Headwaters Tech Hub – Overarching Narrative

Executive Summary

We established the **Headwaters Regional Technology and Innovation Hub** (Headwaters Tech Hub, or HTH) to extend our region's leadership in smart photonic sensing systems that can be deployed in autonomous systems and applied to critical defense, resource management, and disaster prevention. The eight HTH component projects will accelerate our ability to commercialize technologies at scale and increase our technology footprint in sectors vital to U.S. national and economic security. Our established photonics cluster is a global leader in remote sensing, particularly advanced lidar and spectral imaging. Smart photonics sensors are crucial enabling technologies for a range of private industry sectors including vehicles, precision agriculture, construction, and national defense. With Hub implementation funding, our consortium, which includes local companies, global industry partners, universities, government agencies, and workforce and economic development groups, will execute an agenda aimed at increasing our shared capacity to take on technological challenges and catalyze new investment into the region's economy.

The HTH encompasses the tightly connected geographic corridor of western Montana that includes the Bozeman and Missoula MSAs and the Butte–Silver Bow and Kalispell μSAs. The HTH region is in a low-population state that is eligible to receive funding from NSF EPSCoR, and significantly benefits small and rural communities. The corridor includes tribal lands, and our application includes plans to partner with tribal colleges and improve opportunities for tribal workers, businesses, and communities to thrive in the region's tech economy.

The Headwaters Tech Hub

Vision

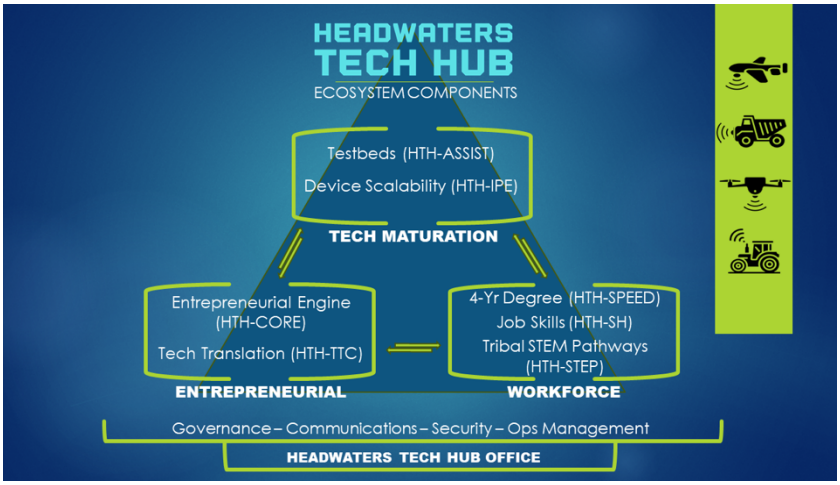
The Headwaters Tech Hub endeavors to be a global leader in advanced smart photonic sensing systems and their deployment into industry sectors critical to U.S. national and economic security. Smart photonic sensors such as lidar and spectral imaging are enabling technologies that will increasingly define how humans understand and interact with their surroundings in the decades to come. Our Hub will keep the U.S. at the forefront of this technology wave by accelerating the pipeline from product introduction to wide market adoption, growing businesses that can compete and thrive in the global marketplace, and strengthening pathways for Montanans to enter and thrive in the Hub's expanding workforce.

The HTH Consortium

Our large consortium reflects the critical importance of smart remote sensing technology across market sectors and the expansive impact that the HTH will have on our geographic region. Members include private companies, industry associations, higher education institutions, state government, workforce and economic development groups, and venture firms.

Entity Type	Headwaters Tech Hub Consortium Members
Workforce Training Organizations	Accelerate Montana (Consortium Lead), Montana State Workforce Investment Board (SWIB)
Institutions of Higher Education	Montana State University, the University of Montana, Montana Technological University, Salish Kootenai College (a Tribal College).
Government	Montana Dept of Commerce, Montana Dept of Labor and Industry, Montana Office of Indian Affairs, Montana Office of the Commissioner of Higher Education
Industry Groups or Firms	Montana Photonics & Quantum Alliance, Aurora Innovations, Reveal Technologies, Hyundai America Technical Center, Bridger Photonics, Vision Aerial, John Deere, RDO Equipment
Economic Development Organizations	Missoula Economic Partnership, Prospera Business Network, Butte Local Development Corporation, Grand Farm
Economic Development for Underserved Communities	State Tribal Economic Development Commission
Organization to Promote Economic Stability & Opportunities	Montana Chamber of Commerce
Venture Development Organizations	Homestake Venture Partners, America's Frontier Fund, Next Frontier Capital

Component Projects



HTH component projects will capitalize on the region's commitment to strong partnerships and market-driven innovations to take advantage of current opportunities in technology-focused economic development and achieve global competitiveness. Two projects focus on technology deployment and maturation—a testbeds project to enable more efficient technology assessment and accelerate customer adoption (**HTH-ASSIST**) and a project to establish an integrated photonics capability to accelerate device scalability via reduced size, weight, and power (**HTH-IPE**). Two projects will focus on technology-driven business development—an ecosystem integrator and catalyst to sustainably grow new companies within our region (**HTH-CORE**) and a technology translation catalyst that will facilitate the commercialization of Hub-based technologies into new markets (**HTH-TTC**). Three workforce projects will grow, attract, and retain researchers, entrepreneurs, engineers, and workers to fuel the HTH ecosystem. One workforce project focuses on increasing four-year degree opportunities in engineering and related fields (**HTH-SPEED**); another will employ skills-based approaches to train and connect workers for HTH-related job opportunities (**HTH-SH**); and a third will be led by a tribal college in the HTH region and will increase STEM training opportunities for Native and rural students across education levels (**HTH-STEP**). Montana is the only state in which every reservation has a tribal college and, as of 2016, one of only three states that provides state funding for tribal colleges. Finally, we include a project (**HTH Office**) to drive Hub-wide strategy and collaboration, and advisory and evaluation activities to ensure effective Hub governance.

Summary of HTH Commitments

There has been deep enthusiasm for the HTH and its portfolio of component projects, reflected in the strong commitments that consortium members have made toward the project's success. Our Hub is notable for its breadth and diversity of stakeholders. More than 20 different entities are contributing formal match commitments to the projects, including more than $2.7 million from industry partners, nearly $1.3 million from the Montana state government, $3.3 million from participating public universities, $800,000 from Salish Kootenai College, and more than $700,000 from workforce and economic development groups.

Beyond these match commitments, we have secured nearly $5.3 million in additional financial commitments from consortium members and other partners to support activities aligned with the HTH agenda. We also have several industry hiring commitments, indicating enthusiasm for our workforce projects, and dozens of commitments from organizations and individuals to provide advisory time in support of HTH efforts. The groundswell of support for our work has been astounding; we view it as a strong indicator of what our Hub and portfolio projects will achieve.

Global Competitiveness

Our regional cluster is already a significant player in the national and global market for photonics innovation and remote sensing applications with more than 40 companies and currently nearly 1,000 employees. The proposed portfolio of Tech Hub projects and aligned HTH commitments will enable us to stay at the cutting edge technologically, accelerate expansion into strategically

new application spaces, and extend current technologies while overcoming many workforce and market barriers that have previously constrained growth in this rural region. The global cross-industry demand for detail-rich environmental awareness afforded by these technologies is already incredibly high and will only grow. Photonics-enabled sensing allows us to detect and confront risks like never before, whether protecting soldiers on the battlefield, inspecting pipelines, bridges and other critical infrastructure, monitoring crop health and water safety, or detecting and combating wildland fires. Our adversaries recognize the value of these technologies; China has identified lidar as a critical choke point where the US has a technological advantage and is investing heavily to close that gap. To remain ahead we must accelerate our ability to produce photonics-enabled sensors at low cost and at scale. The nation's collective ability to meet these demands is constrained by two major factors—the ability to manufacture sensors at scale with reduced size, weight, and power (SWaP) requirements, and the ability to process sensor data to drive decisions on a use-appropriate timescale.

The HTH will target our region's photonics-aligned innovation ecosystem to meet these challenges, guided in part by our planned Defense Technologies Advisory Group (**HTH Office**). The Integrated Photonics Ecosystem (**HTH-IPE**) project will directly address SWaP requirements, opening pathways to accelerated deployment of sensing technology at scale across industry sectors. Our Technology Translation Catalyst (**HTH-TTC**) will help identify ripe application spaces, analyze markets, and match innovators with customers, while our entrepreneurial engine (**HTH-CORE**) will catalyze the launch and maturation of solution-driven companies into successful businesses. Business growth has historically been a greater challenge for innovation clusters located away from the major existing technology and capital-dense hubs along the America's coasts, but the nation's continued global competitiveness depends on harnessing assets nationwide. As new products enter the market, a key bottleneck to customer adoption is the lack of information on real-world capabilities; our testbeds project (**HTH-ASSIST**) will establish rural/rugged testing environments across our region, creating broader possibilities for technology evaluation and assessment. These testbeds benefit the full spectrum of corporations, from startups to national and multinational companies, and leverage our region's unique geography. The success of these efforts and the region's broader economic livelihood depend on growing a skilled workforce that reflects our region's diversity. The three HTH Workforce applications will tackle this challenge, building a globally competitive workforce for the future.

Environmental Considerations

Montana has a deep-rooted natural conservation ethic, placing high priority on care and responsible management of public lands. This ethic has at times been in tension with the state's active natural resource industry, but we view this as one of many opportunities where HTH-driven technologies will help overcome persistent challenges, guided by our planned Resilience Technologies Advisory Group (**HTH Office**). For example, autonomous smart-sensing technologies and drone-mounted environmental devices would help forestry professionals monitor forest health, harvest safely and efficiently, assess and mitigate wildfire risk, and validate carbon uptake as part of climate mitigation strategies. The technologies have great application to disaster prevention and mitigation—particularly fire and floods. They could also improve monitoring for foreign/terrorist activity that might compromise our nation's critical natural resources—food, water, timber. The planned **HTH-ASSIST** Rugged Terrain testbed will provide a location to assess these technologies and demonstrate their effectiveness to accelerate customer uptake. Similarly, HTH-driven advances in precision agriculture will allow for more efficient targeted applications of fertilizers and pesticides, reducing chemical runoff, while autonomous farm equipment will likely reduce greenhouse gas emissions. The HTH team understands that environmental and

climate considerations are central to U.S. national and economic security and will direct our innovation and technology deployment efforts accordingly.

Equity

Two groups most prominently experience disparities in social and economic equity within Montana: Native Americans (8.7% of the state's population) and rural residents (47% of Montana's population). The unemployment rate on the Flathead Reservation, Montana's largest, is ~2x that of Bozeman. Rural students complete bachelor's degrees at nearly half the rate of their urban counterparts, excluding them from 67% of Montana STEM occupations. As the HTH strengthens the region's technology-driven economic engine, we will focus on activities that will create meaningful opportunities and lasting wealth for Native American and rural communities. Native-led and Native-focused organizations play a central role in Hub leadership and governance, with the Montana Office of Indian Affairs and the State Tribal Economic Development Commission participating as Steering Committee members and Salish Kootenai College leading a project. The HTH external evaluation plan will ensure a focus on the Hub's impact on rural and tribal populations.

The HTH focus on tribal and rural communities is most visible in our STEM pathways project (**HTH-STEP**) led by Salish Kootenai College and the skills-based training and hiring project led by the Montana Department of Labor and Industry (**HTH-SH**). These projects recognize that building a strong, capable technical workforce means engaging students early and consistently and providing training on-ramps aligned with community preferences and needs. Both programs are designed to do just that. And while both are initially targeted to primarily benefit communities within the HTH geographic region, they are being designed for expansion, so that rural Montana residents outside the region will also realize benefits via leveraged investments. Other HTH component projects are aligning their equity efforts with these two primary efforts.

Expected Outcomes

Our hope and expectation is that EDA Tech Hub implementation funding will be the catalytic investment our ecosystem needs to become a national and global leader in smart photonics sensing and autonomous technologies. We are starting from a strong baseline, with more than 40 companies employing approximately 1,000 workers at an average salary of more than $72,000. The photonics industry in Montana today is estimated to support up to 5,000 direct, indirect, and induced jobs throughout the state, contributing more than $300 million in total wages to the economy. Ten years from now, the photonics industry could grow to 6,000 direct jobs, which would total nearly 25,000 direct, indirect, and induced jobs throughout the HTH region.

Beyond the top-level metrics, our intent is for the benefits of the HTH innovation engine to be more evenly distributed across our region, and for those benefits to more equitably reach Native American and rural communities. Qualitatively, we expect these measured impacts will translate to our region being viewed as a major contributor to the nation's tech economy in high-demand areas of direct relevance to national security, autonomous systems, and environmental and natural resource management. We know our photonics-driven ecosystem has a lot to offer to the nation, and we are confident that EDA implementation funding will let us realize our potential.

Timeline

While our broader HTH vision and agenda extends for a decade and beyond, this implementation phase application is built around a five-year period of performance, with most component project applications extending over that full period. The **HTH-IPE** project to establish pathways to develop low-cost photonics sensors at scale has an aggressive market-driven three-year timeline. The **HTH-SH** skills-based training effort has a four-year timeline. All projects are anticipated to start on October 1, 2024.

Why Smart Photonics Sensing?

Our world is at a frontier of autonomous environmental sensing and decision-making, and while the social and technical challenges are daunting, the strategic and operational benefits are compelling and span nearly all industry sectors. One prominent example is autonomous vehicles. Safe and robust autonomous vehicle operation at scale is an approaching milestone in the perpetual race for global tech leadership, with China investing heavily in the technology. While most public attention focuses on urban applications, such as passenger vehicles and drone-based package delivery, many of the most beneficial and achievable use cases would deploy autonomous technology to reduce human risk in hazardous environments—jobs in national defense, search and rescue, mining, construction, agriculture, forestry, transportation, and energy. Data show that jobs in these industries are among the most dangerous in the United States. Autonomous technologies would make many of these jobs safer, protecting American workers, while also enabling the country to maintain its global competitive advantage.

Or consider the demands of robust situational and environmental awareness. We increasingly live in a world where complex autonomous decision-making is possible, *if* we have a sufficiently robust understanding of the surrounding conditions. This can mean targeted application of irrigation or pesticides in agriculture, battlefield awareness for our soldiers, leak and structural inspection of critical infrastructure, or large-scale monitoring of carbon uptake for climate mitigation. Often, real-time sensing and data analysis demands exceed human capacity.

The technological commonality among these use cases is smart photonic remote sensors such as lidar and spectral imagers. Broadly speaking, these sensors collect light across spatial and temporal scales and assemble data for analysis. Photonic sensing is already a powerful tool and becomes progressively more so as light transmission and detection capabilities advance and as we better understand how detected signals connect to environmental conditions. Computing hardware and software advances, including AI, have made it possible for these sensors to become "smart," such that data collected can be analyzed on-platform to inform decisions in near real-time. However, while the promise of these technologies is strong, backed up by demonstrable advances, their adoption into broad use has been slow, potentially giving global competitors an edge. Why? The HTH consortium has identified two crucial bottlenecks that have slowed technology deployment, particularly in non-urban areas.

The first relates to manufacturing scaling. At the initial stages of commercial technology deployment, photonic remote-sensing packages tend to be large and manufactured individually by skilled technicians. This limits both the number that can realistically be produced and the size of the vehicle on which the sensors are deployed. Mass production and reduced package size and power requirements would improve the scalability of advanced photonic sensor production and make many more such technologies commercially viable. To date, such manufacturing capability is not widely available, though allies and adversaries alike are investing heavily in building the design-to-foundry-to-assembly pipelines needed to move the technology forward.

A second significant bottleneck lies in the parallel industry-wide needs to assess the safety and effectiveness of autonomous systems in unstructured settings in very different locations, and to demonstrate the benefits of new products to customers. Suitable testbed facilities are in short supply and very high demand, particularly for technologies needing large spaces or complex environments. While some of the largest companies can maintain their own testing sites, these are often not available to the broader community and, even when they are, the inevitable intellectual property concerns keep many potential users away.

Overcoming these two challenges is a major focus of the HTH implementation strategy. The HTH as a *rural* hub, as envisioned by the CHIPS and Science legislation, will bring rural expertise

to address challenges that preferentially impact rural regions but are nonetheless of national importance and global relevance. In parallel, we will build stronger capacity to nurture entrepreneurs, companies, and workers to accelerate the development of the HTH ecosystem and develop strong pipelines so that Montanans of all stripes are positioned to become leading innovators and the high-skilled workers America needs to maintain its global technological lead.

Why the Headwaters Tech Hub?

Montana is home to dozens of photonics companies and has exceptional strength in the advanced remote-sensing technologies such as lidars and spectral imagers that are crucial to environmental awareness and autonomous systems deployment. This established cluster is the foundation from which the HTH will achieve its vision to the capabilities and broad adoption of autonomous technologies across a range of use areas vital to America's economic and national security.

Existing photonic sensor products made in Montana are already key parts of international supply chains for defense, space exploration, and manufacturing. Examples include optical materials, components, and systems used in laser-guided missiles and night-vision surveillance systems; the world's most ultra-pure laser crystals, which enable unprecedented space exploration; and spectral imaging systems that maintain the security of our global food supply. Companies in our consortium represent the leading edge of Montana's remote-sensing innovation. Bridger Photonics produces an aircraft-mounted lidar system capable of mapping methane and other leaks from energy infrastructure. Aurora, Inc. has developed an advanced lidar system that will accelerate autonomous vehicle deployment for on-road use.

Our region's record of success in photonics sensing has led to increased industry partnership. Hyundai America Technical Center, Inc. selected our region for their New Horizons Studio with a focus on developing autonomous vehicles adapted to extreme environments. John Deere and RDO Equipment have joined the HTH consortium, recognizing us as key partners in their efforts to advance autonomous technologies in the agriculture and heavy-equipment industries. Similarly, the defense sector has recognized our region for its innovations in Intelligence, Surveillance, and Reconnaissance (ISR) remote sensing technology, as reflected by Reveal Technologies' rapid growth. Meanwhile, our universities continue to advance the research envelope in applied photonics technology. Montana's current NSF EPSCoR project focuses on developing smart photonic sensors for forest and wildfire management. We are partners with North Dakota State University on their recently funded NSF Research Innovation Engine (RIE) focusing on agricultural technologies, and Montana universities lead two additional NSF RIE planning awards in photonics-adjacent topics with broad cross-regional partners.

EDA's designation of our region as a Regional Tech Hub reflects the impact we already have in the photonics sector, and recognizes the potential for what we can become. That potential is impressive. Montana-led research, commercialization, and innovation is expected to drive high growth in globally critical photonics market subsectors, including automotive lidar ($9B market by 2033; 66% CAGR), drone lidar ($2B market by 2033; 28% CAGR), and hyperspectral imaging ($30B market by 2033; 10% CAGR). These subsectors will outpace overall photonics market growth over the next 10 years ($1.5T market growing to $2.8T overall market by 2033; 6% CAGR). The HTH is poised to contribute critical technologies to power this market growth.

But the numbers only tell part of the story. Part of the HTH's competitive advantage is our rural geography and Montana itself. This advantage manifests in a few ways. One is practical—many of the sensing platforms and autonomous technologies that we will rely on in the future need space to operate and test. We have the advantage of being able to incorporate several open-air testbeds into our plans, initially focusing on rugged terrain, precision agricultural, and on- and off-highway activities (**HTH-ASSIST**). In the future, we envision expanding into defense

applications, mountain operations, and more. But more important than the land itself is that we are a region with a deep local knowledge of what it means to live and work in these environments. We count soldiers, farmers, foresters, and ranchers among our neighbors and families; in many cases, our homegrown photonics experts grew up learning these occupations. These roots and relationships guide our team's understanding and will help our Hub to innovate in these spaces faster and more effectively than our competitors.

The HTH implementation strategy leverages our region's strengths to turn our competitive advantages into global leadership. We will maintain our photonics leadership by enabling an integrated photonics ecosystem aimed at addressing SWaP challenges across a range of applications, initially focusing on lidar and hyperspectral imaging. We will leverage our geography to stand up open-air testbeds to assess technology capabilities and speed customer adoption, focusing largely on areas that align with our rural roots. Most importantly, we will make the most of the ingenuity and hard work of our communities—training people to be part of our tech economy, in alignment with their talents and interests, and building up local companies to make our economy stronger. Our expected result is a vibrant Hub that keeps the U.S. at the global forefront while also advancing Montana's economic vitality.

Commitments to HTH Success

Enthusiasm for the EDA Regional Tech Hub opportunity has been incredibly strong since the program's rollout. Many stakeholders from across Montana and beyond were eager to be part of the HTH effort. Coupled with our large geographic region, this has led to an exceptionally large and diverse consortium—27 total members including many public and private sector partners. Our portfolio of applications reflects the commitments of dozens of partners, bringing together strong and broad industry engagement with robust institutional support from Montana's state government, major academic institutions, and key non-profit organizations.

Private Sector Partners

The photonics and autonomous technology industry in Montana and beyond is deeply involved in the HTH portfolio, as are key players in the state's venture and business development sectors. Two HTH component projects are led by private sector partners. **HTH-IPE**, which will establish integrated photonics capabilities and infrastructure in the region, is led by the Montana Photonics & Quantum Alliance and includes as a subrecipient Phix, Inc., the new Bozeman-based U.S. subsidiary of the Dutch photonics assembly firm. The **HTH-CORE** entrepreneurial engine project is led by HomeStake Venture Partners and will focus on building up new firms in Hub-aligned industries. Industry partners have made substantial match investments in three other HTH component projects (**HTH-ASSIST**, **HTH-SPEED**, **HTH Office**); the **HTH Office** investments are especially noteworthy, signifying the supporting companies' interest in advancing the overall HTH agenda. There are millions of dollars in additional aligned industry leveraged investments, as well as non-monetary hiring and facility-use commitments and provisions of advisory time.

Public Sector Support

The organizational foundation for the HTH lies in the incredibly strong and unified support from the region's major academic institutions, state government, and influential workforce and economic development non-profits. Higher education institutions lead four HTH component projects, including three by public universities (**HTH-TTC**, **HTH-ASSIST**, **HTH-SPEED**) and one by Salish Kootenai College (**HTH-STEP**), a tribal college. This leadership reflects significant commitment in itself, but the consortium's higher education institutions have also committed nearly half of the total required match for the EDA application, more than $4 million. Montana's state government has also made strong commitments to the Hub's success, with the Department of Labor and Industry leading one project (**HTH-SH**) and the Departments of Commerce and

Transportation making in-kind staff commitments to two others (**HTH Office** and **HTH-ASSIST**, respectively). Non-profit workforce and economic development organizations have also committed significant resources. Accelerate Montana has agreed to be overall consortium lead, leads the **HTH Office** application, is co-applicant for **HTH-ASSIST**, and is providing $500,000 in match support to **HTH-SH**. Grand Farm, a North Dakota-based economic development group with strong ties to the FARMS NSF Regional Innovation Engine, is also providing match support, and three in-region economic development organizations are supporting **HTH Office** outreach and policy efforts as subrecipients.

Worker Engagement and Equitable Economic Prosperity

We expect the HTH to transform the regional technology economy. Both our consortium and our region are eager for this change, but we know that such economic transformations often do not benefit everyone equitably. As we designed our HTH agenda, we aimed to ensure that benefits would accrue to workers as well as employers, and that our projects would proactively ensure that the pool of economic beneficiaries expands to better include underserved Native American and rural communities.

Our portfolio of eight component projects includes three dedicated and complementary workforce projects that collectively represent a $27 million investment, nearly a third of our total budget. These projects are designed to fill known gaps in our region's workforce training capabilities, specifically to provide focused opportunities in areas of expected need. Some of this need is at the four-year degree level. **HTH-SPEED** will train engineers and environmental scientists to be ready for key high-paying jobs as the HTH ecosystem grows. The **HTH-SPEED** programs will prioritize diversity in hiring faculty and design intentional pathways, including from 2-year and tribal colleges, to grow a diverse student base. Careful curriculum design and wraparound services will promote retention of these students. The **HTH-STEP** program, led by Salish Kootenai College, is singularly focused on harnessing the talents of Montana's Native and rural communities to meet smart-sensing industry demand. **HTH-STEP** will help meet career education and STEM workforce needs, offering hands-on, place-based learning for competitive local and national contributions. This will support rural and Native community resilience. The HTH Skills Hub project (**HTH-SH)** is designed to upskill and reskill the ~66% of Montanans without four-year degrees, ensuring the deployment of an agile system for identifying and responding to employer skills needs. **HTH-SH** will include continuation of existing programs that facilitate and coordinate access to financial assistance and wraparound services to remove barriers to training participation.

Housing and Regional Infrastructure: Leveraging Assets and Overcoming Barriers

Over the past two years, the State of Montana has committed to enhancing the well-being and infrastructure of its communities, particularly in the HTH region. Significant investments have been made in wrap-around services and infrastructure projects that promise to yield substantial benefits, largely via federal initiatives. Among these is a monumental $628 million investment in broadband infrastructure, aimed at extending reliable internet access to previously underserved and underrepresented communities across the state. The greater use of online training and remote work, increasingly possible due to broadband improvements, brings greater place-based workforce and economic development opportunities for reservation and rural workers. And the 2023 introduction of the $200 million HOMES Program and Governor Greg Gianforte's diverse, bipartisan Housing Task Force are pivotal steps toward expanding water and sewer infrastructure, crucial to accommodate the growing housing needs throughout the state. Montana has also earmarked $110 million to fortify the childcare industry, to stabilize services and expand availability for essential workers and emergency situations. The HTH region will benefit from

these investments, as it will from ongoing efforts to reform zoning policy, improve public transit, and bring intercity passenger rail back to southern Montana. We anticipate the HTH and its consortium members will be active participants in policy debates that align with Hub interests at the local, state, and national levels.

Tracking our Progress

The HTH will invest in the creation of a robust performance monitoring system tailored to its unique structure and activities. Dr. Julia Melkers and a team of external evaluators at Arizona State University's Center for Organization Research and Design will work with HTH leadership to design a system that enables timely and accurate reporting and builds on Hub resources. The evaluation process will serve as a source of learning and improvement for consortium members and partners, while providing pathways for the Hub to build on success and identify new opportunities for growth. The HTH Office will leverage this data collection and analysis to communicate with stakeholders to promote trust, transparency, and engagement. Preliminary Hub-level goals and metrics are summarized below. North star metrics are highlighted. Metrics will be disaggregated (e.g., by race/ethnicity, geography, gender, etc.) whenever possible to understand impact on underserved populations.

SMART Goals	North Star Metrics	Additional Metrics
Enable the creation of 6000 direct and 25,000 indirect good jobs in the HTH region by 2029.	#, % job growth $ average earnings	$ real wages #, % union jobs educational attainment # unfilled roles in sector
Improve commercialization of HTH research and grow and modernize manufacturing of smart photonic sensing systems.	# patents $ licensing revenue	#, $ IPE contracts # new customers # products tested
Support the creation of a robust entrepreneurial ecosystem, increasing HTH firm density by 50% by 2029.	# new startups $ private investment	% startup early survival rate
Establish the HTH as a model for technology-driven economic growth in rural regions by 2029.	%, $ regional GDP growth	% tax revenue growth $ raised by capital type % rural poverty rate

The evaluation's goal is to maximize the collective impact of component projects on the Hub ecosystem. Dr. Melkers will also lead the development of a comprehensive case study process to trace the evolution and outcomes of the HTH. This study aims to identify causal mechanisms that strengthen Montana's unique rural innovation ecosystem and will provide insight into effective models for Hub institutionalization and sustainability. It will generate valuable insights for other rural communities. A Letter of Commitment provides more detail.

A Sustainable Hub for the Future

Our ambition for the HTH is expansive but also market driven. We have designed many of our projects to become significant revenue generators over our performance period, with portions of these revenues directed toward sustaining the continuity of the activities. We will employ a blend of strategies to achieve financial sustainability. Two of our component projects, **HTH-ASSIST** and **HTH-TTC**, are new not-for-profit project-based services offered to customers in the HTH community and beyond. While some projects are subsidized using EDA funds in the initial years to demonstrate capabilities and build customer base, the goal for each is that the revenue generated by project fees will sustain the programs. Our for-profit **HTH-CORE** entrepreneurial engine will employ a "sustainability first" model to pre-fund a Purpose Trust that will support the project's efforts beyond the EDA performance period. Proceeds from company revenue shares or equity stakes will go first to the Purpose Trust to ensure a minimum two years of forward funding. Only after that would studio principals and staff earn a share of the profits.

EDA funding for **HTH-IPE** will provide initial support to establish IPE capabilities and process and subsidize projects to demonstrate the power of this approach to photonics sensor scalability. We expect these efforts will motivate future in-region private ventures that will apply

the IPE process to new applications, bringing returns on EDA's initial investment. We envision future capital investments in IPE capability focusing largely on private investors, while certainly also taking advantage of aligned government opportunities, where appropriate.

We are confident that EDA's investments in our three workforce component projects (**HTH-SPEED**, **HTH-STEP**, **HTH-SH**) will yield benefits to support their continuation beyond the initial performance period. The former two projects focus on building new student opportunities that lead to careers in the HTH innovation ecosystem. We expect that excitement about HTH efforts and demand for employees will drive enrollments in these new programs and bring in sustainable tuition revenue. **HTH-SH** aims to strengthen skills-based pathways into the workforce and training opportunities and will refocus the coordination of strategies among organizations across the state that generally have pre-existing funding bases.

Ultimately, the sustainability of the HTH is much more than the sustainability of its component projects. In the months since receiving EDA designation, it has become clear that there is a hunger for collaboration and partnership well beyond what can be achieved with the initial anticipated implementation funding. The HTH steering committee is already planning for broader-scale strategic engagement to build on our current momentum and leverage the capabilities that we will stand up with EDA support. A sustainable funding model for the **HTH Office** with diversified funding streams is a key part of that strategy. We are seeking direct support from the State of Montana, philanthropic foundations, and industry partners. We are also considering possible cost-sharing strategies where non-workforce programs under the HTH umbrella provide a small portion of their revenue to the HTH to enable the continued advancement of our ambitious shared agenda.

Progress Since the Phase 1 Application

The Phase 1 application effort and subsequent EDA designation were the launchpad for a focused conversation in the HTH community that has led to a deeper understanding of what is possible for our Hub through sustained, strategic collaborative effort. The immediate effect has been to bring our diverse stakeholders together, set aside competitive rivalries, and focus on crafting a strategy and implementation plan that will raise our innovation ecosystem to a new level.

HTH governance and leadership was a major focus of our initial activity. We have established an 11-member HTH steering committee that balances original consortium members with new voices that expand the perspectives involved in our decision-making process. Organizational members include the state chamber of commerce and its photonics industry alliance, the region's leading universities, state government agencies, workforce and economic development groups, an in-region venture capital firm, and two members focused on MT's tribal communities. We have also hired an HTH Executive Director and Regional Innovation Officer, Dr. Tim VanReken. Dr. VanReken joined the HTH after advising our team extensively during the Phase 1 effort. He has extensive experience in engineering R&D and geographic capacity-building, including nearly a decade as EPSCoR Program Director at the National Science Foundation.

Beyond governance, in recent months our team worked to broaden and strengthen our relationships with local communities and expand our partnerships with highly innovative companies in our region, as well as nationally and with global allies. These began as informal discussion groups organized around shared interests—Tribal communities, national security, early-stage entrepreneurs—but they will be formalized and integrated across our projects, with three HTH-wide groups in key priority areas and several activity-specific groups incorporated into component projects. Our outreach and partnership efforts are also reflected in the wide array of commitment letters from community leaders, employers, entrepreneurs, funders, advisors and more, showing support for the hub and identifying tangible ways they will contribute to our shared success. Collectively, we're ready to get to work.