**Renewable Bioproducts Institute (RBI) Graduate Research Fellowships**

**Paper Science & Engineering (PSE) Academic Program of Study**

**Request for Proposals**

**For Academic Year 2022-2023**

# Introduction

The Renewable Bioproducts Institute at Georgia Tech benefits from a substantial endowment that is invested to advance the evolving science and technology needs of the bioproducts industry through leadership development and graduate research. The endowment over the years has produced more than 1,500 graduate scientists and a leading body of scientific research. Receiving endowment support is a two-step process: (1) faculty propose a research project in spring semester and from those that are selected for funding (2) a student is assigned to the fellowship in fall. This document describes the request for project proposals from GT faculty for fellowships that will begin in academic year 2022-2023.

# Eligibility

As a GT IRI, RBI strongly encourages interdisciplinary collaborations. A principal goal of RBI is to use the endowment to incubate and develop strong teams that will eventually grow into large, externally funded programs. We have two categories of awards: **Traditional** 1-student awards and new **Building Teams** multi-student awards. **Traditional** awards are required to have two principal investigators with distinct expertise or disciplines who will co-advise 1 student. **Building Teams** awards will have 3 or more interdisciplinary PIs and can request up to 3 students, as long as the effort is well justified. For example, the multi-student efforts should aim to define and develop frontier areas and new subdisciplines as applied to forest and agricultural biomass products and processing. The students supported can be from any of the following schools: ChBE, ME, MSE, CHEM, ISyE, CEE, or BIOE (Bioengineering Program schools). Proposals that include faculty PIs from ISyE, CEE or BIOE (new programs supported in this RFP) are required to have at least one PI from ChBE, CHEM, ME, or MSE, to provide a connection to the original core programs familiar with RBI’s practices and mission. PIs can be from the same school, but their teaming must clearly provide interdisciplinary training for the student. Applications that enhance diversity and inclusion of traditionally underrepresented groups in engineering and science are encouraged.

# Requirements

Applications, emailed as a pdf document to dione.morton@rbi.gatech.edu, are **due by February 10, 2022 in the format specified in the table on page 2.** Award announcements are expected by May 6, 2022 and student assignment to the fellowship should be completed by end of Fall Semester 2022. Failure to recruit qualified students by that time jeopardizes the award.

Applications must include the **elements in the table on page 2**. Please read the section below entitled. See *Protection of Intellectual Property* and consider this in proposal preparation.

The Traditional fellowship application **must not exceed six pages** (inclusive of the cover page, and references) plus 1 biosketch for each PI. The Building Teams applications are allowed two additional pages for a total of 8 + the biosketches. The application must be a standard letter-size (8.5-11 inches) document with 1–inch margins on all sides. The font must not be smaller than 11 point. Figures, if included must fit within the page limit.

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|  **Cover page**(1 page) | TitlePI names and affiliations (all faculty advisors are considered PIs)Number of students requested (2 PIs can request 1 student; teams of 3 or more PIs can request 3 students)RBI Strategic mission alignment (select at least one). Proposals that bridge more than one focus are also encouraged.1. Paper, Packaging and Tissue
2. Biorefining and Bioindustrial Technology
3. Circular Materials Economy

Abstract* 350 words and one optional figure. Suitable for sharing with RBI member company representatives and potentially other prospective funding sources (See *Protection of Intellectual Property,* below) and which could be included on a web site describing RBI projects.
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| **Program Alignment**(2 page) | * *Industry & sustainability alignment*. Select **one** [industry technology research need](https://www.appti.org/technology-roadmaps-downloads.html) **and one** [UN sustainability goal](https://sdgs.un.org/goals), with which your proposed project aligns and describe this in 200 words or less. RBI Member Company representatives provided information about their areas of interest at the RBI Proposers’ Day event on November 17, 2021. Slide presentations and contact information were made available to participants. Those without access should contact Dione Morton (dione.morton@rbi.gatech.edu) to be added.
* *Results from previous RBI fellowship support (if applicable)*. Include how have those results been leveraged to apply to external funding or support technology transfer activities (200 words)
	+ If this is a continuation to a previously funded RBI fellowship, how is the proposed application innovative and a/or departure from previous work? (100 words)
* How does this award catalyze future external interdisciplinary proposals and what funding sources might be approached? (200 words)
* *Student Advisement.* How will the advisement of the RBI fellow prepare them to assume leadership roles in industry or academia? (100 words)
* *Team organization*. How will the co-advisement of the RBI fellow(s) be structured? This is particularly important to describe for multi-student efforts. How will materials and supplies be supported? (200 words)
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| **Research Narrative**(1-student proposals have a 3 page maximum and 3-student proposals have a 5 page maximum) | **1. Innovation and Impact** **1.1 Overview*** Provide a general description of the project and how the proposed technology works in non-technical terms.
* Describe the overall project goal.

**1.2 Impact** * What is the problem being solved with the proposed research?
* What is the project’s potential to disrupt current thinking in science or engineering? Alternatively, what is the project’s potential to disrupt current technology?

**1.3 Innovation*** How does the project provide an innovative solution to an existing scientific or engineering challenge?
* What are the technical goals and anticipated results of this project?

**2. Proposed Work** * Provide a description of the approach to be taken.
* Lay out the background theory, simulation, modeling or experimental data that supports this approach.
* What are the critical technical risks of this proposal? How do will they be mitigated?
* Describe the project’s key objective in appropriate detail and the tasks that need to be accomplished to achieve those goals.
* Provide any alternative approaches considered.
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| **Biosketch**(1 page per PI) | * A biosketch narrative for each PI should be provided, written in the third person, covering the two topics below. No picture should be included.
* PI’s research area and how it aligns with the mission of RBI. (<100 words)
* PI’s expertise and facilities and equipment capabilities relevant to the proposed project. (<100 words)
* The 5 most relevant intellectual products to the research proposal
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# Protection of Intellectual Property

Titles, abstracts, biosketches, program alignment, and student advisement descriptions will be shared in RBI communications with member companies for the purpose of gaining their support for funding the submitted projects. Please be mindful of this when developing these items. RBI member industry representatives are bound by GT RBI By-laws that protect our proposals; nevertheless, we recommend caution when preparing these sections. Do not include confidential/proprietary information. To preserve intellectual property protection, no aspect of the proposals will be shared beyond Georgia Tech without your express permission.

# Strategic Alignment

RBI aligns Fellowship funding with Georgia Tech strategic areas and leverages the endowment with broader initiatives across the campus. Collaborative programs are encouraged, as are programs that an industry or a consortium of industries might co-fund. In the 2022-2023 cycle, recognizing that many paper industry companies are exploring alternative fiber and fuel sources, we are open to proposals that consider either forest or agricultural sources of biomass. Here agriculture can be interpreted broadly, and encompasses terrestrial crops, marine plants, and algae, among others. *If you have any questions about the suitability of a proposal idea, you are encouraged to discuss them in advance with Carson Meredith, RBI Executive Director.*

RBI has three strategic thrusts, discussed further below, in its research mission:

*Paper, Packaging, and Tissue* includes pulping and paper-forming innovations, new or enhanced products, and process decarbonization and energy efficiency.

*Biorefining and Bioindustrial Technology* includes advanced pulping technologies, biocatalytic, fermentation or synthetic biology strategies to produce chemicals, fuels, and pharmaceuticals, and relevant advanced separations and recovery strategies.

*The Circular Materials Economy* includes design and synthesis of new products and processes that utilize biomass to keep carbon in the value chain. A focus of this effort is on alternative plastics, and can include recycling, upcycling, biodegradation, and characterization.

Reference to industry priorities and alignment with the RBI strategic thrusts above are significant factors in the proposal review.

## Paper, Packaging, and Tissue

Growing global population and the emerging markets to serve its needs will require vast amounts of materials for paper, packaging, chemicals and energy. Our objectives include developing materials and products from sustainable and renewable forest and agricultural biomass, to reduce energy intensity and CO2 emissions in manufacturing, to make more efficient use of water, and to facilitate substitution of petrochemical-based applications with those based on renewable forest- and plant-based materials. Accordingly, this area includes pulp-, paper-, packaging- and tissue-related (a) innovative manufacturing technologies and process improvements, including decarbonization, and (b) new, innovative product applications for forest bioproducts. Concepts that have the potential to be cost-effective, scalable, and applicable to large-scale markets are of interest.

### Innovative Manufacturing Technologies and Process Improvements

*Breakthrough manufacturing and/or step-change manufacturing resource, energy, emissions, or cost reduction.* Specific interests are in innovative approaches for reducing fiber cost through higher performance, enabling effective use of lower quality fiber, and advanced fiber recycling technologies. Also in scope are novel sustainable paper manufacturing processes, including new or better separation technologies and applications and/or alternatives to the current power generation and kraft recovery processes, yielding significant reductions in energy, CO2 emissions, and water use. This category also includes applications of big data and analysis techniques, smart manufacturing, and life cycle analysis. Manufacturing process intensification, modularization and decarbonization projects that would yield energy efficiency and manufacturing cost reduction are of interest.

### Innovative Improvements and Applications for Bioproducts

RBI is interested especially in modification of fibrous structures to promote novel forest- and plant-based products such as displacing petroleum products in food and beverage packaging, foodservice, personal care, and healthcare items. Other interests include novel products from 2D printing for electronics or displays and 3D printing and additive manufacturing. Development of unique recyclable or biodegradable polymers that can be coated onto paper and packaging to impart liquid- (oil and water), gas- and moisture-barrier properties are of interest.

Contact Chris Luettgen (chris.luettgen@rbi.gatech.edu) to discuss program details.

## Biorefining and Bioindustrial Technology

1. Biorefining. Biorefining is broadly defined as the chemical, biological or mechanical processing of biomass into value-added products. We are interested in proposals that address one or both of two paradigms:

1. The Pulp Mill of The Future. How do we adapt pulp mill flows to derive higher value from the lignin containing streams? How do we convert recovered lignin into valuable chemical and fuel feedstocks? How do we improve valorization of other pulp mill streams e.g. tall oils?

2. The Refinery of The Future. We envision a future where conventional petroleum refineries will gradually adapt to biomass feedstocks. Additionally, with the increasing use of electric vehicles, we expect the refinery product slate to shift from gasoline to chemicals and diesel or jet fuels. We seek research that addresses the following questions: How do we adapt existing refinery infrastructure to accept biomass inputs in increasing quantities? How do we lower the carbon footprint of liquid fuels? How is electrolytically-generated H2 utilized effectively to adapt biomass-derived molecules to hydrogenated forms useful in fuels? For those refineries using biomass, how do we increase efficiency with advanced reaction and separations technologies?

Contact Matthew Realff (matthew.realff@chbe.gatech.edu) to discuss program details.

1. Bioindustrial technology broadens this to include the use of synthetic biology principles to engineer microbial-based processes to convert and valorize biomass. This category includes processes for more efficient breakdown of biomass into cellulose, hemi-cellulose, and lignin, as well as conversion of these products into valuable chemicals and fuels. We are particularly interested in research proposals that address fundamental and manufacturing challenges for future high-margin/high-volume chemical products from biomass, including renewable monomers and pharmaceutically active compounds. Proposed approaches should have a plausible path to cost-effective production at industrial volumes and offer similar or better performance than currently available approaches.

Contact Pamela Peralta-Yahya (pperalta-yahya@chemistry.gatech.edu) to discuss program details.

## The Circular Materials Economy

*The challenges of a carbon-constrained material economy include proliferation of products in landfills and oceans at the end-of-life, reliance on limited resources, greenhouse gas emissions and loss of product value at end-of-life.* Addressing the scientific challenges and developing technologies for new biomass-derived materials that can function in a circular lifecycle can be a significant value to the forest-based manufacturer’s portfolio of products. We seek proposals that address fundamental questions in enabling the circular materials economy by using biomass-sourced feedstocks, by use of paper-based products, or by use of biorefining and bioindustrial technologies for manufacturing, recycling or upcycling. Areas of emphasis include but are not limited to: (i) synthesis of new monomers from biomass, (ii) functional composites with biomass-derived fibers, (iii) alternative packaging plastics, (iv) recycling, upcycling, and biodegradation, (v) characterization of bio-based materials, and (vi) economic, policy-level and life cycle analysis of circular biomass-based materials.

Contact Kyriaki Kalaitzidou (Kyriaki.kalaitzidou@me.gatech.edu) to discuss program details.

# Selection of RBI Fellowship Proposals for Funding

Applications will be reviewed and selected for funding through a three-step process that includes review by the RBI Member Council, the PSE Academic Committee, and the RBI Leadership team including the Director, Associate Director and Strategic Coordinators, described [here](http://www.rbi.gatech.edu/obtaining-fellowship-funding).

# Terms of Awards

RBI fellowships are generally awarded for a term of up to 4 years (PhD student) or 2 years (MS student)~~,~~ and are contingent upon satisfactory progress toward the degree objective.  In the case of a student’s having made progress toward his or her degree before the fellowship award, the award terms may be reduced.  Advisors are responsible to obtain any funding required beyond the RBI award term.

# Conditions of Support

As a prerequisite to receiving and continuing the RBI Fellowship, we must receive from faculty advisors a commitment to RBI and the PSE academic program.

1. We require that an annual progress assessment be completed by the student and the faculty advisor to ensure that the RBI Fellow is making satisfactory progress.  RBI retains the right to terminate support if project progress is unsatisfactory or the project scope is changed without RBI approval. The report is due on May 31. The assessment reports may be shared with our member companies, and faculty must therefore be mindful of intellectual property considerations when preparing the assessment reports. The form for this report can be found [here](http://www.rbi.gatech.edu/sites/default/files/documents/Annual%20Report%20of%20Progress%20v4%20Final%201105.docx).
2. We expect RBI Fellows to participate in periodic GT-RBI industry meetings and provide posters and presentations reporting research plans and accomplishments.
3. Students receiving support must complete the 4-course requirements of the Paper Science & Engineering program required of PSE minors described [here](https://rbi.gatech.edu/paper-science-engineering-program-0).
4. Students must be enrolled full-time to remain eligible for an RBI Graduate Research Fellowship. Internships are encouraged and will be accommodated with the advisor’s recommendation and RBI executive director approval.
5. **Faculty and students are to acknowledge RBI support (*e.g.,* in the acknowledgement section) in publications and presentations resulting from RBI endowment-supported work**, and are to ~~i~~nclude the **Renewable Bioproducts Institute in the affiliations at the beginning of the document or presentation**. For papers, a suggested acknowledgement may read “Student X was [partially] supported by a RBI Graduate Research Fellowship from the Renewable Bioproducts Institute at Georgia Tech.” Presentations at workshops, seminars and conferences should include the RBI Logo in an acknowledgement slide.

# Links

* [RBI Strategic Mission & Vision](http://www.rbi.gatech.edu/about-renewable-bioproducts-institute)
* [Process for Obtaining Fellowship Funding](http://www.rbi.gatech.edu/obtaining-fellowship-funding)
* [Fellowship Student Annual Report Form](http://www.rbi.gatech.edu/sites/default/files/documents/Annual%20Report%20of%20Progress%20v4%20Final%201105.docx)