



MARIA Algal Innovation Whitepaper A 12-Month Implementation Plan (January–December 2026) Executive Summary

The Maine Algal Research Infrastructure and Accelerator (MARIA) is a use-inspired innovation project designed to leverage algae biodiversity, in all aspects and interpretations, into quantifiable economic, workforce, and societal outcomes for Maine. The project’s core premise is that the Provasoli-Guillard National Center for Marine Algae and Microbiota (NCMA) genetic repository of micro- and macroalgae, paired with Bigelow Laboratory’s and other statewide research infrastructure (RI) assets, can generate biochemical and functional “Big Data” that becomes the durable ‘feedstock’ for continued algal innovation and these economic, workforce and societal outcomes.

This whitepaper translates the funded project goals and objectives into a partner-friendly implementation plan for the upcoming calendar year informed by, and in response to, stakeholder feedback captured during the 2025 All-Hands Workshop. Stakeholder feedback was gathered during a planned question and answer activity session, written ideas anonymously received, team workshop prioritization exercise leveraging the Eisenhower Matrix model, and a focus group discussion. Stakeholder feedback strongly reinforces the need for: (1) near-term demand for tangible products (e.g., pigments, anti-fouling coatings, bioplastics, crop antimicrobials, pharmaceuticals, etc.) and engagement pathways (e.g., consulting, research support, etc.), (2) physical and financial accessibility of research infrastructure, (3) rural and cross-cultural engagement built on trust and growth of long-horizon relationships, and (4) reduced barriers to engagement through mentorship, and practical, modular training.

Over the next 12 months (January–December 2026), the MARIA project team will prioritize execution of the following four integrated workstreams based upon stakeholder feedback:

1. **Data-to-Discovery:** generate and make available, through sustainable financial models, interoperable biochemical/functional datasets across the algal Tree of Life. *These are the roots of future algal solutions.*
2. **Research Infrastructure Enablement:** identify and close capability gaps with people and platforms, and codify access pathways that entrepreneurs can and will actually use. *These are the mechanisms by which future algal solutions are realized.*
3. **Workforce Translation:** develop and deliver modular training and infrastructure to educators to provide onsite training that maps directly to partner workflows and provides obvious and accessible entry points for students, career transitioners, and rural communities. *These are the people who will implement future algal solutions.*
4. **Innovation Acceleration:** develop and operationalize an opportunity funnel supported and fueled by an Opportunity-Capability Map and “ME Blue Economy Week” activities



that convene researchers, entrepreneurs, investors, educators, and rural Maine communities. *These are the outcomes of our successful execution of this plan.*

What follows is a forward-looking program narrative and a detailed 12-month plan to implement the above workstreams and achieve MARIA's funded goals.

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Michael Lomas
MARIA, PI

A handwritten signature in black ink, appearing to read 'Manoj Kamalanathan', is shown on a white background.

Manoj Kamalanathan
MARIA, co-PI



Algae represent a uniquely versatile technology platform: they can be cultivated at scale, engineered or selected for performance, and ‘tuned’ to produce specific proteins, pigments, polymers, antimicrobials, and other functional metabolites. The MARIA project’s distinguishing strategic advantage is that it is not a single product thesis; it leverages NCMA’s strain diversity to support a continuous flow of innovation (Figure 1). Stakeholder feedback from the All-Hands Workshop reinforces that this strategic advantage will only deliver impact if stakeholders can see (and touch) tangible outcomes—products, prototypes, training modules, and accessible infrastructure—within a short cycle time.

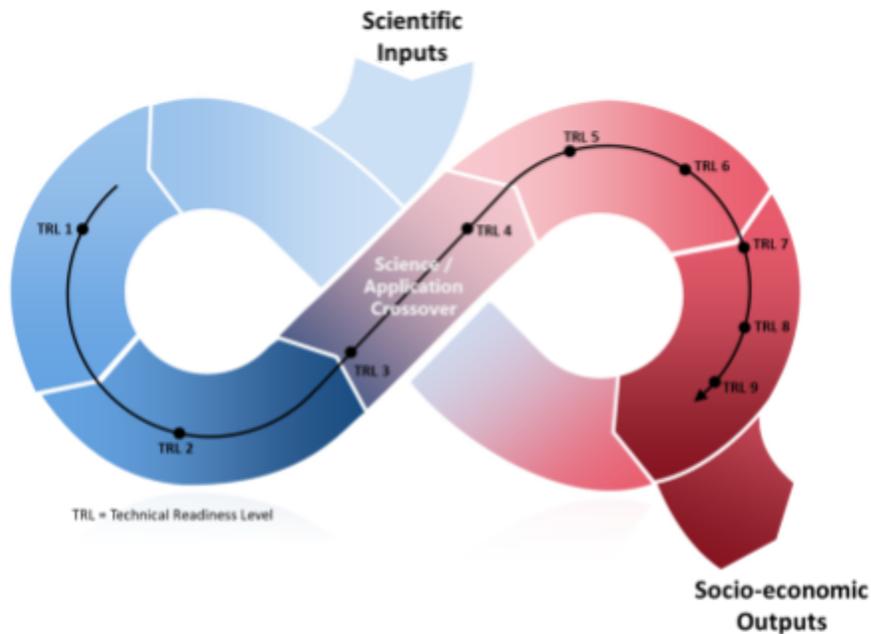


Figure 1. Continuous flow path from science to societal output enabled by the MARIA program and its developed workflows.

1. What does the MARIA project offer?

In pragmatic terms, MARIA and its partner network should operate as an integrated activity, empowered by the four interrelated workstreams central to exploiting MARIA’s strategic advantage.

Workstream 1 — Data-to-Discovery: Detailed information on microalgae biology and biochemistry is derived from deep data research. This leads to our ability to imagine



different ways that algae could be cultivated for use in different products and services across a wide range of relevant sectors. There are millions of possible datasets that can be derived from the cultures within MARIA, and thus exponential potential for discovery of new products and technology breakthroughs using microalgae. This is MARIA's compounding asset.

Workstream 2 — Research Infrastructure Enablement: Research Infrastructure is only enabling if it is discoverable, priced predictably, and packaged as “services + playbooks,” not just equipment. We will build a formal system for interacting with and using the R&D infrastructure that we are building around MARIA, where companies gain access to our knowledge and resources to bring products to commercial deployment.

Workstream 3 — Workforce Development: Workforce Development is a throughput metric. Training must map to real workflows (cultivation, analytical systems, data management and analysis tools, customer discovery, regulatory, scale-up), informed by company needs, and culminate in placements, internships, and project-based outputs.

Workstream 4 — Innovation Acceleration: Acceleration requires operating discipline. We must create specific processes to engage with partners, both those that have industrial applications that need to understand the potential use of microalgae, and those that seek to engage with our R&D teams to leverage MARIA assets.

To effectively coordinate Workstream 1 through Workstream 4 requires a strategic approach; the “data feedstock” must be made directly investable. To implement this, MARIA will treat datasets as investable assets with explicit downstream utility and use needs and requirements informed by our own vision(s) as well as those of our industry partners. Data, and all activities that derive from it, needs to be:

1. **Standardized:** development and application of standard analytical procedures, defining minimum metadata requirements, defining and implementing QC thresholds, and consistent versioned data releases.
2. **Interoperable:** data must be searchable, data output products must be accessible, reproducible, and permissioned, with clear linkages, where possible, from strains → biochemicals/traits → candidate applications.
3. **Translatable:** scoring opportunities, either internal or external, in a vertical stack chart based on parameters such as product-market fit, technical feasibility, differentiation, regulatory friction, unit economics potential, and Maine supply chain fit.



4. **Time-bound:** to prevent “science for science’s sake” from hindering commercialization pathways and stalling translational timelines, while preserving discovery as the long-term compounding asset.

Effectiveness of MARIA, while heavily dependent upon the data and the analytical infrastructure that generates it, is more than just the data. MARIA’s effectiveness is dependent upon other physical infrastructure resources and ‘human capital’. This ‘human capital’ includes a science expert network to advise on biological traits of algae linked to data of interest, and to carry out experiments needed to verify proof of concept and beyond. It also includes a business mentor network to help advance amazing innovations to even more amazing societal outcomes.

MARIA has to have a broad reach. Despite the amazing qualities of Maine, it is the inter/national extent of our network that will allow our algal innovation mission to scale. The NCMA, and by proxy MARIA, has a broad reach through its active collaboration with other public access algal collections globally, and engagement with the Algae Biomass Organization.

2. What does the regional algal innovation ecosystem want?

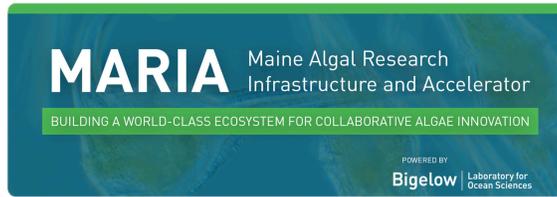
The collected feedback from the All-Hands Workshop provided a concrete innovation agenda, aligned with the project goals, which MARIA can help translate into an opportunity pipeline.

2.1 Product opportunity themes to prioritize (linked to Workstream 1):

Meeting participants explicitly asked to see more clarity for opportunities in the following areas, in no particular order:

- **Algal pigments** for ink/dyes/paints (including textiles).
- **Natural anti-fouling paints/coatings** for boats and gear.
- **Bioplastics/advanced materials**, including coatings for compostable cups/plates.
- **Antimicrobial/antifungal solutions** for crops.
- **Food and nutrition concepts** (protein shake; algae in foods; gelatin replacement for alternative proteins; sunscreen).
- **Antioxidants/medicinal uses** for pets and humans.
- **Data science & management** as a first-class product enabler.

Implication(s) for MARIA: creation of “trackable opportunity verticals” inside the Opportunity-Capability Map —each with a defined list of needs (traits, metabolites, assay types, performance metrics, and regulatory considerations) will lead to sustained success.



2.2 Resource and Research Infrastructure access (linked to Workstream 2):

Meeting participants asked pointedly for:

- Reduced access barriers to biological materials by potentially **gifting strains** (or underwriting access costs).
- A **mobile macroalgal nursery** as a shared training capacity for landlocked institutions.
- Improved accessibility of **fee-for-service equipment** (e.g., via partners underwriting costs of instrument use).
- Targeted development of **computational biology** capabilities specific to algae.
- Clarity on microalgae research innovation in Maine and connections with the much more visible macroalgae research.

Implication(s) for MARIA: Reducing access barriers will increase interaction and throughput rates increasing likelihood of achieving success metrics.

2.3 Workforce Development: engagement, accessibility, and relevance (linked to Workstream 3):

Meeting participants emphasized that rural engagement requires:

- **Low-barrier entry points** for students, founders, Indigenous internships, and opportunities for career transitioners, as well as long-horizon trust building.
- Visible presence via **verified public outreach as a trust mechanism**, and practical “translate big science” formats like lunch-and-learns and participation in existing state-wide blue economy events.
- Integrating **computational modeling tools** into the bioproduct data workflow to take the data to the next level.
- Expanding informational metadata, e.g., storing **chemical structure data** in the MARIA database, with more quantitative data.
- Clear mapping of training programs and/or course work to business partner workflows to ensure ‘WFD-Business Fit’.
- Documenting/exporting lab modules (e.g., algae + zebrafish workflows, genetic sequencing and bioinformatics) to build new partnerships with inland institutions and organizations.

Implication(s) for MARIA: broad engagement, particularly in rural areas, must be designed, not assumed. The MARIA program should publish a rural engagement plan with defined channels, partners, and measurable participation outcomes.



2.4 Business development constraints in Maine (linked to Workstream 4):

Meeting participants cited the following core business development barriers:

- **Scaling economics** (i.e., “need a cheaper way to grow it”).
- Limited **market pull/financial backing**, small market share, and policy friction.
- Classic sequencing problem: “build product first vs. validate need first.”
- Geography: sparse population and widely distributed hubs, plus upfront cost to test ideas. Sparse population also leads to cold-start failure.
- Lack of general public knowledge about algae products, risk aversion in new product and process adoption, increasing upfront research costs.
- Limited number of Generally Regarded as Safe (GRAS) certified strains leading to long and expensive regulatory timelines for certain sectors.

Implication(s) for MARIA: MARIA must find a way to provide (1) customer discovery support, (2) subsidized experimentation pathways (strains + assays + prototyping access), (3) clear policy/regulatory navigation starting early in the funnel to break down barriers to economic translation along the way, (4) help design a launch strategy that increases the probability of business success in Maine, and (5) Identify new strains with high market potential and create a priority list for future GRAS certification.

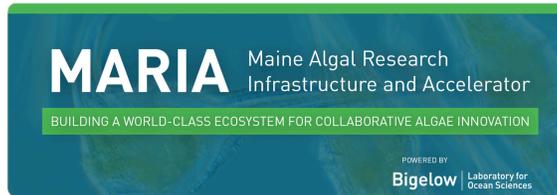
3. Aligning What MARIA Can Offer and What the Algal Innovation Ecosystem Wants: The 12-month plan (January–December 2026)

Workstream 1 — Data-to-Discovery:

Deliverable(s) by December 2026: at least two (2) versioned, partner-relevant, accessible, dataset releases spanning diverse microbial taxa and including biochemical + functional trait layers, where possible, designed to support multiple product verticals for companies in the algal innovation space.

Implementation Steps:

1. **Define & Publish SOPs and QC requirements:**
 - Document harmonized sample handling, extraction and analytical protocols, and data reporting templates. Define acceptance criteria and QC procedures.



- o Write a standard “how to use this data” guide that is shared with all data access requests and/or data access license purchases. The [Molecules Gateway](https://www.google.com/url?q=https://micro4all.com/molecules-how/%23data_proc&sa=D&source=docs&ust=1770384663321653&usg=AOvVaw0XFhGN9Sytj2mh3De5E_T) guide (https://www.google.com/url?q=https://micro4all.com/molecules-how/%23data_proc&sa=D&source=docs&ust=1770384663321653&usg=AOvVaw0XFhGN9Sytj2mh3De5E_T) will serve as an exemplar template.
- 2. **Assemble “Trait + Metabolite Minimum Viable Dataset (MVD)”**
 - o Identify and integrate appropriate strain metadata to improve interpretability.
 - o Process internal data using documented analysis protocols and procedures.
 - o Identify internal functional trait data (e.g., growth rate, stress tolerance proxies, pigment profiles, antimicrobial screens, polymer-related traits, etc.), internal discrete biochemical data (e.g., fatty acid profiles), external genetics data in GenBank and link all via the strain CCMP####.
 - o Assemble MVD of all available strains by a milestone date for the first release.
- 3. **Public Release of data access:**
 - o Release 1:
 1. Set up subscription service cost model (tiered by user type from individual to company) embedded in NCMA ecommerce platform for billing/payment.
 2. Create a data access portal either through (NetSuite) NS or through a separate interface as appropriate for security and access.
 3. Create and link Form based search function to stakeholders as a V1.0, unless a more user friendly search can be put in place by the milestone date.
 4. Market dataset access to stakeholders via digital and manual channels.
 - o Release 2:
 1. Release expanded dataset (ie., metabolomes from more strains, and any other data compiled), updated partner guide.
 2. Release more user friendly, and more advanced search functionality.
- 4. **Continue Value-Added Information Generation:**
 - o Track and compile MARIA-identified value-add:
 1. Identify high-signal metabolites and links to traits/functions
 2. Publish short briefs (e.g., what compound/application is it, what it may enable, what are next verification steps, and which partners are/maybe relevant)
 3. Refine data-search functionality to prove utility and value.
 - o Partner-identified Opportunities
 1. Through outreach, identify market driven product/process interests as inputs to creation of short briefs.
 - o Development of computational biology tools and capabilities to support data analysis by all stakeholders



Workstream 2 — Research Infrastructure (RI) Enablement:

Deliverable(s) by December 2026: an entrepreneur/company-usable RI environment with defined services, onboarding pathways (e.g., contracted research, consulting, etc.), and predictable pricing.

Implementation Steps:

1. **Assemble scientific mentor network and technical support team(s) with clear roles**
 - o Align scientific mentors, either internal or external to Bigelow Laboratory as appropriate, by domain (cultivation, omics/chemistry, materials, bioactivity), and define processes to engage.
 - o Provide “Entrepreneur-in-residence” style translation support, through MCE, the new Bigelow Laboratory Technical Transfer Officer, and/or other ecosystem contributors as appropriate, to address the product-vs-need sequencing issue.
 2. **Create the MARIA RI Service Catalog (v1.0)**
 - o Articulate available assays, sample handling and instrumentation protocols, cultivation capabilities, turnaround times, sample requirements, and expected outputs.
 - o Publish transparent pricing and pathways for early-stage testing (e.g., “first experiment” or “new customer” vouchers) that can be accessed via digital or personal methods.
 - o Address stakeholder request to reduce strain acquisition friction—create a defined mechanism for subsidized strains or underwriting.
 3. **Close priority RI capability gaps**
 - o Identify bottlenecks that directly affect the opportunity verticals (e.g., pigment analytics throughput, antimicrobial screening capacity, polymer/material test methods).
 - o Identify solutions and funding for the bottlenecks
 4. **Launch a mobile macroalgae capability**
 - o Evaluate concept feasibility, identify partners, and develop an operating model for a mobile macroalgal nursery pilot.
 5. **Codify collaboration expansion**
 - o Formalize collaborations that broaden jurisdictional RI reach (e.g., collaboration with EPSCoR partners in Rhode Island).
 - o Release statement on support that can be provided in support of SBIR/STTR and/or other funding pathways.
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Workstream 3 — Workforce Translation:

Deliverable(s) by December 2026: continue existing and develop new modular training activities with clear pathways into internships, employment, and founder activity, including rural participation growth.

Implementation Steps:

1. **Coordinate existing ‘classroom’ training into a single MARIA curriculum “map”**
 2. **Create/identify new modular training products**
 - o **Module A (2-week biomanufacturing module)** tailored for non-engineering students, as requested (U. Maine Orono; Bashir Khoda).
 - o **Module B (data-to-product workflow)** including chemical structure data handling and modeling integration.
 - o Develop new grant-based opportunities through partnerships with the Algae Biomass Organization and Maine Middle School Teachers.
 3. **Design mentorship coordination across education events**
 - o Implement a shared mentor roster and “scheduling system”. Explicitly include Indigenous internships and mid-career/part-time options beyond summer.
 - o Formalize placements with partner organizations and publish a “pathway to employment” guide.
 4. **“Translate Big Science”**
 - o Develop thematic Lunch-n-learns for interested stakeholders (e.g., non-scientists, businesses and interested community members) with a focus on tangible algae applications and pathways.
 - o Recruit/assign a community liaison; publish an outreach calendar; build social-media storytelling plan as a trust mechanism.
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Workstream 4 — Innovation Acceleration:

Deliverable(s) by December 2026: a process that accelerates advancement of at least two (2) algae-based solutions with SMART (Specific, Measurable, Achievable, Relevant, and Time-bound) deliverables (e.g., prototype, pilot production, experimental results, LOI, or funded follow-on).

Implementation Steps:

1. **Build the Opportunity-Capability Map (OCM) as an operating tool, not a static deliverable**
 - o Encode the stakeholder product themes as verticals (pigments, anti-fouling, bioplastics/coatings, crop antimicrobials, food/nutrition, health/antioxidants, data products).

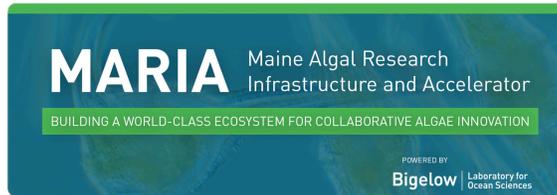


2. **Leverage North Atlantic Blue BioTech initiative**
 - o Build brand recognition where algae is seen as part of blue biotechnology.
 - o Leverage industry and corporate engagement to highlight the power of algae
 3. **Define a stage-gated funnel with clear gates**
 - o Gate 0: problem + customer segment clarity (solves “chicken/egg”, and both active and passive).
 - o Gate 1: lab-scale technical feasibility plan + required RI services identified
 - o Gate 2: prototype + preliminary economics signal (addresses scale/cost concerns)
 - o Gate 3: pilot partner + pathway to capital/policy/regulatory plan
 4. **Revise “Algal Science Day” Activities**
 - o Coordinate the MARIA focused “Algal Science Day” with the broader Maine Blue Economy Week and expand the event into a larger venue. This will attract more attention than an individual event while increasing attendance and bringing adjacent sectors into the same space.
 - o Design day’s activities to better connect entrepreneurs/investors and “big algae thinkers”.
 - o Develop a ‘lunch and learn’ (or fireside chat) series to provide a venue for more science-focused discussions. These would be smaller, intimate conversations focused on developing the science that underpins growth, and/or formation, of Algae companies in Maine.
 5. **Launch an “awareness to engagement” campaign**
 - o Leverage Bigelow and partner institutions communications teams for a public awareness campaign through social media, digital newsletters, flyers, exhibition booths, etc.
 - o Increase entrepreneurial awareness of algae use-inspired perspectives and how to access MARIA through shared written engagement materials, the MARIA website, targeted events such as the Lunch & Learns planned across the state of Maine, giving keynote presentations and providing onsite tours of the NCMA.
 6. **Implement IP and collaboration processes**
 - o Standardize collaboration templates and processes for new proposals; define IP return pathways.
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4. Integrated timeline view (by quarter)

Q1 2026 (Jan–Mar): Build the operating system

- Lock MVD trait panel, strain selection, SOP/QC, and data model (including chemical structures).
- Assemble mentor/tech team; publish service catalog framework.
- Finalize stage-gated funnel + OCM structure; align with product verticals requested.



- Stand up rural engagement plan and liaison approach.

Q2 2026 (Apr–Jun): First visible outputs

- Dataset Release 1; partner usability guide.
- Fee-for-service rates published; “first experiment” subsidies piloted.
- Plan for Training Modules launched; first lunch-and-learns;

Q3 2026 (Jul–Sep): Scale participation and prototypes

- Sprint 2 data generation targeting top opportunities from funnel.
- Use-inspired solution activities move into prototype/pilot work (materials, coatings, pigments, crop bioactives as leading candidates).
- Publish mobile macroalgal nursery pilot concept note and partnership model.
- Expand internships (Indigenous + mid-career pathways).

Q4 2026 (Oct–Dec): Demonstrate outcomes and lock sustainability

- Dataset Release 2; upgraded RI access pathways; collaboration and proposal processes codified.
- MARIA Science Day as part of the Maine Blue Economy Week (demo + investor/partner matchmaking).
- Work with other state initiatives (e.g., Center for Blue Economy) to publish “Pathway to Employment” and “Where Resources Live” information to answer resource discoverability concerns.

5. Risk and mitigation (practical)

- 1. Risk: Data generation without partner utility**
 - *Mitigation:* define MVD around stakeholder verticals; require a “use case” for each assay panel.
 - 2. Risk: RI exists but is hard to access**
 - *Mitigation:* publish catalog + pricing + onboarding; subsidize early experiments.
 - 3. Risk: Rural engagement is episodic and low-trust**
 - *Mitigation:* community liaison + recurring formats + culturally grounded partnerships.
 - 4. Risk: “Scale economics” stall innovation**
 - *Mitigation:* embed technoeconomic analysis-like thinking in the funnel and require early unit-cost hypotheses for prototype selection.
 - 5. Risk: Financial “Insecurity” results in disruption of the ecosystem**
 - *Mitigation:* continue to find the right balance of non-distracting grant-based opportunities in science/WFD and ‘project revenue’ (fee-for-service) to keep advancing availability and development of infrastructure and human assets.
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