. GOERGEN. Thank you, Chair Spanberger, Ranking Member LaMalfa, and Members of the Committee. Thank you so much for the opportunity to testify on innovation in sustainable forest products.

I am Michael Goergen, Vice President for Innovation at the U.S. Endowment for Forestry and Communities. The Endowment is a not-for-profit public charity chartered at the request of the governments of the U.S. and Canada as a result of the Soft Wood Lumber Agreement of 2006. The Endowment is focused on keeping forests as forests, and supporting the communities that depend upon them.

I am focused on innovation in forest products because markets bring value to forests, and we keep things that we value.

Developing new markets, displacing current technology, getting people to think differently about forest products, these are daunting challenges for the forest sector. While we have solutions that solve many of today's environmental challenges, getting them to market requires overcoming many obstacles. At the Endowment, we are finding opportunities to bring together scientists from the USDA Forest Service and their research and development program, state and private forestry, and the National Forest System, university researchers, and the private-sector to accelerate the commercial readiness of a number of the innovative forest products that we are talking about today, including mass timber construction, low value products that utilize forest restoration materials, and one of the most exciting opportunities, cellulosic nanomaterials.

We are finding incredible applications for cellulosic nanomaterials. They are made from the tiniest parts of the tree. These are a new class of materials valued for their mechanical properties, their sustainability, their large-scale production potential, and their low cost.

At the nano-scale, about 1/100 of the width of a human hair—and we can look at Jennifer to see what hair looks like—cellulose has really novel properties. When we get the nano-scale for many materials, strange things start to happen. For example, nano gold is actually no longer that golden color. It is red or pink. In the case of cellulose, we can produce a material that is as strong as steel, but it is only 1/5 of the weight of steel.

Examples include researchers at the University of Maine who are working on several innovative products. One scientist and his team are developing a replacement for gypsum board that was made from sawdust and cellulosic nanofibers that act as the binding

agent. This new type of board will be lighter weight, will not have chemical additives associated with negative human health, and will have greenhouse gas emission profiles significantly lower than traditional products. Another researcher at Maine is actually developing a replacement snack package that would be fully recyclable and biodegradable. That means no more potato chip bags in the forest, in your streams, or on the sides of our roads.

Researchers are investigating an improvement to lithium ion battery technology that could be theoretically double the storage capacity of lithium ion batteries. Imagine doubling the range of current electric vehicles. And we can make those electric vehicles lighter by coating fiberglass with cellulosic nanomaterials, making that fiber stronger. That stronger fiber means we can put less of it in the car part, making those auto parts weigh about 20 percent less.

Another interesting application for cellulosic nanomaterials involves concrete. People use 4 trillion tons of concrete worldwide, but concrete is also the source of about five to eight percent of the world's greenhouse gas emissions because it takes a lot of energy to make concrete. To make the cement component, we actually heat limestone rocks up to about 2,600° Fahrenheit, which takes, of course, a lot of energy. And of course, that produces greenhouse gas emissions. But the rock itself actually has stored carbon in it, and when we heat that rock up, that carbon gets released as well.

If we could reduce the amount of cement in concrete, we could actually have a real environmental win, and that is where cellulosic nanomaterials can actually help. When we add tiny amounts of this material to the mix, we can actually reduce the emissions from concrete by about 18 to 20 percent.

It is interesting. Concrete requires near complete hydration. The challenge being that it is not always easy to get that exactly right. What nanocellulose does is it acts like a straw when it gets into that concrete mix. I am sure many of you have made pancakes from a mix before. You mix that pancake around, you get those dry lumps in the pancake, and they never seem to break up, even though you added all that milk and eggs. Same thing happens in cement. But the nanocellulose carries the water all the way through the cement and actually hydrates all those particles, meaning we get a stronger cement.

What does that mean? We can have stronger concrete, which is fantastic, or we can reduce the amount of cement in concrete, which would reduce our greenhouse gas emission profiles from that concrete. A 20 percent reduction may not seem like a lot, but for a 4 trillion ton product that is used worldwide, it is a significant improvement.

We are collaborating in a town in California called Yreka. It is northern California at the foot of Mount Shasta, and wildfire is a real threat there. The community wants to remove the small dying and dead trees that are there that are choking the forest, but it is expensive to do. These trees have little to no commercial value, and they can't pay their way out of the woods. Cellulosic nanomaterials are emerging as a new market for low value wood, a market that will make it economical to improve forest health, protect that town, and create jobs.

Together, we are going to put the world's first concrete-enhanced nanomaterial bridge in Yreka this spring. The town is going to help us out, and together we are going to build a better infrastructure, a better community, and a cleaner, greener world.

Thank you for the opportunity to testify today.

[The prepared statement of Mr. Goergen follows:]

PREPARED STATEMENT OF MICHAEL T. GOERGEN, JR., VICE PRESIDENT, INNOVATION AND DIRECTOR P3NANO, U.S. ENDOWMENT FOR FORESTRY AND COMMUNITIES, BETHESDA, MD

Chair Spanberger, Ranking Member LaMalfa, and Members of the Committee, thank you for the opportunity to testify on this issue of importance to all Americans—Innovation in sustainable forest products that promote rural economies and forest health.

I have been with the U.S. Endowment for Forestry and Communities (the Endowment) for more than 6 years where I have focused on bringing innovation to the forest sector and accelerating the commercialization of those innovations. Prior to that, I served as the CEO of the Society of American Foresters, the professional society representing foresters in the United States.

While each organization is unique, we find few organizations with roots that compare to those of the Endowment. We are a not-for-profit, public charity chartered at the requests of the governments of the U.S. and Canada as a result of the Softwood Lumber Agreement of 2006. That long-running dispute over softwood lumber production and its export/import, in this instance, led to what we believe is the only time in the world when a not-for-profit was created and funded as a result of a trade settlement between two sovereign governments.

The Endowment was granted a one-time $200 million perpetual endowment with interest and earnings to be dedicated to sustainable management of forests and economic vibrancy of the rural communities nested within or adjacent to those forests. We are a catalyst for innovation that invigorates forest-rich, rural communities by keeping working forests as forests for all their environmental, societal, and economic benefits and values. The Endowment works collaboratively with partners in the public- and private-sectors to advance systemic, transformative and sustainable change for the health and vitality of the nation's working forests and forest-reliant communities.

The forest sector represents a $300 billion/year economic impact in the U.S. and directly employs nearly one million people. As this Committee is aware, many of the forests that sustain this sector are in trouble. Almost ¼ billion acres—fully ⅓ of our forestland is at risk of catastrophic wildfire. Forests are also under threat from insects and diseases. Invasive species infest almost 40 percent of forested acres. Therefore, we focus on creating markets. When there is demand for forest products, the costs of restoring forest health is significantly less as we can conduct management actions that improve forest health and pay for that work by selling the byproducts of those efforts for various uses. Markets bring value to forests, and we keep things we value.

Some people think that harvesting trees is inherently a bad thing, but that is just not true. If we sustainably manage our forests, we all benefit. A recent study of forests in the southern U.S. concluded that as demand for forest products increased over the past 50 years, landowners responded by keeping their land and more than doubling their forests' productivity. The ability to build wealth from forestlands encourages investment in forests resulting in multiple benefits to all stakeholders and constituents. By demonstrating economic value creation, we reduce the incentive to convert our forests to other uses. Markets, old and new, are vitally important to sustaining forests.

Developing new markets, displacing current technology, getting people to think differently about forest products, these are daunting challenges for the forest sector. While we have solutions to many of today's environmental challenges, getting them to market requires overcoming many obstacles. At the Endowment, we are finding opportunities to bring together government scientists, university researchers and the private-sector to accelerate the commercial readiness of a number of innovative forest products including mass timber construction, low value products that utilize forest restoration materials, and one of the most exciting opportunities, cellulosic nanomaterials (CN).

The Potential of Cellulosic Nanomaterials

We are finding incredible applications for cellulosic nanomaterials made from the tiniest parts of trees. These materials will play a vital role in solving challenges facing the planet. Cellulosic nanomaterials (CN) are a new class of materials valued for their mechanical properties, sustainability, large-scale production potential, and low cost. At the nano-scale—about $1/100{,}000$ the width of a human hair—cellulose has novel properties. To give context the head of a pin is 1 million nanometers wide, and we can make crystals of CN that are just 6 nanometers wide. When we get to the nano-scale for many materials, strange things start to happen. For example, nano gold is no longer a golden color, it can be red or pink. In the case of cellulose, these nanomaterials are as strong as steel with only 1/5 of the weight. Making these materials is like making paper, yet more refined. Once we have the CN, they can be used in numerous material applications previously closed to forest products.

Some other nanomaterials have incredibly exciting properties but are just not ready for commercialization as they have only been produced at very small scales. That is not a challenge for cellulosic nanomaterials. While some nanomaterials are talked about in gram quantities, we can produce tons of cellulosic nanomaterials. Safety has also been a primary concern. Researchers at Virginia Tech, American University, Oregon State University, Rice University and others are studying the environmental and human health impacts of these materials and have many encouraging findings. In fact, the Endowment led a consortium that pooled together the resources of several industrial partners to conduct the research necessary to obtain Food and Drug Administration (FDA) reviewed generally regarded as safe status (GRAS). We submitted the necessary notification to FDA earlier this month.

Adding cellulosic nanomaterials to auto parts will make them stronger yet lighter resulting in improved gas mileage and reducing greenhouse gas emissions. A researcher at Georgia Tech is working on reinforcing fiberglass-based auto parts with cellulosic nanomaterials achieving 18–20 percent weight reductions with minimal additions of CN. Researchers at Michigan State University are making packaging that behaves like plastic but is a 100 percent biobased material that is fully biodegradable. Researchers at Purdue University can make lighter-weight bullet-proof glass from CN. Flexible microchips are being made at the University of Wisconsin and are projected to be much lower cost than competing materials.

Researchers at the University of Maine are working on several innovative products. One scientist and his team are developing a replacement for gypsum board that would be made from saw dust and CN fibers that act as the biding agent. This new type of board will be lighter weight, will not have chemical additives associated with negative human health, and will have greenhouse gas emission profiles significantly lower than products currently on the market. Another researcher at Maine is developing a replacement snack package that would be fully recyclable and biodegradable. Imagine no more potato chip bags by the side of the road, in our forests, or our streams.

CN can be used in 3D printers, reducing the use of plastics and opening new applications in the biomedical field as these materials are biocompatible. CN materials have the power to block the sun. Using these findings researchers are exploring topical sunscreen applications that will not absorb into the human body. Since CN is benign in the environment, a sunscreen produced from these materials can eliminate a known impact to marine ecosystems. Researchers are investigating improvements to lithium ion battery technology that could theoretically double storage capacity. Imagine doubling the range of current electric vehicles using a sustainable, renewable forest product.

Another interesting application for cellulosic nanomaterials involves concrete. Gravel, sand and cement are the basic ingredients of concrete. We use it everywhere. Four trillion tons worldwide, in fact. But concrete is the source of five to eight percent of the world's greenhouse gas emissions because it takes a lot of energy to make cement. To make cement, one must first heat limestone to more than 2,600° Fahrenheit, which takes a lot of energy, which produces greenhouse gas emissions. That hot rock itself releases even more emissions from the carbon stored within. Since the world uses so much concrete, even a small reduction in greenhouse gas emissions can go a long way. That is where cellulosic nanomaterials can help. When we add a tiny amount of this material to the mix, we can reduce emissions from concrete production by 18 to 20 percent.

Concrete requires near complete hydration, without going too far. If concrete is made with too much water, it will crack; not enough water and it won't be strong enough. Adding just one percent cellulosic nanomaterials increases the hydration of concrete. The CN acts like a straw and carries water more completely through the concrete mixture. Think about pancake batter. Pancake mix often has dry lumps even after adding liquids. One might expect after adding milk and eggs the dry in-

gredients would mix in easily. But, for some reason they don't. Something similar happens in concrete; yet, by adding CN we get better hydration. This increased hydration makes the mix 18 to 20 percent stronger. We can have stronger concrete, and since cement is the largest source of CO_2 emissions from concrete, we can reduce the amount of cement by about 18 to 20 percent and we significantly reduce CO_2 emissions.

Public-Private Partnerships

Listening to all these exciting end use applications for CN, you may be wondering is there anything you can't make from CN? There may be some things we cannot make as cost effectively, but we truly can make almost anything from forest products. At the Endowment we are overcoming the obstacles to commercialization by bringing together a public-private partnership to advance this technology. Absolutely none of the progress mentioned would be possible without the financial, technical and scientific contributions provided by the men and women of the USDA Forest Service, and more specifically, the agency's Forest Products Laboratory (FPL). Together with FPL we have formed a public-private partnership known as P3Nano that is combining the strengths of the premier Federal laboratory working on forest products with leading researchers and the companies that are making these products. Together we are exploring ways to ensure safety, reduce the costs of production and explore end use applications that leverage the unique properties of CN. The advances made would not be possible without the contributions of the Forest Service.

Government research is critical at so many stages of the scientific process, but it is even more critical when it comes time to overcome what is known as the valley of death. When scientists make new discoveries that hold great promise there is often initial interest in funding that explores the potential of the discovery. There is often funding available when that product is ready for commercialization. The valley of death in between is often short of resources to take that initial discovery to successful commercial products. P3Nano is working hard to bridge that valley, trying to ensure that the most promising of these applications make it to your home to improve your life. It is incredibly hard work and would not be possible without the contributions of the USDA Forest Service and their Research and State & Private Forestry programs.

Mass Timber

Mass timber is another area where the Endowment is collaborating with partners to build the market for these innovative forest products. In December 2018, the International Code Council voted to allow wood structures as tall as 18-stories from the current six-story limit. What makes these buildings possible—and safe—is cross-laminated timber (CLT) and its kin: nail- and dowel-laminated timber, mass plywood panels, and laminated veneer lumber. All these mass timber engineered wood products use the same principle as plywood. Laminating layers of wood with the fibers at right angles creates a strong material with good acoustic, seismic, thermal, and fire performance.

Getting a code change that allows for 18-stories took a concerted effort by, among others, the USDA Forest Service (through collaborative efforts of its State & Private Forestry as well as Research and Development divisions), the American Wood Council (which promotes the use of wood through regulatory and public policy efforts), the Softwood Lumber Board (a "commodity check-off" research and promotion program initially envisions by the Endowment), WoodWorks (a nonprofit industry program focused on education and project support) and the U.S. Endowment for Forestry and Communities as well as a host of others. Building more and taller buildings from wood has numerous benefits. Tall wood buildings sequester carbon. Steel and concrete based buildings have significant CO_2 emissions. More use of forest products brings more value to those products and the forests that grow them. More value in the forest provides landowners with incentives to keep their forests as forests and sustainably manage them. More value for forest products makes it easier for the USDA Forest Service to reduce forest health threats as the management activities often produce lower value material needing a market. Innovation in forest products will help create the markets we need to more fully restore forest health across all our forest lands.

Torrefaction

At the Endowment we are constantly on the search for innovation in forest products. Torrefied wood is an innovation that allows for the lowest value material to find a home in markets that will make a difference. Torrefied wood is a process where wood is roasted at relatively low temperature in a low oxygen environment. The resulting material has significant advantages over the raw biomass used in the

process. Torrefaction reduces moisture, increases energy density and develops a product that stores and transports far better than untreated biomass eliminating some of the logistical hurdles that make low value biomass from restoration efforts a little more valuable.

The Endowment's Restoration Fuels project in John Day, Oregon is the first, commercial scale torrefaction facility in the U.S. and the last stage in the Endowment's and its collaborators' efforts to commercialize this technology. In addition to proving the technology, this effort is designed to help open a large-scale market for forest restoration residuals and open the door to development of additional carbon products that can be produced from thermo-chemical treatment of biomass. This facility will not only serve to help develop the utility market for an advanced renewable fuel, it will serve as a test bed for other companies through our collaboration with the Forest Products Laboratory, the National Renewable Energy Lab and over a dozen research institutions around the country.

Summary

We are collaborating in Yreka, a small town in northern California at the foot of Mount Shasta. Wildfire is a real threat there, so the community wants to remove some of the small, dying and dead trees that are choking the forest, but that is expensive to do. These trees have little to no commercial value, so they cannot "pay their way" out of the woods. Cellulosic nanomaterials are emerging as a new market for low value wood, a market that will make it economical to improve forest health, protect the town, and create jobs. The people of Yreka see the possibilities, so they plan to install the first bridge deck in the world reinforced with cellulosic nanomaterials. Later this spring, community volunteers will conduct a test of this reinforced concrete. We will bring the concrete truck, they will pour the concrete, and all of us will be working together to build not just better infrastructure and a better community but a better, cleaner, greener world. To show our commitment to these efforts the Endowment conducted the largest commercial application of cellulosic-infused concrete when we replaced a more than 40 year old asphalt parking lot at our headquarters in Greenville, SC. The results are real.

Cellulosic nanomaterials, and other innovative forest products are going to make an impact. They will be part of flexible electronics, 3D printing, more sustainable packaging, new-age composites for everything from tennis rackets to rockets. We will build tall buildings with wood, provide markets for the byproducts of forest restoration, and reduce CO_2 emissions from several industries. Forest products are going to contribute to a sustainable future, and it all comes back to trees and the forest. Markets like cellulosic nanomaterials, mass timber and others can help us demonstrate the known value of forests. When we value forests, we keep them instead of converting them for development, and we are encouraged to promote long-term stewardship of those forests. Good stewardship reduces risks from catastrophic wildfire, insects and diseases. It promotes the health of our watersheds and the sustainability of our planet. Even the tiniest bits of them can make a giant contribution. Thank you for the opportunity to testify before the Committee.

The CHAIR. Thank you, Mr. Goergen. We appreciate your comments.

Ms. Cover, you may begin.

STATEMENT OF JENNIFER S. COVER, P.E., PRESIDENT AND CHIEF EXECUTIVE OFFICER, WOODWORKS—WOOD PRODUCTS COUNCIL, SAN MARCOS, CA

Ms. COVER. Thank you. Good morning, Chair Spanberger, Ranking Member LaMalfa, and Members of the Subcommittee. I appreciate the opportunity to be here today to testify about innovative wood products. I would like to start by thanking the Committee for enacting the Timber Innovation Act in the 2018 Farm Bill.

As mentioned in the introduction, I lead the WoodWorks program, which is a nonprofit entity that removes barriers to wood utilization commercial construction. We have provided assistance on about 700 mass timber projects that have utilized mass timber for some aspect of their design, and we have done this for no cost, because we are a nonprofit entity. We also provide about 300 educational opportunities throughout the U.S. annually, which helps

architects and engineers become more familiar with designing with this type of material.

WoodWorks is a true public-private partnership in that industry funding matches government funding at about a 3:1 ratio. Our primary industry funder is the Softwood Lumber Board, an agricultural check off program, and our primary government funder is the U.S. Forest Service. Chief Christensen has been a huge key supporter of the WoodWorks program, and together, we have accomplished some amazing things, including opening up an entire new market for wood products in blast resistant design.

I would like to draw your attention today to the importance of supporting the use of innovative wood products in the built environment. Let's start with what these products are. Mass timber products are large structural panel members that can be 30′ to 60′ in length. For example, a floor system that can be just dropped right into place on a construction site. And these materials are made up of much smaller diameter materials, whether it is veneer or 2x's or 1x's that are built up and not—these typically come from smaller diameter trees, and that is really where the win-win situation comes from in terms of forest health and end-use construction benefits.

Why are these products important? First, from a forest health perspective, mass timber has the ability to change the conversation around landscape restoration efforts. Mass timber can help keep our private lands forested because it creates a new—sort of a brand-new market that is high value for the materials coming off of our forests. Additionally, on our public lands, it creates a new opportunity that is an economical driver to help increase the cost recovery for the Forest Service on their restoration projects. Additionally, mass timber manufacturing will create new high-tech jobs in these rural communities, and this could really change the face of some of these communities. These manufacturing facilities will offer opportunities such as computer and software engineering related to CAD and building information modeling, and that provides opportunities that aren't typically in these types of areas.

Another significant benefit of building with mass timber is the carbon sequestration attributes of the material. I have included an example in the testimony packet here today of the 87,000′² building on the campus of UMass Amherst, and on this project, we calculated the carbon impact of using innovative wood products instead of alternative more fossil fuel-intensive materials, and we found that it was equivalent of being able to pull over 500 cars off the road for an entire year. If we think about this, it is scale. This is one building, and taking this to scale, it is really quite impressive what the impact could be.

I have touched on the clear tangible benefits to our society, the improved forest health, the carbon reduction in our atmosphere, as well as increased and better jobs for rural communities. But what is driving the uptake of mass timber in the marketplace is really the benefits from the design community's perspective, and this includes the renewability of the material, the aesthetic appeal, the speed of construction, being the three main ones.

The opportunity that we are looking at is about 17,000 projects are built every year in the U.S. that do not utilize wood construc-

tion, but there is really no code limitation on those buildings. Those buildings could be wood by the building code requirements. The only thing really keeping these buildings from being built in wood is perception and education. Mass timber is relatively new in the U.S., but internationally, this is not a new material. It has been around for 30 years. One manufacturer in Europe had told us that last year alone, they supplied 500 projects with cross-laminated timber. And to put that in perspective, here in the U.S., we had 38 projects go to construction utilizing cross-laminated timber last year. We are just at the very beginning of this building revolution here in this country.

WoodWorks has been working hard to identify and resolve hurdles to market adoption, and having the support of the agricultural check off program and the U.S. Forest Service has been really critical to our success.

In conclusion, I would love to see our legislative leaders commit to a more sustainable built environment. I would like to ask each of you to consider taking the lead by building government structures in your states using mass timber. WoodWorks will be there as a resource to help those design teams along at no cost.

Thank you for your time and consideration this morning.

[The prepared statement of Ms. Cover follows:]

PREPARED STATEMENT OF JENNIFER S. COVER, P.E., PRESIDENT AND CHIEF EXECUTIVE OFFICER, WOODWORKS—WOOD PRODUCTS COUNCIL, SAN MARCOS, CA

Introduction

Chair Spanberger, Ranking Member LaMalfa, and Members of the Subcommittee, thank you for the opportunity to submit testimony to you today about innovative wood products. My name is Jennifer Cover and I serve as the President and CEO of WoodWorks. I would like to start by thanking the Committee for enacting the Timber Innovation Act in the 2018 Farm Bill.

WoodWorks is a nonprofit entity that provides project support to the design and construction community that is seeking a more sustainable way to design. At no cost, we help engineers, architects, developers and general contractors navigate both the design and construction process when using innovative wood structural systems. Last year alone we provided technical assistance on over 350 building projects, helping designers successfully construct offices, schools, hotels, and commercial projects using innovative wood solutions. We also offer over 300 educational opportunities annually around the country.

WoodWorks is a true public-private partnership where industry matches government funding on a 3:1 ratio. Our primary industry partner is the Softwood Lumber Board, an agricultural check off program funded by the softwood lumber industry. Our second key funding partner is the U.S. Forest Service. Chief Christiansen has been a huge champion and supporter of the WoodWorks program and we have made some amazing advancements with their support.

Why Innovative Wood Products in the Built Environment?

Mass Timber products are large wood structural panel members, like a 30′ long floor panel that can simply be dropped into place. These large panels are built up from much smaller materials which is what creates this incredible win-win situation with forest health and end-use construction benefits. A few of the materials that are considered mass timber are CLT—cross laminated timber, NLT—nail laminated timber and DLT—dowel laminated timber.

Improved Forest Health

Mass timber has the ability to change the conversation around landscape restoration efforts. Mass timber usage creates additional market demand for multiple products, which in turn keeps private forests as forests, and makes a greater percentage of forest-types economical. That can, in some regions, lead to better cost recovery on restoration projects, such as those that are a focus of the Forest Service to reduce the risk of wildfires. There are a few manufacturers that are currently exploring the

use of alternative species such as Ponderosa Pine or that are looking at the inclusion of insect damaged materials and both are showing promising results. These types of advancements can start to create a high-value end-use market for materials that have historically been of low value.

WoodWorks is working with the Forest Service to trace material from restoration thinning on a National Forest through the manufacturing process and into a completed wood building.

WoodWorks has just started to engage in the French Meadows projects, a unique partnership between the Forest Service, The Nature Conservancy, Placer County Water Agency and numerous others, on the Tahoe National Forest. We are working to identify ways in which material coming out of the forest can find its way into mass timber. Tree species in the Sierra Nevada are currently being tested to confirm that they meet the criteria of use in mass timber. Should the results of this testing go as expected, it has the potentially to open up a significant volume of lumber for use in mass timber in an area where there is a significant need for forest management.

Increased and Improved Rural Jobs

Additionally, mass timber manufacturing will create high tech jobs in rural communities which could change the face of some of these communities by offering opportunities that are not currently an option in some of these areas. Such as computer and software engineering roles for CAD and building modeling as well as building layout.

Carbon Sequestration

Another significant benefit of building with mass timber is the carbon sequestration attributes of the material. As a tree grows it sucks carbon dioxide out of our air and locks it into the wood fiber where it remains stored for the lifetime of the building which is typically more than 3 or 4 decades and even longer if the material is reclaimed or re-used. Meanwhile, the regenerating forest continues the cycle of carbon absorption. Additionally, wood products typically require less embodied energy to manufacture than other building materials, and most of that comes from renewable biomass (*e.g.,* bark and other residual fiber) instead of fossil fuels. Substituting wood for fossil fuel-intensive materials is a way of avoiding GHG emissions. Life cycle assessment (LCA) studies consistently show that wood outperforms other materials in this area (Sathre and O'Connor, 2010). When using a carbon calculator to evaluate the environmental impact, we often see that the use of wood as opposed to a more highly fossil fuel intensive material in a typical 100,000′² multifamily project can have the environmental carbon impact equivalent to pulling 500 cars off the road for an entire year. A specific example is for the 87,000′² student building at the UMass Amherst, we calculated that that the use of innovative wood products had the environmental carbon impact equivalency to pulling 535 cars off the road for a year. When you think about the impact of this at scale, it is quite impressive. Especially when you consider that this benefit is currently often overlooked but something we are now actively educating about.

Market Drivers

I have touched on the clear tangible benefits to our society—improved forest health, reducing the carbon in the atmosphere and increased as well as better jobs for rural communities, but what is driving the uptake of mass timber in the marketplace is the benefit from the design community's perspective.

The key market drivers from the design community's perspective are:

1. Renewability: It is the only renewable and sustainable building material that is literately grown by the sun and acts like a sponge sucking carbon dioxide out of our air.
2. Aesthetic appeal: owners are finding mass timber office buildings are renting quicker and at premium rates. Additionally, there is scientific evidence linking exposed wood to healthier work and learning environments.
3. Speed on construction: Most projects are finding that mass timber projects can be built on average 25% faster than projects built with what would be considered more traditional materials. Please see attached case study *Candlewood Suites* for more specific information. In this project the structural system went up 37% faster and the overall project was 20% faster than their historical projects with traditional materials.
4. Field labor shortages and safer working conditions: The construction industry today faces labor shortages. Since much of the work for mass timber buildings

is done in a factory the labor is shifted to a controlled environment and there are fewer laborers needed on site.

5. Elevated structural performance: mass timber is a lighter and more ductile material so [it] performs better in earthquake and high wind situations

Building owners are achieving all these benefits for similar or less overall costs—this is why WW has already helped on almost 700 projects using MT for some aspect of their design.

Mass Timber Projects In Design and Constructed in the U.S.

(December 2019)

This has been an exponential growth experience. WW hosted the first CLT symposium in 2013 and that year we had a half a dozen designers reach out to us to try a project, now just 7 years later we are helping on 458 projects.

The only thing keeping buildings from being built in wood is perception and education. To put U.S. mass timber momentum in perspective—if I just pull CLT, there were 38 CLT buildings constructed last year in the U.S. And if we look to Europe, one manufacturer alone supplied over 500 projects to a region not much larger than Texas. There are 17,000 buildings that are currently being built annually within the building types that WoodWorks focuses on. These buildings are currently being constructed with materials that are more fossil fuel-intensive than wood and all those buildings could be built using wood by code. There is an incredible conversion opportunity in front of us.

Hurdles

The role of WoodWorks is to provide project level support but also to identify hurdles to market adoption and remove them.

Blast Testing

When we realized that wood was cut out of all conversations on military projects because of weak performance in blast applications, WoodWorks set out on a joint project using funds authorized by the Timber Innovation Act with the FS to remove that hurdle. We conducted blast testing at Tyndall [Air F]orce [B]ase and are now working with the PDC to get the new guidelines written into the military building code. This opens an entire new market for mass timber solutions, and we aren't stopping there. Our next step is to help with the application and to work with those designing military projects to educate them on these new opportunities.

General Contractor Resistance

Another hurdle we ran across was with the general contractors and installers of mass timber. Often the architect, engineer and building owner were all extremely

excited to move forward with an innovative wood solution and it would be the general contractor that would be reluctant. The response was often, that they were unfamiliar with the material, they did not know how to price the job, how to sequence their sub-contractors or how to handle the material. With the support of the FS we launched an educational program within a year of conceiving the vision and I am proud to say that our first workshop in Seattle sold out within the first 2 weeks and we had to move it to a larger venue where it sold out again.

Engineering Education

Currently 100% of the Universities that offer structural engineering degrees in the U.S. require that their students take steel and concrete design but less than 50% even offer a timber design course and if they do it is usually an elective. This may have made sense when wood was only used in single family homes but with the advancement of the building codes to the point where the International Code Council now allows up to 18 story multifamily and commercial structures with mass timber, there is a serious knowledge gap that WoodWorks is filling to make sure architects, engineers and general contractors have the resources they need to successfully build these projects.

Conclusion

We are a small program, but we are also nimble which allows us to meet the needs of this quickly evolving innovative wood product market. Having the support of the agricultural check off program and the U.S. Forest [S]ervice has been critical to our success in meeting the needs of this quickly evolving industry.

Supporting mass timber means supporting a building solution that:

1. Reduces the environmental impact of the built environment by sequestering carbon.
2. Provides a sustainable and competitive option for developers.
3. Creates a healthy and desirable work and learning environment for occupants.
4. Increases and improves rural jobs.
5. Improves the health of our forests by creating an economic incentive for landscape restoration [related efforts].

I would love to see our legislative leaders take the lead by committing to build several government structures more sustainably by using mass timber. It does not need to be preferential treatment of one material over the other, just a level playing field that encourages the consideration of materials that historically have not been given an opportunity to compete. I hope you will consider encouraging government structures in your states to consider mass timber and just know that WoodWorks is here to help those design teams if they need it for no cost.

ATTACHMENT 1

Case Study—Candlewood Suites®

Construction Advantages Sell Hotel Developer on CLT

CLT builds faster and more safely with fewer workers

From the outside, it looks similar to the thousands of other hotels built across the country in 2015. But when you learn that this project was completed 37 percent faster and the structure built with 44 percent fewer person hours than similar hotels, it warrants a closer look.

Developer Lendlease used cross-laminated timber (CLT) to build the four-story, 62,688′2 Candlewood Suites® hotel at Redstone Arsenal, a U.S. Army post near Huntsville, Alabama. Completed in December 2015, the project exemplifies one of the biggest benefits of CLT-construction efficiency.

The 92-room structure, the first hotel built in the U.S. using CLT, is part of the Privatization of Army Lodging (PAL) program, a 50 year public-private partnership between the U.S. Army and Lendlease, a well-known international development company. PAL is designed to provide quality private-sector hotel lodging for soldiers and guests on U.S. Army installations and joint bases. Along with this property, Lendlease owns PAL hotels on more than 40 military installations. The hotels are operated by IHG®, the InterContinental Hotels Group.

Lendlease is no stranger to CLT construction. In 2012, the company's Australian office built Forté, a ten-story CLT residential building in Melbourne. Even so, the decision to use CLT on this U.S. project was not automatic. As owner, developer, design-builder and asset manager for all lodging in the PAL program, Lendlease has

built the majority of its new hotels with conventional steel stud framing. So, before Jeff Morrow, Program Manager for Lendlease, could convince the team to use CLT for the Redstone Arsenal property, he thoroughly researched the idea and presented the potential opportunities of using CLT for this commercial application.

"As an architect, I was initially skeptical of the concept," said Charles Starck, Senior Architect/Design Manager of Project Management and Construction at Lendlease, "but the more I learned, the more I realized this could be a game changer. It's not often that an architect gets a chance to get in on the ground floor of something that's going to have such a profound impact on the industry. Once I realized what fundamental change we could affect with CLT and heavy timber, I was on board."

Constructability

Ease and speed of construction are two of the greatest advantages afforded by the CLT building system. The Lendlease team not only erected the structure 37 percent faster with 44 percent fewer person hours than their typical hotels, they did so using just an 11-person crew—three experienced carpenters and eight laborers. The laborers were formerly unemployed veterans who were trained at the Redstone Arsenal jobsite.

Construction speed was increased mainly because CLT panels arrive prefabricated, which greatly improves efficiency. "Coordination with the CLT supplier allowed us to control the sequence; the trucks arrived loaded with panels in the order we needed them," said Bill Tobin, Vice President and Master Superintendent at Lendlease.

Crews were also able to work through everything an Alabama winter could dish out. "We worked in the rain almost half the time," added Tobin. "That's the beauty of CLT construction: we could work safely in almost any condition and in all types of weather. We just made sure to measure moisture content of the wood before applying finishes to the structure." Most CLT manufacturers will provide a sealant on panel edges and often on the faces. Because the end grain of the lumber is not taking the brunt of the weather exposure, CLT panels do not readily absorb water that can accumulate during construction.

Jobsite safety was another benefit, said Tobin. "Lendlease is extremely safety conscious. CLT panels allowed us to erect walls quickly and safely, with very few crew members working in the radius and swing fall of the crane." Erection crews assembled safety devices and handrails to panels while they were still on the ground so, as each connecting floor panel was lifted into place, the area was immediately safe for workers. Once the floor deck was installed, crews enclosed the exterior of the building before coming back to install the interior walls. This allowed them to eliminate the potential for falls from elevated heights to the exterior as quickly as possible. The approach enabled the team to safely install almost 400′2 of floor every 20 minutes with just three workers.

The fact that eight members of the crew could be trained on site opens far-reaching possibilities for Lendlease. In fact, the industry's shrinking skilled labor force favors CLT construction. A 2015 survey of construction personnel executives [1] warned that labor shortages could slow future construction; 24 percent of respondents said they would be unable to bid more work and 32 percent said they would experience slow growth if their companies could not reasonably meet the need for skilled labor and tradespeople. "It is definitely becoming harder to find people to build," said Morrow. "CLT gave us the opportunity to build this quality building with fewer people."

The Case for CLT Construction

PAL Portfolio	Typical New PAL Hotel (Actual *)	Redstone Arsenal (Actual)	Difference
Gross square feet (sf)	54,891	62,688	+14%
Average # of employees	18 (peak 26)	10 (peak 11)	−43%
Structural duration (days)	123	78	−37%
Structural person hours	14,735	8,203	−44%
Structural production rate/day	460 sf	803 sf	+75%
Overall schedule	15 months	12 months	−20%

* PAL New Build Hotel Historical Average.
Source: Lendlease.

[1] Wilson, K. and P. Warner, FMI, *Craft Labor Recruiting and Retention 2015 Survey Report.*

Project Overview

Candlewood Suites at Redstone Arsenal

Location: Redstone Arsenal, AL
Owner: Lendlease • New York, NY
Architect: Lendlease • Nashville, TN/Leidos • St. Paul, MN
Project Engineer: Schaefer Structural Engineers • Cincinnati, OH
CLT Engineer and Fabricator: Nordic Structures • Montréal, Quebec
General Contractor: Lendlease • Nashville, TN
Completed: December 2015

Cost Considerations

Since Lendlease owns and is responsible for maintaining the Candlewood Suites at Redstone Arsenal, ongoing cost was a key consideration. "In the past, we've used light-gauge metal stud framing for the hotels on military installations," said Morrow. "We cost-modeled the CLT system against data collected on our buildings constructed with metal studs and found we could save with the CLT, mostly because we were able to frame the building so much faster."

The cost analysis was not an apples-to-apples comparison. Labor costs were higher at Redstone Arsenal than at some other military installations, which further added to the advantage of CLT for this project. "CLT was a more expensive material but installation was faster, so we thought this project would be our best opportunity to take advantage of CLT's overall cost effectiveness compared to traditional framing materials," Morrow said. "In addition, Lendlease will realize additional hotel revenues from the earlier completion, which is another benefit of using CLT." Faster construction results in lower capital costs and quicker hotel occupancy.

While some designers choose CLT out of a desire to expose the wood structure to the building's interior, that was not the case for this hotel as it has no exposed wood. The design team made this decision in part so Lendlease could simplify the approval process, but also to meet IHG's aesthetic brand. With a Type IIIB structure, wood exposure is possible but would have changed the methods for proving fire resistance. "Some in the industry think that CLT is best used for pretty, wood-focused applications. However, it can be just as effective for core and shell structural systems, even when it is buried in finishes and clad, because it is easy, simple and

speedy to install," said Tobin. "Redstone taught us that CLT has a place in the market for non-exposed, utilitarian applications."

Starck agreed, saying, "We've proven at Redstone that CLT can be made to work economically in the high end of the low- and mid-rise sectors. Because this represents a large percentage of construction, this is where we can make some serious changes in how we build buildings."

Mass Timber Structure

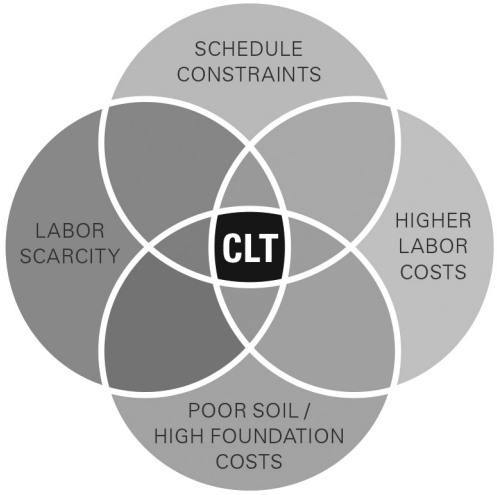
As is typical of a mass timber structure, the four-story, rectangular slab-on-grade hotel used CLT for all exterior walls, parapet walls, interior walls, elevated floor slabs and roof deck. The structure also utilized glulam columns and beams.

While thicker CLT can span up to 25′ without beams or columns, the 3⅛″ thick roof panels of this Candlewood Suites spanned 16½′. In a CLT structure, floors can rest directly on columns without intermediate beams at panel edges because of the bi-directional capacity afforded by CLT's cross-lamination. Redstone's floor panels were 7″ thick and walls came in a variety of thicknesses, with 3″ and 4″ thick interior and demising walls and 4″ thick exterior walls. Wall height at each level was 10½′. The entire stairwell assembly—including shaft walls (which were protected with gypsum to meet the 2 hour fire-resistance requirement), stringers, treads, risers, support beams and landings—was composed of CLT and glulam.

Altogether, the project used 1,557 CLT panels, 11 glulam columns, 44 glulam beams and more than 200,000 CLT fasteners. The sizable number of fasteners was due in large part to the military's blast resistance requirements and is not typical for most CLT construction.

CLT's Sweet Spot

Use of CLT makes the most sense when a project faces at least three of four common conditions.



Building Design

Energy efficiency, moisture and sound protection are always considerations for quality builders. But they were especially important on this project since the builder, Lendlease, is also the owner of the hotel.

"Like most architects, moisture concerns keep me up at night," joked Starck. "I would rather be able to sleep well, so we took a few simple steps to keep things dry inside."

As with all multi-story wood construction, the team had to consider shrinkage and swelling due to fluctuations in environmental conditions. "But shrinkage was a not a major concern for this project," said Doug Steimle, P.E., Principal at Schaefer Structural Engineers. "CLT shrinks very little in any direction since most of the shrinkage in the wood has taken place during the drying process, prior to panel lay-up. This reduces the potential for any further dimensional changes once the panels are in place."

They also had to consider the differential movement between CLT and other materials. This Candlewood Suites featured a full-height, four-story concrete brick veneer with a continuous drainage plane behind the cladding. "To overcome the prescriptive limits for the height of the brick veneer, we used an engineered concrete brick product that is self-supporting up to 85′," said Steimle. "This means we didn't have to support the brick at each floor, which would have complicated the building envelope design."

Typical detailing includes supporting the brick at each floor level, increasing the number of possible locations for bulk water intrusion. The advantage of supporting the brick at each floor is that shrinkage can be isolated at each level and doesn't accumulate at the top of the structure. "But not supporting brick at each floor typically forces us to address the cumulative change between the wood structure and the brick veneer at either the top or bottom of the full-height wall, which is not always easy," continued Steimle. "Because there was so little wood shrinkage, this was not a difficult task with CLT. The anticipated differential movement for the four-story wall was less than ¼″."

They also installed a weep and vent system to ensure air circulation behind the cladding. The continuous brick veneer allowed them to maintain the drainage plane from top to bottom without being interrupted by shelf angles attached to the structure at every floor. "That was unusual," said Starck. "You don't see a lot of buildings with a continuous drainage plane like that. Our goal was to make sure that any condensation which does get into the envelope has free passage down to [the] weep holes, where it can exit the system."

Force Protection

Candlewood Suites at Redstone Arsenal required extensive design collaboration between Lendlease and the U.S. Army Corps of Engineers Protective Design Center (USACE PDC). Because it is located on a U.S. military base, the structure needed to meet Anti-Terrorism and Force Protection (ATFP) standards. Since CLT is not listed as a conventional building type for meeting ATFP standoff, blast resistance and progressive collapse, the design team needed to seek approval from the USACE PDC. Lendlease, their design consultants and the CLT manufacturer supplied extensive engineering analyses to prove compliance with the standards.

CLT Overview

CLT is an innovative engineered wood product originally developed in Europe, but gaining popularity among North American building designers. It can be used for walls, floors and roofs of both residential and commercial structures. CLT panels consist of layers of dimension lumber or structural composite lumber (SCL) glued together under pressure with the grain of the boards in one layer running perpendicular to the grain in adjacent layers. CLT is typically manufactured in three-, five-, seven- and nine-ply panels up to 10′ wide and 64′ long, and then cut to exact specifications. Panels are engineered for specific use in a building and can be pre-cut with window and door openings.

CLT is dimensionally stable and strong, creating an effective lateral load-resisting system. Panels perform exceptionally well in multi-story applications.

Tobin added, "We didn't use intermediate weeps or drains except around the flashing details of windows and penetrations. We used the mechanical flashing plus a peel-and-stick counter flashing as well as a fluid-applied membrane."

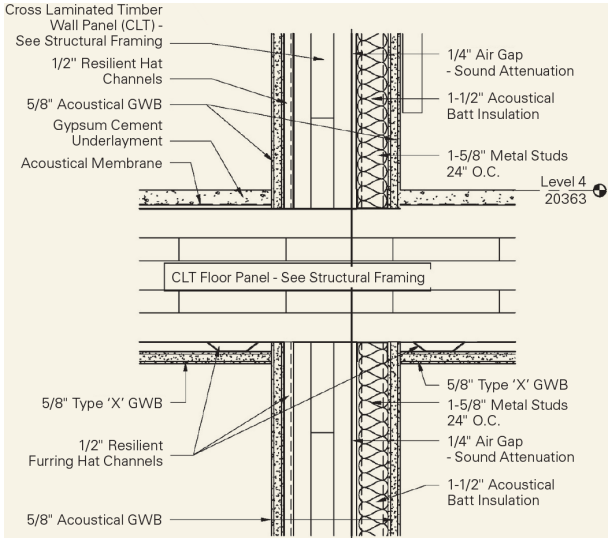
Energy efficiency was also important to Lendlease. By design, CLT systems are intended to provide a tighter building envelope with less air infiltration than conventional light-gauge steel framing. CLT panels for the hotel were manufactured to a tolerance of less than 1⁄16″, which is far tighter than anything that can be achieved in the field using conventional construction and materials. "I think quality control was much easier to manage in this building," said Tobin. "It was simple to train the crew on correct installation and, since the panels were true, it gave us a tighter core and shell."

To further improve energy performance, Lendlease installed 1½″ of mineral wool as continuous insulation. The high R-value and airtightness of this system reduced the size of the HVAC equipment required to heat and cool the building. Lendlease projects that the Redstone Arsenal Candlewood Suites will be 31 percent more energy efficient than previously-built PAL hotels of similar size. In addition, the hotel achieved LEED Silver certification.

Sound control is also critically important in hotels. On its own, CLT could not meet IHG's acoustical requirement between units. However, field testing showed

that the CLT floor and wall assemblies used at Redstone Arsenal produced a Sound Transmission Class (STC) rating substantially greater than that required by code. "The building code requires a minimum 50 STC between units, but our hotel operator requires an STC of 55 so that is what we designed for, using an assembly engineered by an acoustical consultant," Starck said. "After we completed construction and had our assemblies in place, we did some field testing. Our lowest Field Sound Transmission Class (FSTC) for the wall came in at 63. The CLT floor assembly achieved a Field Impact Insulation Class (FIIC) rating of 74, which was also substantially more than the Impact Insulation Class rating of 50 required by code." Field tests typically yield results which are one to three points lower than laboratory tests. The high FSTC rating demonstrates that this CLT assembly has better sound absorption qualities than originally determined by theoretical analysis.

Interior Wall and Floor Assembly



Source: Lendlease.

One of the issues of CLT design is choosing where to run conduit for electrical, HVAC and other utilities. Rather than routing out the CLT panels, the design team decided to run 1½″ furring strips on the inside of the assembly, adding additional insulation in the cavity and supporting a gypsum board finish. A ¼″ air gap between the CLT and furring wall allowed conduit to fit between the gypsum board and the face of the CLT panel.

Understanding the Fire Performance of CLT

Candlewood Suites at Redstone Arsenal was designed and built to IBC 2012, Type IIIB construction, R–1 occupancy (hospitality), and was also required to comply with the Unified Facilities Criteria (UFC), which incorporates the requirements of the IBC plus Department of Defense-specific and anti-terrorism provisions. While it is standard that all Candlewood Suites be sprinklered regardless of height and area, fire resistance was still a consideration because of both the occupancy and requirements of the construction type.

While it has been used in Europe for more than 20 years, CLT is still relatively new to North America and was not an approved structural material under the 2012 IBC. To use CLT at the Candlewood Suites hotel, Lendlease took advantage of Section 104.11, Alternative Materials, Design and Methods of Construction and Equipment, of the 2012 IBC. Using this code-approved procedure, Lendlease had to prove that the building had structural, fire protection and seismic resistance equivalent to the prescriptive requirements of the building code; this required extensive engineering analysis and rigorous design methodologies. Since fire-rated assemblies for CLT did not exist in the IBC, Lendlease used the Calculated Fire Resistance provisions of IBC Section 722, to determine assembly fire-resistance ratings.

A great deal of research is available on the fire performance of CLT and other mass timber products. For example, the American Wood Council (AWC) conducted a fire-resistance test on a load-bearing CLT wall in 2012, which contributed to the inclusion of CLT in the 2015 IBC. Conducted in accordance with ASTM E–119–11a (Standard Test Methods for Fire Tests of Building Construction and Materials), the test evaluated CLT's fire-resistance properties. A five-ply CLT wall (approximately 6⅞″ thick) was covered on each side with a single layer of ⅝″ Type X gypsum wallboard and then loaded to 87,000 pounds, the maximum load attainable by the testing equipment. The 10x10′ test specimen lasted 3 hours, 5 minutes and 57 seconds—well beyond the 2 hour goal.

More recently, AWC sponsored two demonstration fire tests[2] of typical residential occupancies. The test compartments were 8′ 7″ high, with a footprint of approximately 6x12′. One compartment was made with CLT walls and ceiling, and the other with CLT walls and a nail-laminated timber ceiling; both were fully protected with gypsum wallboard. After approximately 180 minutes of burning and temperatures reaching 2,000 °F, the gypsum was removed. The structural wood had remained below char temperature throughout the test, demonstrating that protected mass timber can provide adequate fire perform-

[2] American Wood Council, *Technical Data in Support of G165–PC2: NLT–CLT Compartment Fire Tests Summary,* September 2015.

ance in residential construction, even under the extreme scenario in which automatic fire sprinklers fail and fire service is unable to respond quickly.

For more information on CLT research, visit the mass timber section of the reThink Wood website (*www.rethinkwood.com*), or download the paper, CLT Research: Available and Accessible to North American Building Designers.[3]

Advantages Add Up

Quicker to build. Cost effective to construct. Quieter. More energy efficient. Easier and safer to erect. Environmentally friendly.

CLT's advantages added up.

Even with the additional requirements of blast protection, the Candlewood Suites at Redstone Arsenal demonstrates that CLT is an effective option for non-military hotels and other mid-rise projects.

"Utilization of CLT is an extremely collaborative process," said Morrow. "A lot of the success with this project was due, not only to what Lendlease did, but also to the fact that we had some very competent, able and willing partners, including Nordic Engineered Wood and Schaefer, who were both willing to help us succeed. You can't build with new materials in a vacuum; you must have good partners along the way."

Morrow added, "CLT gave us the opportunity to build a more robust, higher quality and higher performing hotel than we've built in the past. It's just better building."

[3] Podesto, L. and S. Breneman, *CLT Research: Available and Accessible to North American Building Designers*—WOOD DESIGN FOCUS, Volume 26, No. 1, 2016, *www.woodworks.org/wp-content/uploads/CLT-Research_Podesto_Breneman.pdf*.

Carbon Benefits

Wood lowers a building's carbon footprint in two ways. It continues to store carbon absorbed by the tree while growing, keeping it out of the atmosphere for the lifetime of the building—longer if the wood is reclaimed and reused or manufactured into other products. When used in place of fossil fuel-intensive materials such as steel and concrete, it also results in 'avoided' greenhouse gas emissions.

Volume of wood products used: 935,696 board feet (equivalent)

U.S. and Canadian forests grow this much wood in: 5 minutes

Carbon stored in the wood: 1,276 metric tons of CO_2

Avoided greenhouse gas emissions: 494 metric tons of CO_2

Total Potential Carbon Benefit: 1,770 metric tons of CO_2

Equivalent To:

374 cars off the road for a year

Energy to operate 187 homes for a year

Source: U.S. EPA.

Estimated by the Wood Carbon Calculator for Buildings, based on research by Sarthre, R. and J. O'Connor, 2010, *A Synthesis of Research on Wood Products and Greenhouse Gas Impacts, FPInnovations.* Note: CO_2 on this chart refers to CO_2 equivalent.

Use the carbon calculator to estimate the carbon benefits of wood buildings. Visit *woodworks.org*.

WoodWorks Case Study WW–020 • Candlewood Suites® at Redstone Arsenal

ATTACHMENT 2

POWERPOINT PRESENTATION

714 Mass Timber Building Projects

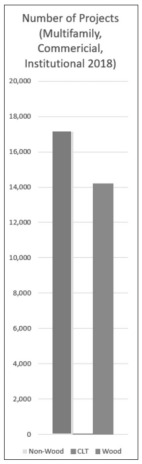
Blast Testing

Removing Hurdles and Opening New Markets

Image Credit: USDA FS FPL/SLB/WoodWorks Live Blast Testing at Tyndall Air Force Base *http://www.woodworks.org/publications-media/blast-testing-research/*.

Working closely with partner organizations, WoodWorks provides technical support to advance wood research in North America. When Lendlease began considering mass timber for what became the first CLT hotel on a U.S. army base, WoodWorks initiated blast testing research and CLT is now included in the military building code.

The CLT blast testing shows just how strong this material can be. It performed exceptionally well and Lendlease is now utilizing CLT to construct Candlewood Suites hotels and guest lodging at U.S. Army bases across the country.



Photos: LEVER Architecture.

The CHAIR. Thank you very much, Ms. Cover.

Dr. Henry, please proceed with your testimony.

STATEMENT OF JOSHUA A. HENRY, PH.D., PRESIDENT AND CO-FOUNDER, GO LAB INC., BELFAST, ME

Dr. HENRY. Chair Spanberger, Ranking Member LaMalfa, and Members of the Committee, I am grateful for the opportunity to appear before you today to discuss the key role that innovative wood products can play in strengthening rural economies and promoting healthy forest management.

My name is Joshua Henry. I am a materials chemist and the President of GO Lab, a building products company based in Belfast, Maine. Next year, our company will become the first in North America to manufacture a recyclable, renewable, non-toxic construction insulation made from softwood residuals, the byproduct of lumber production.

I am thrilled to be here because our story is one that is going to need to become more common if rural communities and economies are going to be able to succeed. GO Lab started over 4 years ago when my business partner, Matt O'Malia, and I realized that there was a suite of construction insulation products in Europe made from softwood fiber that were doing roughly $600 million in annual revenue, and yet not being manufactured anywhere in North America. The realization was both interesting and confusing to us because the technology to manufacture these products had been around for over 20 years, and had resulted in a renewable, recyclable, and non-toxic insulation that, from a performance and application standpoint, was a great fit for the North American building market.

Matt and I did not intend to become manufacturers. At the time, I was a professor in the chemistry department at the University of Maine. Matt, an architect, had founded a company that designed and built the first certified Passive Haus building in Maine, 12th in the United States, and has since grown exponentially and achieved national prominence in the field of energy efficient building design and construction.

We just wanted to answer one question: why had these products, which are both cost and logistically prohibitive to import, never been manufactured in North America? I am here talking to you today because there is no good answer to this question. In fact, what we have found out is that due to the cost of energy, raw materials, and labor in the United States, this suite of products can be manufactured and distributed here at a lower cost relative to Europe, and more importantly, can be cost competitive with all the other construction insulations on the U.S. market. That revelation led me to, somewhat prematurely, quit my job in academia and focus on bringing the technology to manufacture these products to the United States.

The other substantial motivator was the challenging situation that has transpired over the last 4 years in Maine's forest products industry. During this time, six paper mills have closed and over 5,000 jobs have been lost, resulting in $1.5 billion in reduced economic impact in this sector. Maine is the most forested state in the country, and our forests are our greatest natural resource, and they are also a large part of our identity as a state. And Matt and I felt like we had a meaningful, achievable concept for bringing new economic opportunity, jobs, and sustainability to this critical industry.

That was 3 years ago. Today, the demolition and renovation phase of GO Labs first U.S. manufacturing facility in one of those closed paper mills, the former UPM facility in Madison, Maine, is underway and at this time next year, that facility will be manufacturing the first of three wood fiber insulation composites.

We have gotten to this point thanks to a substantial private equity raise, robust support from Maine's Department of Economic and Community Development, and grants from both the Environmental Protection Agency and the U.S. Forest Service. That support has allowed us to employ many of the top manufacturing personnel from that mill. Once up and running, our operation in Madison will employ more than 120 people, generate over $100 million in revenue, and will have introduced a new value-added manufac-

tured forest product to the nation that will inevitably result in future plants in rural communities across the United States.

In closing, I should note that our success, unfortunately, is not the norm. While there are many reasons for this, two have particularly stood out as an obstacle to attracting the investment that meaningful projects like ours require. The first is the migration of our nation's economy away from manufacturing. The second is the increased concentration of wealth in the hands of very few. While I could probably write you a treatise on each topic, I will simply note that both factors have the same effect: to diminish the pool of qualified investors that have the capacity, understanding, and interest in unleashing the dormant economic potential of our rural communities.

Thank you for the opportunity to share our story.

[The prepared statement of Dr. Henry follows:]

PREPARED STATEMENT OF JOSHUA A. HENRY, PH.D., PRESIDENT AND CO-FOUNDER, GO LAB INC., BELFAST, ME

Introduction

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My name is Joshua Henry. I'm a materials chemist and President of GO Lab, a building products company based in Belfast, Maine.

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The GO Lab Story

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I am here talking to you today because there is no good answer to this question.

In fact, what we have found out is that—due to the cost of energy, raw materials and labor in the United States—this suite of products can be manufactured and distributed here at a lower cost, relative to Europe, and most importantly, can be cost competitive with all of the other construction insulations on the U.S. market. That revelation led me to, somewhat prematurely, quit my job in academia and focus on bringing the technology to manufacture these products to the United States.

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The forests are Maine's greatest natural resource.

They're a large part of our identity as a state.

And Matt and I felt like we had a meaningful, achievable concept for bringing new economic opportunity, jobs and sustainability to this critical industry.

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Today, the demolition and renovation phase at GO Lab's first U.S. manufacturing facility, at the former UPM Paper mill in Madison, Maine, is underway and at this time next year, that facility will be manufacturing the first of the three wood fiber insulation products.

We have gotten to this point thanks to a substantial private equity raise, robust support from Maine's Department of Economic and Community Development and grants from both the Environmental Protection Agency and the U.S. Forest Service.

That support has allowed us to employ three of the top manufacturing personnel from that mill. Once up and running, our operation in Madison will employ more than 120 people, generate over $100 million in revenue and will have introduced a new, value-added manufactured forest product to the nation that will inevitably result in future plants in rural communities across the U.S.

That outcome is virtually assured by ongoing changes in code requirements for energy efficiency in buildings. Motivated by a desire to reduce the operational and environmental cost of our built environment—and to contribute to our shared national objective of energy independence—states and municipalities have adopted building codes, vetted by the U.S. Department of Energy that, on average, reduce the energy consumption of new buildings at a rate of 3% per year.

But that reduction in operational energy consumption, achieved by the insulation that currently dominates the $11 billion U.S. market, is substantially offset by the energy consumed during the manufacturing process used to produce these products.

The insulating wood composites GO Lab is bringing to market are different.

They require minimal energy to make.

As the only scalable insulation made from organic matter, wood fiber insulation has the unique ability to sequester carbon dioxide.

The end result is a group of manufactured products with the unusual distinction of having an environmental footprint that is actually positive.

Thank you for the opportunity to share our story.

The CHAIR. Thank you very much for your testimony.

This is such an incredibly exciting topic and I am grateful for you all being present here today. Members will be recognized for questions in order of seniority for Members who were here at the start of the hearing, and after that, Members will be recognized in order of arrival.

I will begin by recognizing myself for 5 minutes.

I am so excited to be holding this hearing today, and I thank you all for your enthusiasm on what I think to be a really fascinating topic.

Mr. Goergen, I would like to start with you because in my notes, when you were talking, I was really just tremendously impressed by the possibility that exists when we are looking at cellulose technology. I am a mother of three children, and when you mentioned snack packs and replacements for snack packs, you might not have been able to see it from here, but my eyes lit up: so I am excited about that possibility.

But I was wondering if you could speak at a little bit more length about two things: first, specific to my district in my state, we have talked about innovative wood products and how they can make more forest types economical. One of the most abundant tree species in my home State of Virginia is the yellow poplar, and while this tree species has many desirable traits, the market for hardwoods isn't as robust as some softwoods. Can you discuss some of the ways that nanotechnology could expand potentially options for hardwoods in places like Virginia? First portion of my question, and then my second is could you dive in a little bit more about the growth that you all are pursuing in Yreka, California?

Mr. GOERGEN. Sure. Thanks for the question, and I am concerned about snack packaging too for my kids, both in terms of the impact on the world, but also the plastics that are in those containers that actually can transfer into the food as well. Those are the kinds of solutions that we are offering, and it is pretty exciting.

When we look at yellow poplar as a potential source for nanocellulose, the great news is nanocellulose can be made from any material. It doesn't matter. We can make it from any tree species that is out there. There is a huge window for us, and what is really interesting too——

The CHAIR. And has there been research in all different tree species at this point?

Mr. GOERGEN. Yes.

The CHAIR. Wow. Okay.

Mr. GOERGEN. We have looked at hardwood, we have looked at western woods. Typically the easiest method to make nanocellulose is from paper, and you have paper manufacturing, of course, in Virginia. But, we can actually make it from raw wood as well, which we have demonstrated.

The CHAIR. And can you make it from recycled paper, previously utilized paper?

Mr. GOERGEN. Yes, yes, and we have done that, again, in this project in Yreka, California. I am glad you asked about Yreka.

What is really interesting there is what we have done is we looked at the forests in California and we said, "There is a huge problem here. There is no market for a lot of these materials. They are really low value. Can we take raw wood from Yreka and turn it into nanocellulose?" We did that. We actually used some recycled fiber in combination with that as well, so we could demonstrate all those things at once.

And what we are trying to do there is we are actually building a bridge deck that is completely made from nanocellulose. We have done it. We made the deck; we just need to install it and we are waiting for——

The CHAIR. And when you are talking about bridge deck, you are talking about the actual bridge that cars and people would cross?

Mr. GOERGEN. This is the full deck that they—people will drive over. In fact, actually it is a logging road, so logging trucks will drive over it. It is kind of a nice symbol for sure.

But what is exciting about it is the whole community is behind this effort as well. They are really committed to trying to utilize that forest, figure out ways that they can bring real value to their town. And so not only are they excited about that particular bridge deck that we are going to put in for them, we are actually building a facility at their baseball field so that parents can actually sit at their baseball games and sit on a concrete pad as opposed to sitting on the ground or whatever. And they are going to build that with us out of cellulosic nanomaterial enhanced concrete.

It is a really exciting project—we are really excited to be a part of it, and the whole effort is designed to do exactly what we are talking about today. How can we get more forest products into all kinds of applications that really matter and can reduce the environmental footprint that we have in the world right now? And

products like mass timber and some of the things that we are talking about with cellulosic nanomaterials can actually do that.

The CHAIR. And from your experiences, can you discuss the importance that Federal support plays in the development of these products? And I will open it up to all of you to comment on that.

Mr. GOERGEN. There is no way that we would be where we are right now without the support of the USDA Forest Service. We often talk about how there are all these exciting new products that are coming to the market, and they are always 5 years out, right? And then 5 years comes around, and it is still 5 years out. Well, the work that we are doing, because we have the support of the Forest Service, we have grade A scientists that are doing this work. They have a pilot facility at the Forest Products Laboratory in Madison, Wisconsin that is making this material in quantities that we can actually use it in that 4 trillion ton concrete industry. They are right there with us doing this work together. Without that government support, there is no way we would be there. And of course, without the private-sector we wouldn't be there as well. It is that marriage between us with all of us working together, we can actually take those steps forward.

If we had more time, I would talk about what we are doing with FDA and how we are bringing companies together to actually solve that problem there as well. Exciting opportunities for the future, and it is only because of the collaboration between government and the private-sector and university researchers.

The CHAIR. Thank you, and Ms. Cover and Dr. Henry, in the second round we will come back to you. But briefly, you would agree with his assertion that the Federal support is necessary?

Ms. COVER. Oh, definitely, yes, the U.S. Forest Service has been an incredible partner on our journey. We would not be able to accomplish what we have done, both from an education perspective with the architects and the engineers, developers, general contractors, but also just on the way we have been able to open markets that were just previously not available to wood at all.

The CHAIR. Fantastic.

Dr. HENRY. Yes, I would say we received a Wood Innovations Grant from the U.S. Forest Service last year, a Federal grant from the EPA, SBIR Development Program. We are working on the Wood Innovations Program with WoodWorks on adoption and code issues associated with our products, so it has been extremely helpful in bringing in a new product market.

The CHAIR. Thank you.

I now recognize the gentleman from Georgia, Mr. Allen, for 5 minutes.

Mr. ALLEN. Thank you, Madam Chair, and thank you for your insight this morning. I come from the construction world. I was in the construction business for 40 years before being a Member of Congress.

From the standpoint of government involvement, most of the building codes are written by the government agencies. What progress have you made there on getting your products introduced, and of course, from a code standpoint, you have to meet certain requirements; and then also, the architects and the engineers are the folks that do the design work in the construction industry. Give me

some background on your progress, and I will just give that question to all three and how your product is being developed. Because we do need to keep this free market. Price obviously has something to do with it as well, and you are competing with steel and concrete, so give me your sales pitch on that as well.

Ms. COVER. Is it all right if I go first?

On this topic in terms of codes, there has been extensive development on the code front. In the 2015 IBC cross-laminated timber, mass timber has included actually in the body of the code, and in the 2021 code, you will be seeing an adjustment for tall wood. It will allow for up to 18 stories with mass timber construction in the built environment.

Mr. ALLEN. Will that be nationwide?

Ms. COVER. That will be nationwide, yes. As the various jurisdictions accept the code, that is when it will come into play in each area of the country. There are a number of jurisdictions that are already pre-adopting it because engineers and architects are so excited to start moving forward with this building opportunity.

We are providing assistance on over 70 projects right now that are over the current code limitations in the height. There is already extreme excitement before the code is even fully adopted, so that has been really exciting to watch.

In addition of terms of progress being made, WoodWorks educates. We provide over 300 educational opportunities a year, and that allows us to award about 46,000 practitioner education hours every single year. It is incredible the number of people that we are touching, again thanks to the support of the Forest Service.

And then in terms of cost and projects, since you come from a construction background, one of the things to note is that mass timber tends to be 20 to 30 percent faster to construct than alternate materials, and right now, the actual—if you look at just direct costs, there is a range. It is anywhere from five percent less than traditional materials up to ten percent premium to go with a mass timber solution, and that is for direct costs only. And the difference that you see there is generally due to whether or not the building was originally designed in mass timber. There is a lot of efficiencies that can be found if the building is set out with how you do your column lines, how you lay out your spans, based on the panel size themselves.

Mr. ALLEN. Do you have span limitations more so than steel and concrete?

Ms. COVER. Not necessarily. It depends on the loads that you are looking at for the particular building you are designing——

Mr. ALLEN. I am sorry we are getting in the weeds, here, but——

Ms. COVER. It just—I mean, there are limitations and the column lines, depending on the loads that you are dealing with might be slightly closer, but what we find is with exposed wood, it has a much more open feel. In a lot of these office spaces, even if the column line is maybe 3′ less than it would be if it was a concrete column or steel column, you are still—the room itself feels very open, and so there is a huge driver there.

On the cost, one other thing just to keep in mind is that additionally, you have to look at the value. You have speed of construction that is much quicker, so there are savings there in cost in terms

of construction loans, and you are also able to rent the buildings out quicker and generally at a premium. When a developer is analyzing this, they really look at the value, the overall value to the owner.

Mr. ALLEN. Okay. Comments from Dr. Henry?

Dr. HENRY. I would just add to that that we come at it from the free market side. We have a design construction business. We built more CLT buildings than any firm in the State of Maine, and we recently completed a building in Connecticut that went up in 3 days. It gives you an idea of how this technology——

Mr. ALLEN. Are you talking about structure?

Dr. HENRY. It was a residential structure.

Mr. ALLEN. I got you.

Dr. HENRY. But the onsite construction of that building went up very quickly. It was a great success, also used all wood fiber insulation, unfortunately imported from Europe.

As far as codes go, this product has been existent in Europe for over 20 years, as I said in my testimony. We know what the code challenges for insulation manufacturers—the challenge is really code adoptions. And so, advancing this sort of product and sort of wood products in general—I would say dimensional lumber manufacturing, it is important for us to—for districts that that code adoption, which happens on the state level, to keep pace with the publishing of new codes.

Mr. ALLEN. Okay. We will continue—I guess we are going to do a second round. Okay. I will continue—we will continue this discussion on the second round, but I need to yield back. Thank you.

The CHAIR. Perfect. I would like to welcome Chairman Peterson of the full Agriculture Committee, who has just joined us, and we will continue with questions from my colleague from Arizona. Mr. O'Halleran is recognized.

Mr. O'HALLERAN. Thank you, Chair Spanberger.

Today's hearing focuses on an issue of great importance to northern Arizona. I am looking forward to discussing innovative forest products. These products are instrumental in building a restoration economy that provides sustainable jobs and improves forest health.

The district I represent, Arizona's First Congressional District, includes all or part of six National Forests, each of which is filled with ecological beauty. They play an important role in Arizona's rural communities and our state's water supply. I have actively supported forest restoration policies for over 20 years.

While in the Arizona legislature, I co-chaired the governor's Forest Health Oversight Council. Together, we produced a report with recommendations for stakeholders, local governments, the state, and Congress to maintain forest health and prevent natural disasters. Today, U.S. Forest Service's 4FRI Initiative is the largest restoration effort in our nation. It serves as a testbed for innovation in forest management and efficiency development.

Identifying a valuable use for biomass and low-value small diameter ponderosa pine remains the major issue to the success of 4FRI, and the establishment of a sustainable restoration economy.

I remain optimistic that creative minds will develop—such as yours—efficient and sustainable uses for biomass and small diame-

ter ponderosa pine so we can reduce the fire risk of Arizona's forests and improve the health of Arizona's watersheds.

Ms. Cover, I heard that—when I was out in the meeting here, I heard that you mentioned ponderosa pine, so I am heading towards you for my first question. It burns through forest fires. We burn it in biomass. We try to find products, we ship it, and that is just beginning. There is so much we do with it, but as you know, it is a product that has its problems. I would like to hear your evaluation of what we can do.

Ms. COVER. That is a great question. Thank you very much.

The manufacturing standard for CLT is called PRG–320, and it is set up to allow for innovation. It is not limited to any specific species. Currently, in the U.S., we do have certain species that are more typical. You have Douglas fir, large spruce pine fir, and southern pine is your more typical species used in CLT, but it is not limited to those. There are only a few limitations in terms of the way it is graded that will limit what materials can be used.

I am aware of one manufacturer that has already started to test ponderosa pine for use in CLT, and they are seeing really positive results. Assuming that that advancement moves forward, it would be a great opportunity for ponderosa pine in CLT materials.

Mr. O'HALLERAN. Along those same lines, we have been trying to find those particular types of people. I am going to send our people to you to do some further investigation.

But can you identify any specific areas that you think are the most important for us to pinpoint and identify for use? Because this is just millions and millions and millions of acres, and we have a density issue within the environment. We have distance issues as far as cost goes. And so, we are trying to identify how we are going to reach those levels of need in order to get that forest clear as far as being able to save it.

Ms. COVER. Yes. We started to have some conversations with Chief Christensen in regards to what are some opportunities to connect these materials to the manufacturing facilities. That goes a little bit beyond what WoodWorks expertise is. We do the education and try to grow the market demand, but we are looking at ways that we can support the Forest Service in that effort to try to find that solution.

As soon as we get the certification where it can be utilized in the material, then hopefully the market demand will drive it, and that will help in some of the increasing of the cost recovery efforts, in trying to get the material off the forest land and into these products. We are trying to work on the demand side and get it to the point where it is certified and able to be used, and then hopefully then that will help drive to make those connections.

Mr. O'HALLERAN. And for the other two panelists, I would like your opinion on if the Forest Service has come to you and tried to identify the challenges of ponderosa pine?

Dr. HENRY. I would just say that the technology that we are bringing to the U.S. market, Mr. Allen talked about market solutions. This is—so far, our testing has been doing this. This is a softwood species that is species agnostic in terms of the technology and the implementation, so we look forward to our second plant in Arizona.

I would just say that in terms of a market solution that we have tried to bring to Maine with our challenges is what really is needed for driving people to go into the woods, which is a challenge in Arizona as much as it is a challenge in Maine, to harvest that wood. You need value-added products. The importance of this meeting here today is to drive products that are more than just dimensional lumber that have such thin margins.

Mr. O'HALLERAN. My time is over and I yield back. Thank you.

The CHAIR. I now recognize my colleague from California, Mr. LaMalfa, the Ranking Member, for 5 minutes.

OPENING STATEMENT OF HON. DOUG LAMALFA, A REPRESENTATIVE IN CONGRESS FROM CALIFORNIA

Mr. LAMALFA. Yes, thank you, ma'am.

This is a great topic today. I appreciate the panelists here. We, of course, have a lot of challenges with the whole forestry issue, especially in the West and my home State of California where it seems like if we are not burning ½ million acres in a year, then we are having a light year. And at the same time as a country, we are the number two importer of wood products, I am just wondering what are we doing?

The cross-laminated timber, that is an exciting technology we can move forward and more and more into nontraditional thought on construction. I know that we are going to have some perceptions, perhaps, with the regulatory side, with construction side, with certifications. I would like to hear just a little more from the panel on that. Also, a product called biochar, I have heard a little bit about that over the years, but it seems like there is just a lot of potential there.

Bottom line for me is that more material we are getting out of the woods into some type of positive use, and as Mr. Goergen was talking about up there in Yreka, which is my home area, as you know, by the way, this is really exciting that we can change the terminology from Eureka whenever there is an invention made to Yreka, I have found. Eureka is on the coast; Yreka is in the upper central part by Oregon there. Let's get more Yreka going here.

Anyway, I appreciate that.

The situation of replacing steel and concrete more and more, how is that going to be met by—again, Mr. Allen was kind of talking about code enforcement, engineers, accepted—how long will that take to become an accepted, certified part of building code, for example? Mr. Goergen, and all three panelists?

Mr. GOERGEN. On the code issues, Jennifer might be best to start.

Ms. COVER. Perfect. In terms of codes, it has been accepted so it is already in the 2015 building code. It has been accepted and mass timbers called out in that building code.

Mr. LAMALFA. How tall of a building can—are we talking about?

Ms. COVER. That is within current code limits, which is 85′.

Mr. LAMALFA. Eighty-five feet?

Ms. COVER. Yes.

Mr. LAMALFA. What is that in stories for us that——

Ms. COVER. It is six to seven stories. But then with the 2021 code, the adoption of that will go up to 18 stories. And California is one of the states that is looking at early adoption.

Mr. LAMALFA. Okay. Now, a question that is going to come up—and I am sorry to bring it up. Every picture of an old building you see from 1880, 1890, isn't around anymore because always the story is there was a fire. And so, what are we—what can you build into this for fireproofing or at least fire—a higher level of fire resistance, because again—I mean, maybe it is an unfair question, but it is one that is going to be out there on the table by the general public.

Ms. COVER. It is a very fair question. I am happy to address it.

Really what is exciting about what took place with the testing and the research in order to go taller with wood is there was extensive requirements on the fire side in terms of fire safety testing. With the acceptance of these new code requirements, you have a much higher level of safety than is required historically on a lot of the different construction practices.

One of the things that was done was a two-story apartment building was built, and five different tests were done. It was fully loaded so that you were simulating as if it was an 18-story building, and it performed exceptionally well. A five-ply CLT panel in one of those tests was exposed to 1,800 °F in the fire. It lasted for 3 hours and 6 minutes, which is much longer than the 2 hour code requirement. The results have been phenomenal. Mass timber burns differently than traditional wood materials, and that is why you can go taller with it, because it actually chars and then it protects that wood against further heat damage.

If you think about when you are camping, you try to hold a lighter to a giant log, it won't ignite. That is the idea here is that it self-extinguishes because it creates a char layer once it does burn, and it protects itself.

Mr. LAMALFA. Okay, thank you.

Also, please, panelists, what I am looking at, too, is we have just—as was mentioned here—an overloading of material in our forests of an increased density and the market isn't always there for some of the lesser products. That is what is exciting about some of this, too. Do we see that we are going to use what is already coming out of the forests more intensely, or does this mean that we are actually going to be going in and getting a bigger net of all tree material, whether it is the less marketable stuff, less usable, or saw logs in conjunction with that? Are we going to get a net increase of material coming out of the forests?

Mr. GOERGEN. Yes, I hope the answer to that question is both, right, so that we are better utilizing what we are already harvesting, and we are harvesting more, especially that problematic restoration requirement material that we need to remove from our forests. There is such a gigantic backlog of material that needs to be removed, and having markets to address that removal is critical to it.

Mr. O'Halleran mentioned this from northern Arizona. You have lost so many mills in that area. When we lose the mill infrastructure, we lose the loggers, we lose all sorts of different parts of the system, and then we can't remove that material. These products

are going to be able to help us restore the market pool that is going to help us actually manage those forests and remove more material from them over time.

Mr. LAMALFA. So, you believe that it is an unknown right now then?

Mr. GOERGEN. It is unknown to some extent, but I am very bullish on it. It is absolutely going to increase the amount of wood that we are removing from forests.

Mr. LAMALFA. Thank you. I will come back in the second round. I appreciate it.

The CHAIR. The chair now recognizes my colleague from Maine, Ms. Pingree.

Ms. PINGREE. Thank you very much, Madam Chair. Thank you so much. All of your testimony and questions answered have been really interesting, and I greatly appreciate having you here today.

I will start with my hometown visitor. I think, because so many of us represent rural communities, we have a really good understanding of what happens when manufacturing jobs are lost. And when you lose an entire sector, as you mentioned, four mills in 6 years, that is staggering in a state of 1.3 million people, especially in the most forested state in the nation. We are just such a heavily dependent state on forest products.

And so, really all of what you have been talking today has been really exciting in Maine, as some of these opportunities are opening up to us. Getting them from great idea university research to the end-stage of manufacturing, as all of you have attested, is really complicated.

Perhaps, Dr. Henry, you could just talk a little bit more about the project you are doing in Madison, a town of 5,000 people, and the impact this could have, and maybe some of the challenges of getting it to the stage of actually producing the materials next year.

Dr. HENRY. Yes, thank you.

As Mr. Goergen mentioned, when something as traumatic as what happened in Maine over the last 4 years happened, the critically important thing, urgency to act at that point is to maintain that infrastructure. There are people whose jobs, whose livelihoods depend on that industry, and it is not a simple thing to just bring that back. Once it is gone, it is a much bigger investment to rebuild that infrastructure. That infrastructure dies because there are not value-added products that can enter the market effectively and support that manufacturing infrastructure. That is why what we are talking about today is so important is having innovative products that have the value-add that allows them to enter new markets and incentivize the investment in manufacturing infrastructure.

As I mentioned in my testimony, I can speak directly to the challenge of getting investment into the manufacturing infrastructure and how difficult that is. But having value-added products, having the whole stream of support that you are seeing here today is absolutely vital. The support for the government for research and development to develop those products and find new markets, that is what is necessary. If you want to solve problems like the challenge that you have in California or Arizona, there needs to be new prod-

ucts that enter new markets for wood products, otherwise, you are not building that new infrastructure.

The project in Madison has been immensely gratifying to everyone on our team. The work that we have done with the community of Madison to bring that back, we have reemployed a number of the people who worked at that mill in designing the project. They have real ownership on a literal basis of our company in bringing that project together, and the state has really galvanized behind this project to make it happen, because they realize the critical need to act quickly when something like this happens.

We immensely value the work that you do in terms of bringing funding to these projects and the work that all of my fellow testifiers here today do as well.

Ms. PINGREE. I will get a chance—we are going to have a second round, too. I am just going to follow up on all the other guys questions later, but I want to reinforce what my colleagues have said, which you did. I mean, one of the things we hear about a lot is this whole issue of both losing the infrastructure once the facilities are turned into something else or they are demolished, which has happened with some of them, you don't have that plant to rehabilitate and bring back the jobs. Also, the skills and training—not everybody wants to work in the woods. These are dangerous jobs. It takes a lot of training. It is expensive equipment to harvest wood today. The people who drive the trucks, every stage for the way, we hear about labor shortages and the challenges that are already coming up. Having a sense of urgency about how quickly we need to move on this. This isn't something we can kind of wait out into the future.

I thought, since the Ranking Member mentioned it, it would be interesting for you to talk a little bit about. It is counterintuitive to think about an insulation material that is made out of wood products, because again, people think about fireproofing and how it even works. Could you just describe that a little bit and how and why it is going to be safe?

Dr. HENRY. Sure. This is a suite of insulation products. One of the exciting things is that it addresses all phases of the built infrastructure, interior insulation, exterior insulation, the batt product is a direct replacement for fiberglass. The board is a direct replacement for foam. These products, the board, for example, has a better fire rating than foam does. People have a perception of wood as being dangerous from a fire perspective, but if you talk to any firefighter, they would prefer a house made—residential construction—constructed house made entirely of foam. The danger of fire to firefighters is really the—gassing of non-organic material to them. Really, it depends on what you are looking at, but our products meet all the safety code ratings for residential construction and small multi-family construction. There is no issue there. As CLT has faced, it is a perception issue. It is not a reality issue.

Ms. PINGREE. Great. My time is up, but thank you so much.

The CHAIR. The chair now recognizes the gentlewoman from Washington, Congresswoman Schrier, for 5 minutes.

Ms. SCHRIER. Thank you, Madam Chair.

These are really interesting questions. Thank you all for being here today.

My question, really is very similar to Mr. LaMalfa's, because we have, in many ways, similar districts. Washington State has this tricky combination of overgrown forests, too much fuel potential for these massive fires, a desire for cross-laminated timber, and a real market for it now that we can build up to 18 stories.

But, we also have this crumbling infrastructure without mills, small diameter mills, and even the notion that even if we could do this and mill this locally, the transportation makes it cost-prohibitive.

We have this kind of a forest health crisis coupled with the lack of mills, and I wanted to just paint a picture, which is the State of Washington has been losing mill infrastructure over the past few decades. A recent report from the Washington Department of Natural Resources showed that between 2006 and 2016, the number of mills in my state declined from 137 to 88, down 36 percent. And in central Washington in particular, we have a really big gap in wood products infrastructure, and we also have about a 30 percent higher cost of construction that could be solved if we had local cross-laminated timber.

In my district, forestland owners often have to truck their logs 150 miles or more to the nearest mill, making it impractical, increases cost, *et cetera.*

And so, I am excited that we have companies in Washington State producing these innovative wood products, and I am excited to hear about the ones you talked about today. We have two new facilities doing cross-laminated timber in Spokane and in Colville, and I am wondering, looking at the practicalities here, wanting the smaller diameter trees pulled from our forests, knowing that we need these small diameter mills, and knowing that we need private industry to kind of partner with forestry. I was wondering if you have examples of partnerships between the U.S. Forest Service and private industry to fill these gaps? Whoever would like to answer that question.

Dr. HENRY. Sure. Yes, we work with the U.S. Forest Service on—we received a Wood Innovations Grant. Maine is a state in which most of the lands are privately owned, but we work intimately with dimensional lumber manufacturers. This is a technology that is totally complimentary to CLT manufacturing, two-dimensional lumber manufacturing. We use the residuals of softwood lumber production for our product, and—I am getting a little off target for what you are looking for, but you touched on a very key issue, which is transportation. We need to create sufficient markets for the investment in mill infrastructure. If you don't have the market there, it doesn't matter—well, nothing matters. If you don't have the market to sell the product, you can't invest full stop.

As to code, I don't know if my fellow members here would agree, but from our perspective, code is essential to creating that market for an insulation product, keeping up with code. From the IECC Energy Code, that really it does two goods, which is it supports the wood products industry, and it also supports energy independence for our country. The built infrastructure uses about 30 percent of the energy that we use as a society. If we were to all implement code up to 2018 to the 2021 code, that would be a huge boon to the

insulation industry, and this suite of products is a perfect fit for our 100 percent wood frame construction residential market.

Mr. GOERGEN. Let me tell you a quick story, too, about the Forest Service and working with partners in Washington State. The Colville National Forest where Vaagen Brothers Timber—and I am sure you know them very well—there is a collaborative there that is working on solving some of the restoration challenges in that area. They are looking. They are saying we have to reduce these risks. This is environmentalists working with industry, working with a whole bunch of different folks, all coming together to try to solve these problems. And the Forest Service doesn't always have the funding that is necessary to conduct the environmental analysis that needs to be done, the archaeological studies that need to be done, *et cetera, et cetera, et cetera.*

This collaborative actually found ways—I don't know if they were doing bake sales for forestry or what they were doing, but they found ways to gather money together and pay for some of that up-front cost of the environmental analysis that was necessary to harvest timber to reduce the risk of catastrophic wildfire. They raised that money. The Forest Service went through the process. The Forest Service still made the decision, but the community came together, paid for the analysis, paid for the ideas behind it, reduced the cost to the government in some ways. They sold that timber. That timber actually paid for all the costs of that up-front analysis. At the end of the day, they reduced the fire risk, and that is an effective partnership between the Forest Service, the community, and industry. And we need to replicate that 1,000 times throughout this country and we will start to solve some of these challenges.

Ms. SCHRIER. Thank you so much, and thank you for pointing that out.

The CHAIR. We will now begin a second round of questions, and I will begin by yielding myself 5 minutes for the first question.

Dr. Henry, I appreciate the distinction that you and others have made between embodied carbon in the manufacturing process of materials used in constructing a building *versus* the operational carbon emissions once a building is in use. It is estimated that roughly 11 percent of global greenhouse gas emissions come from building materials and construction, and that the other 28 percent comes from the building operations.

Can you explain why tackling the operational carbon emissions is also critical to reducing the emissions of the built environment, and how can innovative wood fiber insulation products like those made by GO Labs help to effectively reduce the carbon footprints of buildings?

Dr. HENRY. Yes, there is—so, thanks for drawing the distinction. There is energy expended in the manufacturing, obviously, of all building products and there is energy used in heating these buildings, and all of our built infrastructure. When it comes to operational energy, we are sort of experts in that. My partner, Matt O'Malia started this firm 10 years ago in 2008 at that great time for the building construction industry that focused on the ultra-energy efficient design and construction that could reduce energy consumption by 90 percent.

It is important to point that out because that 30 percent of energy consumption that we use as a society—everyone wants to talk about self-driving cars and battery technologies and things like that. That is a technology that could be implemented today to reduce our environmental footprint on society, but it has to be done very carefully. You see in the building industry an increasing push towards tighter buildings, so buildings that have a significant air sealing component to add significant amounts of insulation. But it is important to recognize that that is a living environment that—we are not just trying to reduce energy consumption. People have to actually live in those buildings, so there is actually not just energy flow, but mass flow through those systems as well. We shower in those buildings. We cook in those buildings. We produce a lot of moisture, and that moisture has to be breathing through those buildings. What is very unique about wood fiber insulation is that it transmits moisture better than any insulation product out there on the market today. You see with increasing building code foam products being strapped to the exterior of wood frame insulation buildings. In our opinion, that is a horrible idea. You are basically wrapping a building in cellophane, and that means that those are zero perm products, which means that they don't breathe at all. That moisture is going to get trapped up against that wood. It is going to contribute to mold and rot of our buildings. So, the endurance of buildings is less.

It is a little bit counterintuitive to think of. We think of wood products manufacturing as an old industry, but these products are really the Gor-Tex, the future of building industry. They allow that product—just like you used to have these rubber rain jackets and you would run outside and you start sweating, and you are wetter on the inside than you would have been on the outside. Gor-Tex allows you to move outside and not trap moisture on the inside. That is what these materials are able to do.

The CHAIR. Thank you for that explanation.

I would like to bring it back for the remainder of my time to my district. I represent a central Virginia district. We are ten counties in total, majority land mass rural, forested land included, but we have growing suburbs. And in the suburbs, the area of town where I grew up used to be farmland. Now there are neighborhoods everywhere.

My question for you is what—and I will start with Dr. Henry and Ms. Cover, and Mr. Goergen, you can join in as well. What is your vision for where these are being applied? Do you have a vision for this being in these suburban neighborhoods that are popping up and growing 100, 200, 1,000 homes at a time that we are using these technologies, or are we still focusing on individual house construction by interested parties and potentially large building structure by a developer who wants to use these technologies? Where do you see this going, and where would you love to see it in 5 years?

Dr. HENRY. I have two daughters under 5 years old. If I thought this was a niche product that we were bringing to market, I would not have quit my job. We fully expect this to be a $1 billion product and a mainstream product for the United States. It uses the residual products that the wood products industry needs to use to motivate getting people into the woods to harvest those products that

are such a danger in terms of forest fire risk and things of that nature.

I absolutely think this is going to be in every home, as you mentioned, across the nation. We anticipate it will all be GO Lab product.

Ms. COVER. Yes, for mass timber, I would say the market is a slightly different focus in terms of it could be used in residential construction; but, as we were talking before in terms of the cost, where you are going to find it most cost-effective is going to be in the commercial market. And when I mentioned the 17,000 buildings annually earlier, that is a commercial market. That is not residential.

And where it will be—the sweet spot where it will work out for mass timber is likely going to be in that 17 to 18 story range. That is where right now there isn't a cost-effective solution when it comes to cost per square footage. If you look at our urban environments, you typically see that dichotomy of buildings that maybe cap out at six stories that are light frame construction, and then you get to 20 to 50+ stories of steel or concrete. Because typically, the alternative materials don't become cost-effective until 20 stories. Now you have a gap from seven to eighteen stories that now mass timber can fill. I think that will end up being—when we talk about cost, most likely where it will be most cost-effective.

The CHAIR. Thank you very much.

I will now yield 5 minutes to the Ranking Member, Mr. LaMalfa, for a second round of questions.

Mr. LAMALFA. Thank you, Madam Chair.

Just coming back to the usage of more and more biomass. We also, in my—south of Yreka in the area of Paradise, California, you have all heard of the situation there where there is still just hundreds of thousands of trees to be disposed of that are going to be a hazard. Either they are falling over or a fire hazard in the future. They are looking—one group is looking at creating a pelletized fuel product in order to further the restoration going on from the Camp fire and the Paradise, Miguela, and surrounding areas up there. What do you think of that, panelists, of that as part of a solution on usage of these materials: partially burned, partially charred timber, *et cetera?*

Mr. GOERGEN. The good news is that we can make these pelletized wood fuels from really low-value materials, and that is a terrific option for us in some places. The problem is cost, right, always. When you are competing with other fossil fuels, it is very difficult to make wood energy cost-effective.

But, there are solutions. This one right here is actually torrefied wood, so this is wood that we have actually roasted in a low oxygen environment, and it turns into a black powder.

Mr. LAMALFA. Is that basically biochar or something——

Mr. GOERGEN. It is very similar to biochar. We can actually make biochar or we can make this pelletized fuel. We actually have a facility going in, in John Day, Oregon right now. It is going to start up in the spring.

What is interesting about it is it turns into this black powder, or we can make biochar from it. And what we can do is densify it, and we actually fueled a coal-fired power plant for 12 straight

hours using a forest biomass product just like this. That plant required no changes whatsoever. Basically, what we did was we said here is a coal-fired power plant that is going to be decommissioned by the state because Oregon doesn't want coal-fired power anymore. We can use a wood product that has a huge environmental footprint throughout the entire West, and we can fuel it with this material. It is a really exciting project. It is a demonstration project that we have right now, but there are so many utilities across the world that are interested in this——

Mr. LAMALFA. I bet you can't wait to tell me what the difference in emissions are from the coal *versus* that.

Mr. GOERGEN. It depends on how you do the calculations and depends on who you talk to, but I mean, this is a very low carbon-intensity fuel, because it is a waste product, right?

Mr. LAMALFA. What about other emissions? I mean, just percentages, concerns with——

Mr. GOERGEN. There is no mercury, there is no SO_2. It is a very, very clean fuel compared to any fossil fuel that is out there. And the other thing that is exciting about it is——

Mr. LAMALFA. Because Arizona has a big problem. They are getting ready to close a plant if they haven't already, a large coal plant down that way.

Mr. GOERGEN. Oh, they are slated all over the West right now.

Mr. LAMALFA. Yes, many of them.

Mr. GOERGEN. I mean, California is like the giant sucking sound in the evening, because they have so much solar power during the day and they pull in so much fossil fuel energy at night, and they want to eliminate that. This is how we can do it.

Mr. LAMALFA. In my neighborhood, too, there are a lot of ag orchard, orchards are constantly being removed and changed out, so you have that as an issue. A lot of times, they are dealing with that by chipping. Is ag tree waste or even straw from fields, is that something that fits in with——

Mr. GOERGEN. We can torrefy all that, including things like almond husks and those kinds of things as well. We can use those materials.

Mr. LAMALFA. And open field materials, straw, things like that?

Mr. GOERGEN. I don't know about straw so much, because it would burn too fast; but, a woody material would be no problem whatsoever.

Mr. LAMALFA. And as far as turning into the nanofibers?

Mr. GOERGEN. Again, nanofibers—you can make it from anything that has cellulose. The question is what is cost-effective to make it, and again, we can make it from any kind of an ag byproduct, but it makes most sense out of wood.

Mr. LAMALFA. Right, right. Okay, very good.

Ms. Cover, would you like to touch on any of this?

Ms. COVER. In terms of the application for mass timber, we are looking at wood products for the application here.

Mr. LAMALFA. Right, and Dr. Henry?

Dr. HENRY. I would just say that you need a complete suite of manufactured materials to really incentivize investment in manufacturing and the wood products space. You need something like CLT, dimensional lumber manufacturing, and then you need prod-

ucts like ours that are based on the residuals from those, from the engineering of those materials and from the dimensional saw mills.

Yes, you need all of these products. You need the pellet manufacturing, you need the CLT manufacturing, you need the insulation. And you need to create markets for those in order for the mills to be successful.

Mr. LAMALFA. Right, long-term markets. Anything you wish to touch on, on Paradise's problem with, again, hundreds of thousands of dead and charred trees that could be incorporated into this thinking on a more immediate basis, too?

Dr. HENRY. Yes, so we actually participated in a venture competition in California that was supported by the U.S. Endowment for California in terms of finding new innovative ways to take those problem materials and turn them into value-added materials. That was very helpful in terms of our company getting exposure to investors. More things like that need to happen to get these stories out there. This Committee is very helpful in terms of our exposure in terms of all of these types of start-up companies that need the exposure to investors, to people who are interested in solving problems in the wood products space.

Mr. LAMALFA. All right. Thank you, panelists. I yield back.

The CHAIR. The chair now recognizes the gentlewoman from Maine for 5 minutes.

Ms. PINGREE. Thank you very much. I have a couple more questions, although I could go on all day. So, thank you so much.

In Maine, we have something called the Maine Mass Timber Commercialization Center, and it is an effort to bring some of the stakeholders together to talk about the economic potential of the forest economy. They are currently working on a life cycle analysis to compare cross-laminated timber construction to traditional steel and concrete. I know we have been talking a lot about that today. One of the challenges currently in the marketplace, besides general acceptance by builders and contractors, is also that we don't have a lot of standards right now that talk about carbon sequestration and building materials. But I fully expect, whether it is consumer demand or just how the codes change, we are going to see a lot more of that.

Ms. Cover, I am just interested—you have talked a little bit about that, but do you think this is starting to change, that we are not going to keep overlooking the carbon sequestration benefits and can you just say a word about why that is so important in CLT?

Ms. COVER. Yes, 100 percent. Operational carbon emissions, as we start to get more control over that, embodied carbon is really what is going to be the conversation. We see that shifting with the architectural community quite consistently, and one of the things is interesting is in foreign governments, there has been a lot of motivation to look at that embodied carbon impact. Vancouver, Canada, for instance, set a goal to reduce their embodied carbon in their new buildings by 40 percent by 2030, and so, this is new. This is a shift. People are starting to recognize embodied carbon and the value of reducing that in the built environment.

One of the things that may be suggested here in the U.S. is to consider benchmarking the carbon that is in the buildings, Federal

buildings, for example, that are currently being built, and then set a target on how to decrease that carbon.

Ms. PINGREE. That is great.

On a somewhat different topic, but it is related—I know in my state, it is related to one of the challenges that you were just mentioning about how you put together the whole package and have solid lumber and all these other products and make a deal that is interesting to investors. And I don't know exactly how this impacts California and some of the other states, but this deals with the RFS standards, so the renewable fuel standard. And I know in Maine, traditionally a lot of our paper facilities—paper mill facilities could use some of the byproducts to generate electricity. They were basically burning them.

And so, when we talk about pellets or other ways to use some of the residuals, that is—it can be an important part of putting the package together.

But, the way it is currently interpreted in the EPA rule, it is only accessible to plantation grown trees. A lot of what people have been talking about today, I don't think is grown on a plantation. That is pretty specific to some southern states, so it really cuts a lot of the forest industry out of this. And I know it is not even under our Committee's jurisdiction because it is an EPA rule, but do you guys want to make any comments about that? I just think it is maybe important for my colleagues to understand better that it is something maybe we should tackle together, because it is really critically important that we have a full package when we are trying to convince investors of this. Maybe you don't want to comment.

Mr. GOERGEN. It is so important, and my colleagues have talked about this before, but that integrated system, right, of all the different products that we are producing from our forests. And these are very low margin businesses. We are not making a lot of money. Most of what we are talking about are really commodity products. The value-added products that Jennifer and Josh are talking about obviously bring more value, but we need those really low value systems as well so we can take advantage of the whole product, because the margins really are not there. Anything that helps and can make a significant impact, and those kinds of incentives really do help us make a go of it all.

There are unintended consequences. You don't have to talk to Congress about that. You all know that better than most of us. But, the unintended consequences of adding a word in there, it may be a really good idea in terms of what we are trying to do, what we envision. But the on-the-ground consequences are significant. In this case, cutting off a lot of potential where we could actually have that marginal gain that would make a company actually viable *versus* 4 mills in 6 years.

Ms. PINGREE. Right, exactly.

Dr. HENRY. Yes, that is a very good point. I think that those low margins are extremely critical to the base of the manufacturing chain for wood products. The loggers that are in there in the woods, those margins, as Mr. Goergen explained, are extremely small for them. When something like 2008 happens, when four mills close down, that is the first impacted group, and the least

flexible groups in terms of—and so, any standards that help to increase their margins, that is really where those small changes go to. And it is extremely—but it is an extremely critical link in the chain.

Ms. PINGREE. Thank you. I have run out of time, but if any of my colleagues are interested in understanding that standard better, it has been a real challenge for the Maine delegation, and we would love to work with anyone else who sees it as potential value for their state.

So, thank you, Madam Chair. I yield back.

The CHAIR. Thank you. The chair now recognizes the gentleman from Georgia for 5 minutes.

Mr. ALLEN. In listening to the discussion, there are some things that this Congress can do. In fact, the 115th Congress, previous Congress, when we had the Majority, we worked on legislation to deal with forest management. Unfortunately, it was entirely partisan. The environmentalists fought it, and so, here we are in a situation where we can't seem to agree on what the solution is. But this Congress can do something about forest management.

I would like to hear from you all, would you tell this Congress how important that is to get this done, and done quickly? I would like to hear from all three of you on that.

Mr. GOERGEN. About ⅓ of the country's forests are at risk of catastrophic events: either wildfire or insect and disease infestations. We have a significant challenge that we all need to meet together. This is not a partisan issue. This is not environmentalists *versus* industry. This is a real crisis in our forests that we need to attack.

And so, the bottom line is we need a suite of solutions that include forest products, that include just flat out management, that includes supporting our logging infrastructure, that includes supporting family-wage jobs in rural America, which you all know how important that is, because a family-wage job in rural America is worth about 20 family wage jobs in urban America. This whole suite of solutions needs to be addressed. And we know that we can do this work. It is a question of time and money. And if we actually create the markets, we can start to address some of those money issues. The time issues are a little harder, but we will get there.

Congress can add some significant weight to this conversation, both in terms of reducing, not eliminating, but reducing some of the regulatory burden that makes it harder for the Forest Service to do their job. These are dedicated professionals that are out there managing these forests in pretty significant ways. The private-sector does a remarkable job of managing forests. They are not always perfect. Family landowners, sometimes it is hard for them, too. The Forest Service has some of the biggest challenges in this country because of the regulatory environment. If we could reduce that burden, it would be helpful, and if we could give them more money, it would be helpful.

Mr. ALLEN. Exactly. Any others that would like to comment on this?

Ms. COVER. Yes, I 100 percent agree with Mr. Goergen. Some specific tactics that would be helpful to building on what Michael mentioned would be definitely supporting the Forest Service in their ability to support programs like WoodWorks and the Wood In-

novation Grants. I mean, that really is a catalyst for a lot of companies that are looking at being innovative in this space.

Modeling in your individual states by encouraging projects to be built with mass timber that are the government buildings—in California, there has been a commitment to build three government buildings with mass timber, which is a fantastic move to be seen there to show some leadership.

Also, in terms of looking at ways to benchmark and then target reduced carbon, embedded carbon in these structures is another approach, as well as competitions. Again, referring to California because that is my home state, we are about to announce a competition there in the state that the results of it for a mass timber building competition in the state, and that really motivates folks. We have six amazing projects that are going to be showcased as a part of that that are trying to really move the dial, and it shows that that is something that wants to be championed by the state and locally, and then that really helps architects and engineers want to engage. And then additionally, encouraging local code adoption in each of your states. I mean, that is something that is really important. There are some jurisdictions that are way behind on the code.

Mr. ALLEN. Right, right. Dr. Henry?

Dr. HENRY. I would second the adoption of code. I would just point out one example. Unfortunately, in our area of a Federal building, which I believe is the Maine Veterans Home which is being built in Augusta, is being made of steel and concrete, and it doesn't have to be.

Mr. ALLEN. Augusta, Maine.

Dr. HENRY. It doesn't——

Mr. ALLEN. I am from Augusta, Georgia. There are two Augusta's in this nation.

Yeah, and real quickly, just wanted to add about this, the sawmill problem. It is a trade problem. Timber is one of the largest industries in the State of Georgia. What do we do? The Chinese go in the sawmill business, so we start shipping whole logs through the Savannah port to China. Guess who bought our sawmills, rather than going out of business? The Canadians, because they have a massive insect infestation problem in their forests because of the problem with management, so they are coming to Georgia now and have bought our sawmills. Can you believe it? I mean, you can't make this stuff up.

Anyway, thank you. It has just been great and yes, Congress needs to act. We need to get this done. There are lot of opportunities. Thank you very much.

The CHAIR. I want to thank everyone for a productive hearing today. I especially want to thank our witnesses for their dedication to ensuring our nation's forests continue to drive the rural economy. Federal support for wood products is crucial if we want to ensure the success and sustainability of the industry. And for my part as a Representative from central Virginia, I will continue to look for ways to shine a light on the great work happening in this industry across the country. I look forward to seeing more of these innovative ideas prosper in the future in this sector, and I am so grateful for the time that you all have spent with us answering our questions. The conversation has begotten many additional ques-

tions, but I have found it to be a really intriguing conversation, and I am delighted by the work that you all are doing, and I am grateful for the time that you have spent with us here today. Thank you.

Under the Rules of the Committee, the record of today's hearing will remain open for 10 calendar days to receive additional material and supplementary written responses from the witnesses to any question posed by a Member.

This hearing of the Subcommittee of Conservation and Forestry is adjourned.

[Whereupon, at 11:29 a.m., the Subcommittee was adjourned.]