THE UNIVERSITY OF MAINE

Forest-based Opportunities for Resilient Economy, Sustainability, and Technology (Maine-FOREST)

EPSCoR Planning Grant: Knowledge-Sharing Findings, Discussion of Themes, and Collaboration Opportunities

NSF Award 2241675

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MAINE EPSCoR

This report is a collaborative effort by UMaine's Center for Research on Sustainable Forests and EPSCoR office

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NSF EPSCoR Track 1 Forest Planning Grant

Executive Summary

In late November 2022 through early January 2023 the Maine Planning Grant team for the *National Science Foundation (NSF) Established Program to Stimulate Competitive Research (EPSCoR)* conducted knowledge-sharing conversations with 11 leaders in the field (subject matter experts) who spoke about forest industry opportunities, workforce education, research, conservation, policy making and Indigenous engagement. The conversations were anonymous, and each lasted 45 minutes to an hour. Overall, experts were tremendously enthusiastic about the opportunity ahead, and collaborating with the EPSCoR team.

Experts hailed from industry coalitions, government, land conservation, manufacturing organizations, non-university research institutes, non-degree training organizations, and universities. Tied closely to the Center for Research on Sustainable Forests (CRSF), we did not meet with wood science (e.g., nanocellulose) engineers, public schools or loggers, as those were already represented in CRSF's current work and partnerships.

Experts shared gaps they saw in research and workforce capacity (e.g., skill and staffing). They described solutions they and their peers were undertaking.

experts also shared their aspirations for the social and scientific dimensions of the EPSCoR grant, and stated how it would expand capacities, awareness, investment, community well-being, and policy-innovation.

> *[O]n the positive side, the general public awareness of forests as a natural climate solution is increasing. My friend Jamie French said, "We could be ushering in the 'Decade of the Forest' if we play our cards well." Funding is coming in, and we don't want to miss this opportunity. I am an aspirational pragmatist.*

Experts expounded on forest industry gaps and described the (often fragmented) responses coming from institutions, nonprofits and industry players. First, experts argued that traditional degree-based education needs to be supplemented by non-degree, on-the-job, apprenticeship and "stackable" content — all using innovative delivery modalities. This content should be coupled with more transparency into careers and development options.

Second, experts mentioned public perceptions and misinformation, coupled with policy and investment-return uncertainty, which they considered to be drivers of conflict, investor-hesitancy, and professionals' reluctance to enter (or stay in) forest-related careers. Experts pointed to government, non-profit, and industry efforts to address these information issues, but feared a lack of coordination may be limiting impact.

Third, experts noted that data science has penetrated forest-related careers and, coupled with several environmental science sub-disciplines, should attract many young digital natives. Yet, data science without forest domain knowledge is incomplete, and experts called for well-managed partnering across disciplines. Experts also suggested widening the aperture on data science to include both natural and social data. In other words, in addition to traditional data, such as sensor and population data, experts drew attention to data patterns showing misinformation in media and public meetings, lack of information on wood products/suppliers, and the need to curate and ease the access to forest-professional learning, organizations, and mentoring resources.

A component of the solution to these complex gaps is nimble networks (or "communities of practice"). Networks are widely viewed as valuable in achieving scale, reach, transparency and belonging. Experts felt networks are essential to resolving planning, coordination, messaging, and content

fragmentation. However, experts pointed out that networks require systematic and persistent investments in design, convening, and communication. For the EPSCoR program, experts recommended leveraging existing network(s), rather than establishing new networks.

There are implications for Maine's EPSCoR proposal, as well as pilots or collaborations ahead of the NSF award. Table 1 summarizes broad recommendations (to be funded not just by NSF EPSCoR). Table 9 (under "Conclusion: Experts' wish list for content in the EPSCoR Project Proposal") provides direct input to the EPSCoR proposal.

On February 13th, 2023, one month after the completion of the knowledge-sharing sessions that led to this report, the EPSCoR Track 1 grant Planning Team researchers met with the experts who contributed to this report, and

Table 1. Summary of Experts' Forest Sector Recommendations

Category	Recommend NSF EPSCoR investment
2.1 Workforce Development	Expand experiential learning pathways and definition of professions in this industry. Include indigenous and other ways of knowing.
2.2 Data Management/ Analysis/ Application	Expand AI focus and capacity. See AI (and data curation) as more than just geographic/biological data but also social, web and other media.
2.3 Public Education and Communication	Using AI and behavioral insights, systematically research and combat polarization and misinformation about forests, forest sector actors, and jobs.
2.4 Livable Communities and Affordable Housing	Regard local communities as part of the workforce solution: Climate-smart, culturally aware, equity-producing, jobs-creating. and abundant with forest recreation opportunities.
2.5 Industry attractiveness	Reduce the cost of entry, and develop the manufacturing, supply chains and outlets for local wood products at commercial scales.
2.6 Network strategy	Engage and expand existing networks. This will be more time- and cost-effective than starting new networks. Networks bridge ways of knowing and may accelerate DEI initiatives.
2.7 Direct partnering strategy	Tap existing Maine and regional organizations and tribes that are connected, resourced and skilled.

some of their teammates. 20 people attended this 90-minute meeting. In-depth breakout teams probed into the meta themes of data/AI, economics, inclusion, and learning (derived from Table 9). Some key takeaways from the February 13, 2023, meeting:

Collaborate and translate. Opportunities discussed cut across data/AI, economics, inclusion and learning categories. These need to be framed and translated to have a positive impact.

Pilot, adapt, and spread: This group showed a strong bias for action as most breakouts talked about moving into or expanding pilots quickly and iterating.

Manage knowledge, big and small: There are promising developments for workforce and economics, but we have to improve the forest sector's brand as "green economy" and "climate or carbon positive." At a local scale, 1:1 and small group mentoring of learners improves worker's self-confidence and affinity for the sector.

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Contents

1. Knowledge-Sharing Program Overview and Findings

In Section 1 we describe the rationale for the conversations, the high-level findings and the unique words of experts (which we have anonymized). This will be followed by Section 2 where we will discuss the implications for the NSF EPSCoR Grant and related investments. Section 3 concludes with a summary of experts' wish list for the NSF EPSCoR Track 1 program.

1.1 Profile of Knowledge-Sharing Process and Experts

Maine has a long-standing commitment to a sustainable, resilient forestry sector. Engaging the leadership of UMaine's own Aaron Weiskittel, Ph.D., UMaine and collaborators were invited to apply for a $20 million, five-year National Science Foundation (NSF) Established Program to Stimulate Competitive Research (EPSCoR) grant. The goal is to develop and deploy insights on wood fiber-based products, forest AI and sensors, carbon solutions, and tourism, as well as the workers and communities that participate in the forest-related sectors. This proposed project would involve research, workforce development, and collaborations with public and private partners. This NSF EPSCoR project would help diversify and grow the state's forest-based research and workforce capacities.

Rationale for Knowledge-Sharing Process

The EPSCoR planning grant team conducted 11 conversations during late November 2022 to early January 2023. The goal from the knowledge-sharing process was to convene a network to advise and inspire the NSF EPSCoR proposal and to help define the network's purpose. The conversations were each between 45 minutes and one hour, and two members of the planning grant team participated in each to ensure accurate recall and engagement. The conversations were confidential, and the team sent experts a preview of this summary with gratitude for their contribution. Questions used in the knowledge-sharing conversations are in Appendix A.

In this document we summarize the critical issues experts identified, and organizations or networks that they identified. We have kept names of experts confidential.

Expert Profiles

The 11 experts represented seven organization types. As the research team under the Center for Research on Sustainable Forests (CRSF) had ongoing work with the physical science community, we chose distinct personalities who had

expertise in public-interaction, non-academic research, human/professional development, economics, and supply chain. Experts' organizations often had multiple purposes (e.g., research and workforce development). These organization types were the most mentioned by the experts during the discussion:

- Industry Coalition (1)
- Government Agency (1)
- Land Conservation organization (2)
- Manufacturer of Forest-Derived Products (1)
- Non-University Research organization (2)
- Organization focused on non-degree training (2)
- University or College (2)

Experts spoke from their considerable professional expertise, extending well beyond their current posts and affiliations. Areas of expertise identified in their public profiles or historical collaborations with UMaine are shown in Table 2.

As evidence of experts' breadth, they serve on the CRSF board, Forest Opportunity Roadmap (FOR/Maine), Cooperative Forestry Research Unit (CFRU), and Maine Climate Council, to name a few (see Table 5, for additional networks).

Table 2. Counts of Experts' Areas of Expertise

Expertise	Count*
Green economy (production, policy, enforcement, markets)	9
Natural climate solution or climate- smart management	9
Workforce development	8
Wildlife habitat modeling, assessment	7
Renewable materials or bioproducts	5
AI / Informatics / Sensors / automation	3
Cultural Practices	3
Tourism and recreation	3
Freshwater Resources monitoring	2

Note: Totals exceed expert count, as each had multiple areas of expertise.

1.1 Findings: Forest Industries' Opportunities

Experts were optimistic about the forest sector, recognizing that renewed interest in forests - as climate solution, varied livelihoods, and recreation - were leading to greater public attention. Experts noted that forest sector activities could yield multiple outcomes, improving carbon sequestration, housing equity, new green jobs, and knowledge transfer from traditional and

Indigenous managers (Table 3). Not only are the outcomes multi-dimensional, noted experts, but the solutions are also self-reinforcing. Consider these statements from experts:

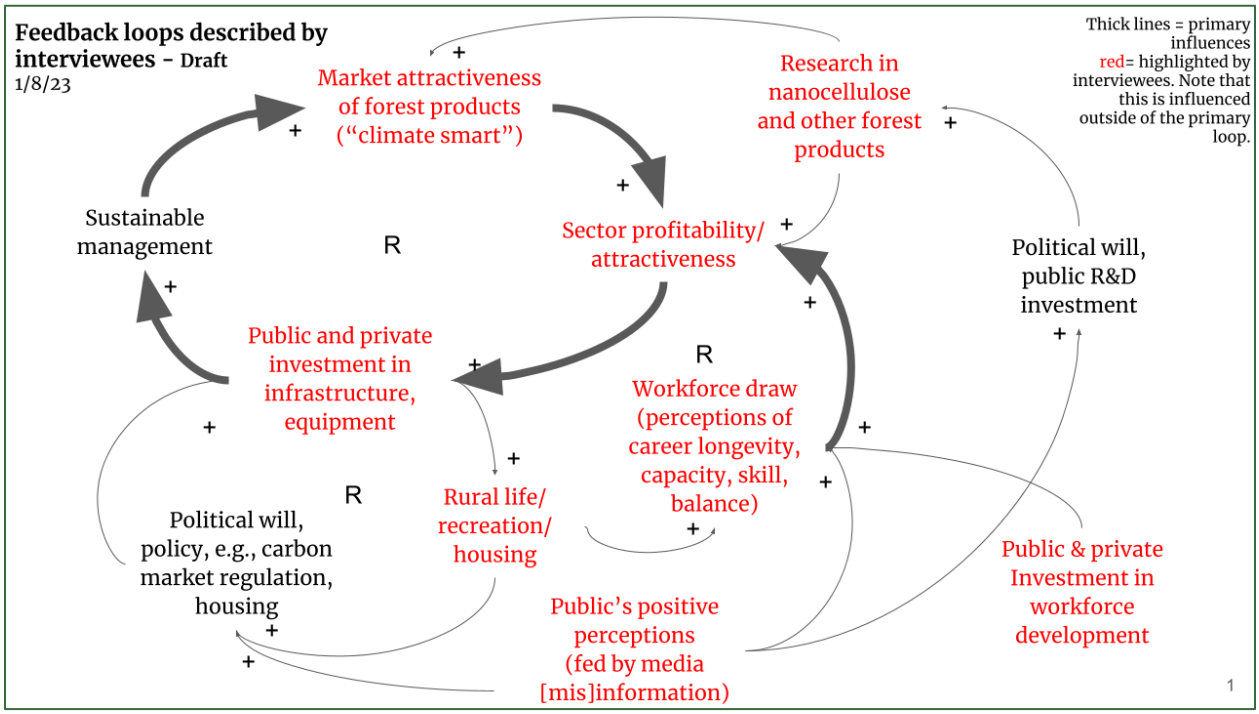
> *Think about long-lived products, e.g., cross-laminated timber. This could be "Made in Maine, from Maine wood."*
>
> *[The industry managers] were slow to come around to climate change [which is a social space], and now they are wanting to talk about child care! They want to be in these social spaces. I'm seeing these interesting movements toward these social issues, which would have been separate in the past.*
>
> *We tried to predict the geographical areas at greatest risk of infestation. Just using machine learning models. [There is a] role for data mining techniques.*
>
> *[SpacePort (https://www.themainespaceport.com) would give us] better satellite data to inform many natural resource management decisions.*

Table 3. Areas of Forest Industries Opportunities Identified by Experts

Forest industry as solution to climate, housing, livelihoods
New blood / new hires with sought-after skills; new media expertise
Startup ecosystem / funds, such as Omnibus Bill, community college funds
Changing public attitudes about forest
Indigenous/diverse intelligence
Data science / open data reducing costs, silos
Industry, nonprofit, academic initiatives and networks with access to communities, social capital

Figure 1 illustrates the feedback loops that the experts described. Bold are the primary influences, and red are the key opportunities that experts pointed to which could improve the forest industries. This systems-thinking diagram shows, with arrow heads denoted with "+," experts' perceived positive feedback between market attractiveness ("climate smart"), sector profitability/attractiveness, investment, sustainable management, and other factors, such as political will, rural life/recreation, research, and minimized (mis)information. Experts appreciated that any of the elements could underperform (such as a reduction in workforce investment, [lower right] or negative social media [bottom, center]), and limit or reverse the positive growth.

Figure 1. Generating a Virtuous Cycle in the Forest "System"



Note: "R" means that the loop reinforces. "B" means the loop balances (flows work in opposite directions). "+" means that, when the item at the beginning of the arrow goes up or down, so, too, does the item on the end of the arrow in the same direction. "-" means that they move in opposite directions. (For simplicity, we have articulated elements so visible loops reinforce them.)

1.2 Findings: Forestry Industries' Challenges

Experts noted that the aforementioned opportunities do not come without challenges (Table 4). With the historical divestment and decoupling of the supply chain resulting in high capital costs of entry, forestry industries face investment risk. Added to this are uncertain markets for green products, supply chain lags, transportation costs, slow establishment of carbon markets, and land return considerations.

These challenges are compounded by profound misinformation regarding forest management. There are persistent images of clear-cutting, and misleading statements about carbon-sequestration and regulators' "green-tape." Misinformation is influencing public perception about how to manage for carbon storage, forest health, biodiversity, and resilience. When global forest industry competitors charge lower prices, buyers often lack information about the true environmental and societal costs of such products. Moreover, in-migrants have little understanding of the value of forest management: many believe no harvesting is the most pro-environmental action they, as landowners, can take. (This is called the "pro-forest" movement.)

> *Key challenge 1: Use of conservation lands for carbon sequestration - concept is getting more and more focus, but it's the wild west, and a lot is unknown. 2: Lack of consistent markets for certain forest products. 3. Uncertainties about the future: for example, emerald ash borer, hemlock woody adelgid, red pine scale.*
>
> *We're better at creating new products than building the markets for them. How are we aligning the forest industry with climate mitigation strategies? Can these products be viably brought to commercial scale?*
>
> *Emerging tech and attraction [campaigns] are de-risking emerging markets. For example, opportunities for co-location or combining nanocellulose products. But [the owners] are weighing those against their global options. There needs to be an incentive to do this here, in Maine. [It comes down to] investing in the commercializing of new products.*
>
> *There are also gaps in getting wood to local sale. Lack of kiln drying capacity (e.g., kilns could be brought to different parts of Maine).*
>
> *Within a market-based perspective, Maine's forests continue to maintain profitability, so forest landowners focus on stewarding*

their forests. Holding those lands for carbon sequestration is also part of their economic profile, but it's viewed as less certain.

The influx, last year, amounted to a 27% increase in real estate transactions. People are moving into seasonal homes full time. [Those people don't have] the same ethics. This has the potential to change the face of forestry in Maine, and I'm pretty concerned about that.

[T]the surge in visitation for recreational purposes coincided with minimal staffing capacity. It really raised a big flag for a lot of communities. … There are different issues in mill towns (Milford, Millinocket) versus [towns like] Greenville, Bethel. There are pressures from AirBnB-type systems. There's a risk of hitting 'boom town' issues.

In southeastern Europe, there's a demand [for pellets]. But what if the EU changes its mind? What happens if we are super tied to this market and it shifts?

Table 4. Challenges that Experts Identified for the Forest Industries

Costs of entry, such as capital startup costs
Operating costs, e.g., labor/skills, manufacturing, transport fuel
Global, non-traditional competition
Capital mismatches, risk-perceptions
Covid owner/labor influx, driving up housing costs, boom-town risks
Persistent image of clear-cutting, misinformation
Carbon market regs, perception
Insufficient diversity in ways of knowing; concerns for BIPOC equity
Indigenous land return
Overlapping workforce initiatives, fragmentations

1.3 Findings: Workforce Opportunities

In parallel to the forest industry opportunities and challenges, experts described forest industry workforce demographics, skills, learning opportunities, and career paths. The workforce is younger, more knowledgeable of conservation science, and exposed to a wider range of technologies and data uses. Migration into Maine during the pandemic has more than offset the death rate, so Maine is growing, seeking housing, amenities, and engagement with Maine's forests. Meanwhile, jobs and careers are aligned to young people's stated goals: Forest jobs use more data science, sustain the environment, integrate concerns for equity and climate, balance indoor and outdoor activity, and balance individual and team activity (by contrast, for example, to Big Tech's downsizing roles). Meanwhile, degree and non-degree initiatives are being sponsored by state, university, and nonprofit players.

> *I integrated the research and community well-being space together. If we could think of it as a more integrated way that is better for workforce development.*
>
> *How do we navigate this challenge? We need things to make rural communities more attractive to young people. There is continued work to do to integrate recreation into the forest economy. Given changing land ownership patterns, that needs attention.*
>
> *[We] saw changing demographics due to Covid migration. People are taking up permanent residence. Suddenly [we see the] the holy grail of the influx of young families making it their home and kick-starting rural economies. The question is: How to get out ahead of this changing demographic?*
>
> *We need to get the equipment into the hands of a new generation of loggers.*
>
> *What's unique is that we have such science capacity. Rapid change is our focus, as is on-the-ground climate adaptation research projects. Restoration experiments on summits, for example.*
>
> *Students interested in forestry are more interested in broader issues, such as resource management, e.g., public policy, water resource issues for the Penobscot Nation. They are interested in tribal well-being.*

As we are thinking about the tourist and recreation sector as a source of jobs, we ask, "How do we shift that sector from being an extractive sector and more of a contributive sector?" People coming to the region [should be] able to contribute to community and forest stewardship.

1.4 Findings: Workforce Challenges

While these opportunities exist, the transition to them can be uneven (Table 5). All experts pointed to gaps in the numbers of workers throughout the supply chain (e.g., logging, trucking, engineering). Several felt migrant worker programs were inadequate. Experts pointed to a shift in the composition of jobs to more technology- and data- based, beyond what is feasibly taught in the space of an undergraduate degree. Experts also pointed out that young workers lack training in professional behaviors, yet they are limited in their ability to get those experiences in low-paid internships.

Nor do young people (e.g., high school or college aged) have complete information about forest career pathways or training options. Experts suggested that such a lack of long-term perspective may cause workers' reluctance to take risks, such as spending time in overtime (at the expense of family or reputation) or in self-development (that might not pay off). Mentoring was considered part of the solution, but experts noted that mentors are often not recognized or compensated.

The bottleneck is truck drivers and loggers currently, but in the future, there will be needs at every part of the supply chain.

Historically logging was a low investment - just a chainsaw and a skidder. Now it's an enormous financial commitment.

Workforce Development is a critical issue: The face of forest resource professions is changing rapidly. It's now all about data. I heard the head of Irving Canada say: "Ten years ago, forest managers couldn't get enough data for making decisions. Today, we don't know what to do with all the data we have access to."

Research requires data. [We] don't have forest industry knowledge. There is a huge need for data management professionals with expertise in specific domains, or collaborators with natural resource expertise.

[People need to know] technology, but also policy: historically [policy was] forest certification and conservation easements to maintain private forest land as forest. Now there are carbon markets. These major policy developments affecting the forest are new. There is a limit to what you can fit into a four-year degree for a professional forester.

We are trying to bridge the college-to-career gap. The old model was unpaid internships, and that has serious [DEI] problems! The talent pool is therefore limited.

Younger people who see how industrial forests have been overharvested want to stay away. They see a landscape of beech sprouts and they just don't trust any of the players.

There must be additional structures in place to help people enter the workforce.

Table 5. Workforce Challenges Perceived by Experts

Youth arriving unprepared for professional careers
Lack of perception of long-term career growth
Workers protective of their personal time
Fragmentation and opacity of degree / non-degree programs
Inequities in access to programs which assume "free" labor (internships)
Lack of proper recognition, pay for mentoring, advisory or training expertise
Immigration / migrant workers programs are limited

1.5 Findings: Experts' Own Organizations' Investments, Programs, and Pilots to Watch

These challenges described above were not just academic. Experts also shared that they experienced the very staffing challenges that they are trying to address, funding gaps, lengthy grant-cycles, misinformation, and labor under-valuation.

Responding to the strengths and weaknesses in the industry and workforce, experts' programs, collaborations, investigations and advocacy showed tremendous creativity. Programs included attracting investment, research and global talent into the sector: offering targeted learning opportunities, providing mentoring-type collaborations, and changing public understanding of forest industries ("public," here including prospective forest professionals, entrepreneurs and employers). Contributions to public understanding come from communications and collaboration with organizations like the Maine Forest Service and the US Paper and Packaging Board.

> *FOR/Maine has an ongoing economic and community development project. We are thinking about the goal of FOR/Maine in a descriptive sense from the community up. Goals are that: 1 Communities have adequate economies from the forest up; 2 They produce a diversified mix of forest products; 3 Forest industry is globally competitive and recognized. [This includes] new products and old products. These products are related to climate. We are most interested in the communities in which mills were shuddered.*
>
> *[Our] aspiration is in the area of AI and machine learning to positively impact the economy of agriculture and forestry, and positively impact climate with reliable and relevant data.*
>
> *[We want to] boost the forest economy, fight climate change, and address the affordable housing crisis.... [We see this as] "Climate Smart Wood Products for Affordable Housing."*
>
> *Organizationally, housing and community revitalization are rapidly ascendant focal areas. That's the growth segment. That's pretty radical from my vantage point. We're aggressively raising funds for housing projects. We need to use innovative financing, leveraging impact investment dollars as seed funding.*
>
> *At a concrete level, going to the lumber yard and not knowing where the wood comes from. [...] How do we have a regional [product]*

lumber yard within 40 miles of everyone's house, and how do we have it work for the community? How do we deal with the externalities, such as the carbon footprint when you purchase lumber from Lowes or Walmart? How do we see the carbon footprint or the environmental footprint before you buy?

Research is a critical part of this work as it can create its own outputs and outcomes. My colleagues and I talk about speaking back to the forestry sector with Wabanaki models. For example, with our land return work, responding primarily with inventories is not helpful; it's a different mindset with different priorities. We need to develop research capacity in natural resources Indigenous knowledge.

Experts' programs also have some overlaps, such as training content common to universities and multiple nonprofits. Removing overlaps is the rationale for a coalition led by Maine Forest Service, the ABC Collaborative, to invest in a database or director of program-trainer-certificate holders. (In the "3. Discussion and Experts' Recommendations for Action" below we expand on experts' wished-for solutions to address some of those overlaps.)

We are developing a graduate certificate program and online learning: [forest] data usage, focusing on policy aspects of owning forest today.

We are expanding a network of facilitators and partners who can deliver their programs. [We are driving for] more forest tech programs at high schools.

We are offering forest field trips for political refugees to make them feel welcome.

[We are] building a better early career opportunity pathway, and plan to establish fellowships. We help facilitate UMaine researchers' work in Acadia.

Beyond college, there must be additional structures in place to help people enter the workforce…We are trying to create an entry-level position environment that provides a living wage.

2. Discussion and Experts' Recommendations for Action

In this section we provide the experts' reflections on the implications of the factors facing the forest industries, their organizations, communities and workers. Also in this section we report recommendations that experts made regarding partnerships, networks to join or leverage, and EPSCoR workstreams.

2.1 Workforce Development: Expanding Experiential Learning Pathways and Definition of Professions in This Industry

As workers consider career trajectories and life in the field, yet employers insufficiently target, there is a need to engage youth, adults considering career changes, and professionals in ways that have meaning for them. They care about climate change, sustainability, biodiversity, and Indigenous communities. Experts recommended programs that target vocational school, gap-year, and community college students, 4-year colleges, and professional development. Potential programs will need to involve tribal community members to make the forestry profession relevant to them.

1. **De-risk** the profession (and reduce the opportunity costs of schooling) with practical experience. Pay for fellowship or internship roles, as a funnel toward employment that pays a livable wage (unpaid internships are no longer a viable model and raise equity concerns). Funding is needed to develop and staff such programs, with a coordinator who connects students to field opportunities.

   > *We are developing a graduate certificate program in forest resources with online learning to help develop better expertise in forest data usage, carbon and conservation policies, and forest operation finance.*
   >
   > *We are expanding a network of facilitators and partners who can deliver our programs. We are also promoting forest tech programs at high schools.*

2. **Pair 4-year college students** with state foresters, natural resource professionals, and forest researchers.
3. **Reduce attrition, accelerate onboarding** by pairing data-savvy new employees with subject-matter experts, like the "teaching hospital" model.

We developed a model called "teaching hospital." [The motivating] idea is: "industries want to up-skill their employees quickly." Educational workshops are the typical response: people come, learn for a while, and go back to their jobs. We did this instead: We brought together six [sector-expert] employees and six [analytics] students to solve problems with analytics support. This pairing model is intense and really effective in solving problems! You have students working with senior managers, and they get to know each other, they solve a problem, and the added benefit is it becomes a very effective hiring funnel.

4. **Define/reward learning components** (e.g., stackable, badge-able, that can be used toward degrees). Using gamification and micro-credentials may reduce perceived risk, raise a sense of affiliation, and increase self-esteem.
5. **Generate just-in-time learning** experiences, e.g., on location QR-code access to YouTube module.
6. **Bridge professional cultural differences** among workers and between non-forest workers and the forest industry through cultural awareness training.

At the community level there are housing challenges. But, there are also issues about welcoming these people of different racial and cultural backgrounds. This goes beyond the workplace itself. I did work with [organization supporting immigrant workers]. People thought that it was just standing up training. We found we had to add training on cultural competency in the American workforce.

2.2 Data Management/Analysis/Application: More Than Just Geographic/Biological Data

The forest sector is now being flooded with field data, but systems don't yet exist to use all this new information effectively, especially related to climate impacts and social data.

1. **Build a data strategy** for unstructured, social data such as misinformation in media about forest clear-cutting and climate.
2. **Curate/open industry data** in the public interest, such as forest management practices and sustainability outcomes, carbon options, and availability of local supplies.

How to create and maintain a single source of information on the availability of local wood? We need to define climate-smart, regionally sourced wood. Establish these criteria to fit into Housing Authority rubrics.

3. **Curate/open education-related data** in the public interest. Improve transparency into content, format, pricing, career statistics (e.g., comparisons/directories). For example, ABC Collaborative's directory of training, certified instructors, and graduates.
4. **Integrate multiple ways of knowing** into the open data or open-source program office (OSPO).

Having research questions to build from Indigenous knowledge is important… Questions should be motivated and informed by Indigenous people and then have them answered via multiple forms of knowledge. It speaks to a different motivation and legitimacy.

2.3 Public Education and Communication: Systematically Combating Polarization and Misinformation

Experts advocated for consuming such data in coordinated education and communications campaigns for northern New England forest industries. Funding is needed for these campaigns.

1. **Develop a shared narrative** that says that forest management, forest (nano)products, and local production are core climate- and plastics-replacement solutions.
2. **Target where there is the most leverage**. Specific messaging should address climate and pandemic migrants and younger, sustainability-focused citizens.
3. **Coordinate communication execution** to combat bias and undemocratic behavior, using researched behavioral insights interventions, such as creating default-values or priming. Use popular media to spread the benefits of forest management and circular economies, as is the task of the Paper and Packaging Board.

Our industry at large has a tainted reputation. "It's your grandfather's industry and it's dying." We have a stronger sustainability story. We've been beating that drum. It's helping some, but some of the statistics let me think that there is a need to get a groundswell out there. When you look at [the industry's

reputation] by cohort, the GenX'ers feel that the forest products industry is helping. If you get younger in age, it gets worse. The message is not getting through…I'm talking about getting into middle schools and saying that a working forest is a healthy forest. The need to clean out forests, and the difference between clear cutting, and then what [wood] products continue to add to the circular economy. For example, people don't know that 85% of the energy of a paper mill we produce ourselves.

Our staff needs more time to work with our woodland owners. Do they have the resources they need? Whenever they say, "How do you manage for conservation," we need to be there.

A few weeks ago a group called "pro-forest" which is lobbying to stop all harvesting. They are spreading misinformation, such as "Simply cutting trees means carbon gets released into the air." It's a subtle change [to communicate better]. We're going to need to address this issue.

The story can be complicated. I don't mean to be insulting, but you kind of have to dumb it down. It's the "Mickey Mouse" story that people will understand.

2.4 Livable Communities and Affordable Housing: Climate-smart, Equity-based, and Jobs-creating

The lack of affordable housing is rapidly becoming the number one constraining issue for forest employment. Rural communities aren't appealing to younger individuals and families. In response, experts were marrying housing, climate change and the local wood economy, but perceived the investment and visibility of such initiatives were insufficient.

1. **Build demand for local** wood (nano)products (see 2.3, #1 above)
2. **Partner on the production of affordable housing** manufactured using local wood products, such as cross-laminated timber.
3. **Provide home buyers and contractors with better visibility into the supply** for local wood products. (See 2.2, #2 above)

I'm thinking about where this equity work could prepare a more diversified workforce… The conversations we've had [with lumber companies] shows a willingness to go there.

Build on the power of local. People want to know where their wood comes from.

2.5 Industry Attractiveness: Developing Supply Chain and Outlets for Local Wood Products at Commercial Scale

In addition to housing, experts were concerned that we are not adequately investing in bringing these low-grade wood products to commercial scale. De-risking business ownership is needed, especially where capital startup costs are high, carbon markets are immature, and returns fluctuate.

1. **Create investment instruments** that pinpoint, and de-risk supply chains gaps (e.g., trucking and kilns).
2. **Reduce startup capital costs with franchise models**. One expert recommended exploring a franchise model that could inject standardized methodologies, legal processes, leased capital, and mentorship.

   It's not just about having equipment sitting there. It gets sold. It leaves Maine. Then you have a very [prohibitively high] cost of entry. The capital costs are very high. There could be some more economically viable business models. I wonder about the franchise model. Airlines lease their airplanes They then give them back to Boeing who sell the parts [or sell the planes]. We could have a similar franchisee model.

3. **Provide transparency into carbon markets**. There is not yet a stable regulatory infrastructure at the state and federal level, inhibiting industry participation in carbon markets. At the same time, the "rights of nature" are an international dilemma. This ambiguity may be impeding the attraction of workers and investors.

   These [markets] are getting bigger and more people are involved. The Federal government has not put a mandatory thing in there [e.g., proportion reserved]. The study would be "At what economic enticement would a small landowner not sell any [wood], because the value is higher [in carbon markets]?" We get a lot of wood from smaller landowners. It has implications around the health of the forest. If we have large swaths of land not cleared in any way, then there are risks of forest fires. We can see there are some areas that are not being managed.

2.6 Network Strategy: Existing Networks May Be More Time- and Cost-effective than New Networks

Networks provide scale, reach, diversity, belonging and productive capacity (including peer advice). Experts stated that networks, rather than individual entities, can develop mechanisms to cross boundaries and work across needs. Networks were perceived as an attractive action model to address challenges and opportunities described above.

> *How could a network support this initiative? … We're the friend makers. [There is] tremendous potential for coordination. The lack of communication means there is inefficiency. People are speaking slightly different dialects, but building the relationships is the meat of the work.*
>
> *If it felt like a fit, I would love to see how we could combine initiatives, raise funds, put the pieces together, and maximize collective impact.*
>
> *I prefer the language, "we're invested in multiple ways of knowing" in acting and experimenting with the forests. Local people. There are ways to message that, that respects that this has to speak for the whole state, but that doesn't silo the Indigenous interests into a single diversity column. There are tensions across the state that involve local people, landowners, uses, and the traditions of Maine. This comes back to legacies of stewardship and caretaking that, in turn, comes back to the Indigenous [philosophy]*

The goals for the EPSCOR proposal, as described by the experts in 2.1-2.5 are so broad that creating a single network that covers all of it would be challenging. Starting and coordinating a new network can be costly, and experts felt that they were spread thin in their current affiliations. At the same time, they agreed that clear network strategy, structure and tactics are essential to building trust, cohesion, volunteerism, and impact, and those are at risk without coordination.[1]

[1] Pugh & Prusak (2013) Designing Effective Knowledge Networks, MIT Sloan Management Review.(Research funded by the Bill & Melinda Gates Foundation).

1. **Leverage existing network(s) rather than establishing new ones.** Partnering would accelerate social capital, process capital and the speed of policy-making insight. Experts named 19 networks from which to select (see Table 6). It may help to combine or revive networks.

   I created a data science group and tried to organize a meet-up every month, with a guest speaker. Initially a dozen came and it grew to 100! It has gone dormant due to lack of ownership/leadership.

2. **Build bridges**: With a focused network objective, reach out to diverse organizations and individuals who have energy, alignment and social capital. For example, commercial forest industry representatives could bring talent to rural community development issues, but they would rely on community development practitioners to define network-based initiatives.

3. **Go beyond Maine**. The Maine forest products sector tends to see itself as unique. Yet, regional partnerships may provide access to more funding, thereby accelerating research, streamlining communications, accelerating curation initiates and piloting technologies.

   You have to have a shared mission. Without that shared view, no one will join. There also needs [to be] capacity built in to coordinate the network. It takes time and money. Networks persist and are most helpful when together we're doing something that none of the organizations can accomplish individually.

   Would be great to have staff - a general coordinator of this initiative.

   If you don't have the trust of the younger generation, as you think about partnerships, you lose them. You need to include the trust factor.

   We need to connect the academic institutions (UMaine and community colleges) with the needs that the local community has.

Experts identified over a dozen existing networks in Maine and beyond with whom to collaborate for the EPSCoR project (Table 6).

Table 6. Experts' Recommendations for Existing Networks with Whom to Collaborate

Network Name	Website	Description
FOR/Maine (Forest Opportunity Roadmap/Maine)*	https://formaine.org/	Intends to be cross-sector collaboration between industry, communities, government, education, and nonprofits (although seems to emphasize industry). Emphases ensuring Maine strategically adapts and capitalizes on changing markets to maintain leading role in the global forest economy. Coalition created with support from US Economic Development Administration and US Dept. of Agriculture.
Forest Carbon for Commercial Landowners (FCCL)	https://ypjc53.a2cdn1.secureserver.net/wp-content/uploads/2021/04/FCCL-Graphic-Prospectus-V2-2005map244.pdf	Networked project focused on whether commercial forests could be managed to store more carbon without constraining landowners' financial performance, and if so, using what specific "instruments." Technical team includes UMaine's Aaron Weiskittel and Adam Daigneault and others from Baskahegan, TNC, Irving, and USFS.
Maine Mountain Collaborative	https://mainemountaincollaborative.org/	Collaborative of land conservation organizations, including Appalachian Mountain Club, Forest Society of Maine, New England Forestry Foundation, and others. Focus is on the state's mountain region. Offers land conservation grants.
Kennebec Woodland Partnership	https://www.maine.gov/dacf/mfs/projects/kennebec_woodlands/index.html	County-based initiative providing tools/strategies to help landowners make informed decisions about their woodlands.
Hubbard Brook Research Foundation*	https://hubbardbrook.org/	Aims to bridge gaps between science and education, public policy, land management, corporate sustainability, and recreation. Facilitates dialogue between citizens and scientists.

Network Name	Website	Description
Local Wood WORKS*	https://www.localwoodworks.org/	Partnership established by Kennebec Land Trust and Maine Forest Service. Priorities are helping landowners keep their forests as forests and promoting policies that support a sustainable financial basis for long-term forestland ownership. Website aims at connecting builders, engineers, etc. to local wood producers. Partner organizations include The Nature Conservancy (TNC), Northern Forest Center, and GrowSmart Maine.
Northeastern States Research Cooperative	https://nsrcforest.org/	Competitive grant program funded by the USDA Forest Service, supporting cross-disciplinary, collaborative research in the Northern Forest. Cooperation among USFS, Hubbard Brook, Northern Research Station, UMaine's CRSF, UVM, UNH, and SUNY.
Northern Border Regional Commission	https://www.nbrc.gov/	Federal-State partnership for economic and community development within the most distressed counties of ME, NH, VT, and NY. Provides funds for economic and community development projects. Has a Forest Economy program.
Long-Term Ecological Research Network	https://lternet.edu/	Founded by NSF. Nationwide network of 28 research sites, including Hubbard Brook. .Mission is "to provide the scientific community, policy makers, and society with the knowledge and predictive understanding necessary to conserve, protect, and manage the nation's ecosystems, their biodiversity, and the services they provide." Has education and outreach resources. LTER data made available via Environmental Data Initiative (EDI).
Maine Downtown Center	https://www.mdf.org/program-partnerships/maine-downtown-center/	Program within the Maine Development Foundation. Part of a nationwide network of programs and communities focusing on strengthening communities through preservation-based economic development. Offers funding for entrepreneurs, small businesses, and nonprofits.

Network Name	Website	Description
Maine Land Trust Network	https://www.mltn.org/	Builds/sustains effectiveness of land conservation organizations. Acts as a central information hub and facilitates collaboration among conservationists. Offers various programs, services, resources.
Maine Environmental Education Association	https://www.meeassociation.org/	Mission: “Builds environmental awareness, accountability, and action by centering equity and advancing systemic change.” Audiences include high school and college students, teachers, community members, nonprofits. Affiliate of the North American Association for Environmental Education.
Maine Outdoor School for All	http://ellms.org/	Network of residential environmental learning centers working together with Maine schools and other partners to facilitate learning opportunities that empower students to create healthy, vibrant communities.
Nature-Based Education Consortium	https://www.nbeconsortium.com/	Maine-based collaborative network of outdoor learning leaders and stakeholders. Focuses on youth access to outdoor learning experiences. Partners include Schoodic Institute, UMaine Cooperative Extension, The Nature Conservancy (TNC), Maine TREE Foundation.
Professional Logging Contractors of Maine	https://maineloggers.com/	Trade organization focused on logger advocacy, safety, quality operations and business innovation. Founding member of the American Loggers Council (ALC) and works with the ALC to influence federal legislation. Created the Northeast Master Logger Certification program.

Network Name	Website	Description
Adaptive BMP Cooperative	Please contact Maine Forest Service at https://www.maine.gov/dacf/mfs/	The Maine Forest Service proposal to work with partners to establish the Adaptive Best Management Practices Cooperative (ABC) to review and recognize forestry trainings that meet strict quality criteria and provide forest practitioners a documented path toward professional expertise for their unique responsibilities.
Maine, Finland, Michigan bio economy working group.	https://www.mitc.com/wp-content/uploads/2022/02/FMM-Forest-Bioeconomy-Collaboration.pdf	In 2019, an MOU between Finland's Ministry of Agriculture and Forestry and Maine Dept of Agriculture Conservation & Forestry was signed by Governor Janet Mills and immediate past Prime Minister of Finland, Antti Rinne.
Paper and Packaging Board	https://www.paperandpackaging.org/	Federal board for improving awareness. Like the "other white meat" pork campaign. USDA. PPB has been operating for seven years. Initial purpose was to promote paper-based packaging. Now they convey an environmental story and tries to dispel misperceptions of forest industry. Uses social media, offer sales tools.
Alliance for Pulp and Paper Technology Innovation (APPTI)	https://www.appti.org/	Industry road mapping. The last (of 2) was published in 2016. The roadmaps communicate grand challenges in the industry and technical goals.

*Entities that have funding but act as networks.

2.7 Direct Partnering Strategy: Existing Maine and regional organizations are connected, resourced and skilled

In addition to the recommendation to engage with existing networks, experts recommended the EPSCoR program leverage or expand the projects and programs of existing organizations (Table 7, Table 8).

> *Another thing I'd like to see is coordination — we're disjoined with other partners, e.g., [UMaine] cooperative extension.*

Table 7. Experts' Recommendations for Existing Organizations with Whom to Collaborate

Education	Wabanaki Youth in Science (WaYS), Maine TREE Foundation, Maine Forest Service, FOR/Maine*, Northern Forest Center, Schoodic Institute, Roux Institute, Mechanized Logging Operations Program, and Girl Scouts**. Multiple players have workforce development programs. In addition,** Girl Scouts **give young girls exposure to the forest industry, management, and climate science through manufacturing site visits and scavenger hunts.**
De-Risking Investment	**Hubbard Brook Research Foundation*, Kennebec Land Trust, Maine Forest Service** in developing educational programs targeted to new forest landowners (e.g., HBRF's Welcome to the Woods Program). Such organizations teach how forest management and local wood products are a solid climate solution. Educational programs are also needed targeting long-time forest landowners who are trying to decide the future of their forest land.
Market Development	**Northern Forest Center, Local Wood Works* (convened by Kennebec Land Trust), Hubbard Brook Research Foundation*** to promote and expand the use of wood and processed wood products (e.g., through grants awarded by the Future Forest Economy Initiative) for building applications, particularly in service of addressing the northern New England's affordable housing crisis (e.g., HBRF's Climate Smart Wood Products of Affordable Housing program).
Data Science, Data Curation, AI	**Forest Service, Colby College, Roux Institute. Roux and Colby** faculty apply AI and data science to solve certain forestry problems and advance forest industry research (while also supporting workforce development, e.g., Northeastern's "teaching hospital" model). Forest service is curating education and training data as part of the ABC Collaborative. Roux and Colby are focused on natural language processing and unstructured data (e.g., web and communications).
Technical Assistance	**Passamaquoddy Tribe and Maine Forest Service. Maine Forest** Service is integrating the technical assistance and communication activities of the Maine Forest Service, Cooperative Extension, Soil and Water Conservation Districts, and Natural Resource Conservation Service. **Passamaquoddy Tribe** (in collaboration with the Maine Forest Service) is currently working on a skidder bridge project. EPSCoR Track 1 could engage by funding fellowships or Tribe representatives to consult or teach.

Table 8. Experts' Recommendations for Research Sites

Maine TREE Foundation's Holt Forest (Arrowsic, ME)
Hubbard Brook Experimental Forest (White Mountains, NH)
Acadia National Park via Schoodic Institute - climate science and invasives research
Northern Forest Center - actively developing local affordable housing opportunities that use local wood products. Also interested in tracking / mining of the press and social media for misinformation instances, reactions, intervention impacts.
Roux Institute's research sites - Using AI and data analytics, with ongoing collaboration with UMaine AI. SpacePort is an example.
MIT Center for Applied Cooperation at MIT Sloan School of Management does tracking / mining of the press and social media for misinformation instances, reactions, intervention impacts.
Maine Department of Labor. Potential AI/workforce research, such as career path leakage/ attrition / retention.
Maine Forest Service and other AI or market research partners.
Maine Outdoor School – Offers educational programs, guided experiences, and organizational services (incl team-building and evaluation).

3. Conclusion: Experts' Wish List for Content in the EPSCoR Project Proposal

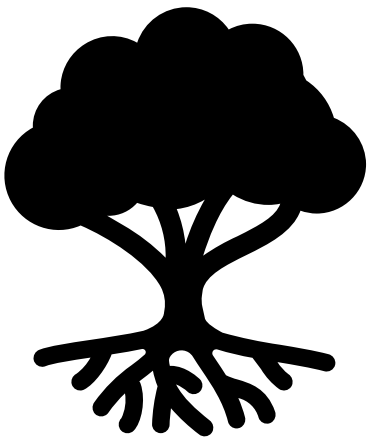
We conclude with recommendations that experts made for the EPSCoR proposal (Table 9). While this is not a statistically significant sample, we've noted the numbers of mentions, and sorted in descending order by mentions.

Table 9. Experts' Wish List for Content in the EPSCoR Project Proposal

Wish list item	Definition	Number of Interviewees
Target learning program design and execution	Develop and/or integrate non-traditional educational opportunities (e.g., non-degree, onsite/in the field, professional, and bridging experiences, such as gap year, fellowships). Target a range of learners, from K-12 through career changers.	8
Make forest related communication/ public education smart, consistent, targeted	Study misinformation patterns about forest, carbon use/sequestration/storage, and careers. Academia, industry, government, community organizations and NGOs must work together to pilot and deploy campaigns that convey the rationale for Forest-as-climate- and-economic-solution.	7
Curate, open-source, share and apply data effectively	Large volumes of data need to be continuously synthesized, curated, and shared (e.g., sensor data, green/ nanocellulose/ mass timber product data, market data, supply chain data, citizen science data, education / training data).	6
Integrate data science, cultural intelligence and policy into learning	Give prospective workers hands-on experience in both the hard and soft sciences: data science/ engineering/ cultural intelligence (e.g., diversity in ways of knowing), policy and policymaking.	5
Address professional and community well-being together	Understand, improve 360-degree experience of forest industry workers, such as housing (including local wood, cross-laminated timber, 3-D printing), broadband, healthcare and other community attributes.	4
Better understand risk for individuals and towns	Understand risk to investor, worker, and town from forest-related business opportunities. Consider risk-profile changes and understand risk by segment, especially in light of tech, climate, demographics, and competitive use of capital, time, public investment, social capital.	3
Coordinate and pay for the mentors and advisors of newer workers	Coordinate natural resource professionals and scientists who will provide mentoring, guidance, career- counseling, training and professional contacts	3

Wish list item	Definition	Number of Interviewees
Incorporate different ways of knowing (especially, Indigenous, other cultures)	Forest management decision making has traditionally been top-down. Incorporate decision making models that respect local knowledge and management.	3

Note: Ordered based on the number of experts who mentioned this wish list item.



Appendix A: Knowledge-Sharing Conversation Invitation and Questions

Knowledge-sharing conversation invitation, containing questions. This was sent by the lead facilitator. The second facilitator took notes. Knowledge-sharing conversation topics were compiled by expert, by question, and by type of organization.

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Subject: Forest NSF EPSCoR project and network

Dear X

Hello, and happy Thanksgiving! [text edited by planning grant team member making into]

I'm writing to invite you to join me in a brief conversation about a research and industry collaboration opportunity in the areas of forest economy, climate and equity.

UMaine has a long-standing commitment to a sustainable, resilient forestry sector. Engaging the leadership of UMaine's own Aaron Weiskittel, Ph.D., UMaine and our Maine collaborators have been invited to apply for a $20 million, five-year National Science Foundation (NSF) Established Program to Stimulate Competitive Research (EPSCoR). The goal is to develop and deploy insights on wood fiber-based products, forest AI and sensors, carbon solutions, and tourism, as well as the workers and communities that participate in the forest-related sectors. This proposed project would involve research, workforce development, and collaborations with public and private partners. This NSF EPSCoR project would help diversify and grow the state's forest-based research and workforce capacities.

We are looking to convene a network to advise and inspire the NSF EPSCoR proposal and the network, and would be grateful for your knowledge and participation. Would you be open to a 45-minute to one-hour conversation with our team in the next few weeks? The conversation will be confidential, and we will share a summary with you.

At the bottom of this email are the questions, and potential time-slots.

Conversation topics

We're interested in learning more about your work, and your views on opportunities and challenges (related to the themes of forest economy, climate, and equity). We'd also like your perspectives on how reinforcing and diversifying the existing network(s) could help the forest sector. Finally, we'd like to hear your interest collaborating in the NSF EPSCoR project network once we win the grant — as a researcher, advisor, investor, or site.
~~~~~~

1. Your organization's work, and your role in the organization

2. Challenges in Maine's forestry sector **– at a MACRO/INDUSTRY level –** that could be in our NSF EPSCoR proposal, including such things as equity, research and workforce capacity, community, policy, etc.

3. Where your organization wants to be in 5 years and where you are today (your forestry-based priorities)

4. The most most critical challenges or barriers you/we need to overcome **– at the level of YOUR ORGANIZATION**.

5. How might the NSF EPSCoR project align/interface with your current work.

6. Your ideas on opportunities for leveraging network(s) during the project.

7. Your participation in or knowledge of other networks (so as not to "reinvent the wheel").

8. Your (or your staff's) potential role as researcher, advisor (e.g., Steering Committee), investor, or site.

Thank you, in advance, for your insights and participation!