



MAINE DEPARTMENT OF
Energy Resources

Clean Energy Partnership

Advisory Group Meeting
November 12, 2025



Agenda

- Introductions, Announcements, and Discussion
- Guest Presentations (UMaine)
 - Wind turbine blade recycling,
 - Roberto Lopez-Anido, *Professor of Civil & Environmental Engineering*
 - Reed Miller, *Assistant Professor of Civil and Environmental Engineering*
 - Accelerated Carbonization for Soil Stabilization (MIRTA team)
 - Aaron Gallant, *Associate Professor, Civil and Environmental Engineering*
 - Sustainable Wood to Fuel and Fish Feed
 - Clay Wheeler, *Director of the Forest Bioproducts Research Institute, Professor of Chemical & Biomedical Engineering*
 - Tom Schwartz, *Associate Director of the Forest Bioproducts Research Institute, Associate Professor*
 - Biofine Developments Northeast,
 - Michael Cassata, *Co-Founder and Chief Development Officer, Biofine Developments Northeast Inc.*
- Discussion & Input from the Public



Announcements

- October 6: Maine Department of Energy Resources Releases Updated Winter Heating Guide
- September 30: Governor Mills Announces Reduction of Heating Oil Reliance in Maine
- September 24: Governor Mills Announces Launch of the Maine Department of Energy Resources
- September 17: Governor's Energy Office Welcomes Maine PUC Selection of New Cost-Effective Clean Energy Projects
- September 16: Governor Mills Announces Opposition to CMP's Request to Hike Electricity Rates



Upcoming Programming and Events

11/17	passivhausMAINE – "Women & Non-Trad Tradespeople" Meeting Maine's Energy Code (Freeport)
11/20	passivhausMAINE – Residential Energy Code Essentials (Virtual)
12/1	Maine Won't Wait Annual Update
12/20	passivhausMAINE – Meeting Maine's Energy Code (Bangor/Brewer)
November	Clean Energy Financing Study – Report Publication
December	TREC Award Announcement
March	2025 Clean Energy Industry Report (CEIR)



Maine Math and Science Alliance launched its Rural High School Futures project in August.



MAINE DEPARTMENT OF
Energy Resources

University of Maine – Energy Programs



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Energy Resources

OffshoreWind4Maine 2.0:
**An inclusive & interdisciplinary workforce
development program on offshore wind**

Clean Energy Partnership Project Update
11.12.2025



Dr. Amrit Verma
Assistant Professor of Mechanical Engineering,
University of Maine (Orono)

Summary of Period of Performance

<i>Period of Performance</i>	<i>Tasks</i>	<i>Project Title</i>	<i>Funding amount</i>
Oct 1, 2022 - Sep 30, 2023	Year 1	OffshoreWind4Maine	\$267k
Oct 1, 2023 - Sep 30, 2024	Year 2	OffshoreWind4Maine 2.0	\$35k
Oct 1, 2024 - Sep 30, 2025	Year 3	OffshoreWind4Maine 2.0	No cost extension

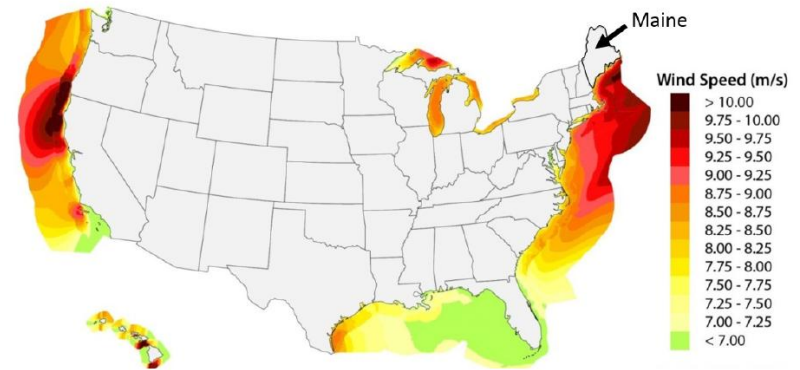
❖ Project concluded this year, and all tasks were completed

Outline of the presentation

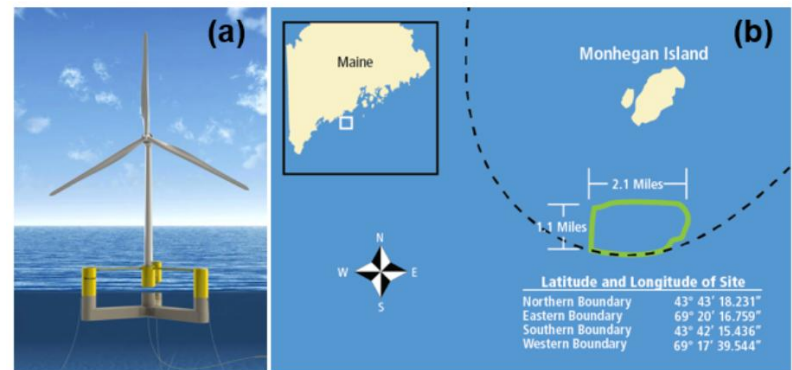
- ❖ Motivation
- ❖ Objectives
- ❖ Developed Programs and courses
- ❖ Highlights
- ❖ Summary

Motivation

- ❑ The Gulf of Maine (GOM) has one of the best offshore wind resources in the US.
- ❑ Several new jobs are expected to be created in Maine, which will require expertise in offshore wind.
- ❑ Maine must advance its educational infrastructure to prepare and train students in offshore wind, thus strengthening the workforce pipeline.
- ❑ There were only two courses available back in 2022 that covered selected topics in offshore wind.
- ❑ Thus, there was an immediate need to strengthen the offshore wind curriculum at UMaine.



<https://www.energy.gov/eere/articles/computing-americas-offshore-wind-energy-potential>

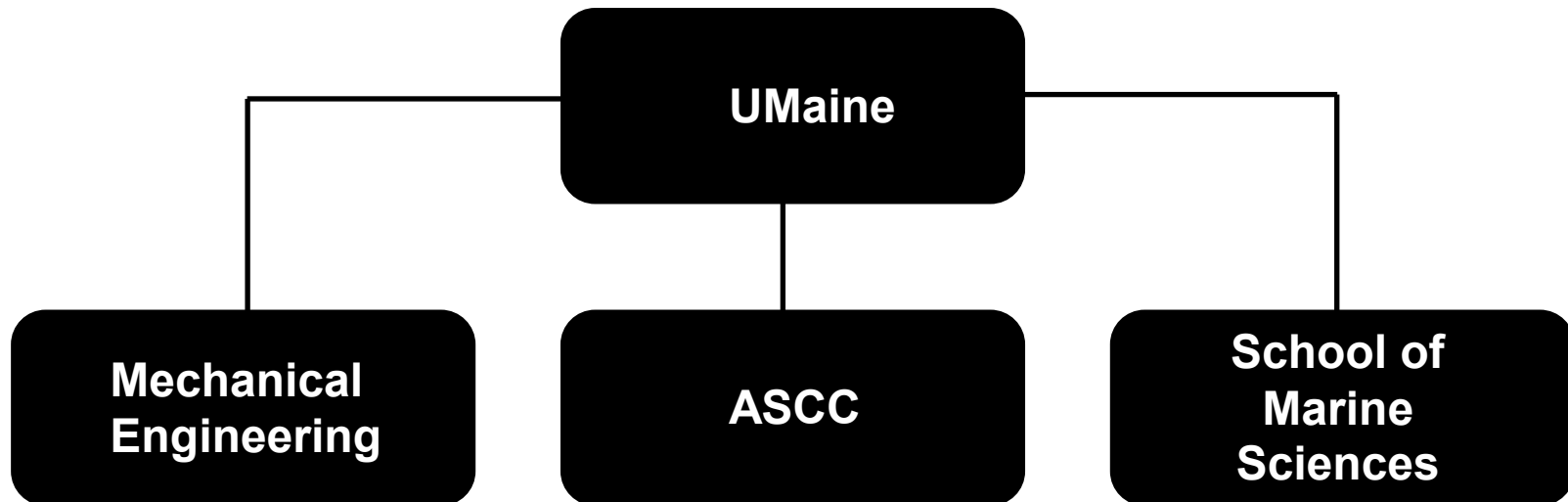


<https://composites.umaine.edu/volturnus/>
<https://umaine.edu/offshorewindtestsite/>

Objective

The objective of the project “**OffshoreWind4Maine**” & “**OffshoreWind4Maine2.0**” was to advance Maine workforce development in offshore wind by

- (a) creating a series of new Micro-credential courses on offshore wind,
- (b) developing transformative undergraduate and graduate-level courses on offshore wind, and
- (c) establishing curriculum programs on offshore wind energy
- (d) providing hands-on experiences to students



These programs will benefit more than 300 students on campus during the project

Developed Programs and courses

❖ Degrees/certificates:

- (a) Undergraduate concentration program in Offshore Wind Energy
- (b) Graduate certificate program in Offshore Wind Energy

❖ Micro-credentials and Micro-badges:

- (a) K-12 Youth Windstorm Challenge Micro-Credential
- (b) Wind/Wave Model Testing Micro-Credential
- (c) Instrumentation Micro-Credential
- (d) Introduction to Offshore Wind Energy Micro-Badge
- (e) Remotely Operated Vehicle (ROV) Surveys Micro-Credential
- (f) Small Boat Operation Micro-Credential

❖ New Courses developed:

- (a) MEE 491/591: Offshore Wind Farm Engineering
- (b) Course Modules on Marine Operations
- (c) MEE 580: Wind Energy Engineering
- (d) MEE 697: Offshore Wind Stakeholder course

Highlights

Hands-on research experiences for students:

- Trained undergraduate students in labs
- Provided hands-on experience for students in performing wind tunnel measurements
- Established a laboratory module on wind tunnel studies for the MEE 491/591
- Included guest lectures from international university experts and industry professionals
- Organized a Joint Summer School with NTNU, Norway.
- Conference presentations & Symposium posters presented by students



Summary

(a) **Number of participants:** We had over 1200+ participants.

(b) **Student posters:**

- Undergraduate co-authors presented conference posters.
- Students won the best poster award at the UMSS symposium

(c) **Career advancements:**

- Several undergraduate students went on to do graduate studies and received job offers and internships

(d) **Sustainability:**

- Every course component and program developed has been fully integrated into the university's educational system.



WEMO LAB
Wind Energy & Marine
Operations Lab



Beginnings: Experiential Learning in Digital Twin Technologies for the Blue Economy

Hiring Undergrad & Grad Students: Fall 2025 !!

BLUE ECONOMY SNAPSHOT

Contributed **\$397 billion** to U.S. GDP & supported **2.4 Million Jobs** (2019)



Maine & New England are critical Blue economy hubs but face:

- o Workforce shortages
- o Declining natural resources
- o Infrastructure challenges

➔ **Digital Twins (DT)** are transforming data-driven decision-making

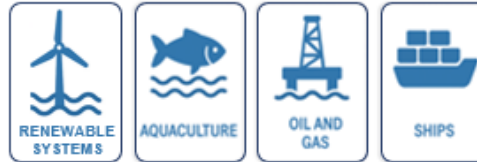
➔ **Demand for DT specialists** are skyrocketing

➔ Yet, hands-on DT training is limited, especially in Maine

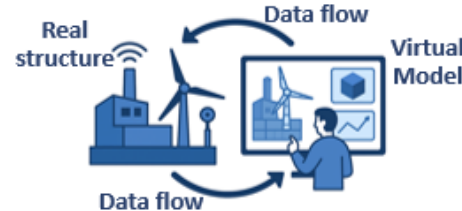
INTERNSHIP OVERVIEW

- Two paid internship options:
 - ✓ 8-Week Summer Internships
 - ✓ Year-Round Internships
- Access to **two UMaine testbeds**
- Preference to **early-stage undergrad (e.g., freshmen)** & grad students
- Include pre-internship workshops, mentoring, and career support
- Earn an industry-informed **digital twin UMaine micro-credential**

BLUE ECONOMY INDUSTRIES



DIGITAL TWIN TECHNOLOGY



Learn: Coding; AI/ML Analytics; Sensor Fusion; Ocean Eng.; Data-driven Eng.; etc.

INTERNSHIP HOSTS

- **5 Blue Economy companies and 1 National Lab** > Kelson Marine; Diamond Offshore Wind; DeepCWind; Kartorium; Vertical Bay; and NREL
- **Faculty labs at UMaine leading DT research** > Mechanical Engineering, Electrical & Computer Engineering, ASCC, School of Marine Sciences

Contact: amrit.verma@maine.edu

Blue Economy



U.S. National Science Foundation

Award Abstract # 2526219

Beginnings: Experiential Learning in Digital Twin Technologies for the Blue Economy

NSF Org:	ITE Innovation and Technology Ecosystems
Recipient:	UNIVERSITY OF MAINE SYSTEM
Initial Amendment Date:	August 26, 2025
Latest Amendment Date:	August 26, 2025
Award Number:	2526219
Award Instrument:	Standard Grant
Program Manager:	Mary Crowe mcrowe@nsf.gov (703)292-5188 ITE Innovation and Technology Ecosystems TIP Directorate for Technology, Innovation, and Partners
Start Date:	October 1, 2025
End Date:	September 30, 2028 (Estimated)
Total Intended Award Amount:	\$999,390.00
Total Awarded Amount to Date:	\$999,390.00

Team



Dr. Amrit Verma
 Assistant Professor of
 Mechanical Engineering
 (Project Manager)



Dr. Andrew Goupee
 Donald A. Grant Associate
 Professor of Mechanical
 Engineering
 (Task 2, 5, and 6)



Dr. Richard Kimball
 Presidential Professor in
 Ocean Engineering and
 Energy
 (Task 5 and 6)



Dr. Rebecca Fisher
 Program Manager - Student
 Research Learning
 Experience
 (Task 1)



Dr. Damian Brady
 Agatha B. Darling Associate
 Professor of Oceanography
 (Task 1 and 5)



Dr. Amrit Verma
 Assistant Professor of
 Mechanical Engineering
 (Task 3, 4 and 6)



Dr. Wilhelm Friess
 Associate Professor of
 Mechanical Engineering
 (Project evaluation)

Mr. Matthew Tomasko
 Offshore Wind Business
 Manager

Ms. Taylor Ward
 Communications
 Specialist VI

■ ASCC ■ MEE ■ School of Marine Sciences



Building Science Workforce Training

Justin Lapp, Associate Professor of
Mechanical Engineering



MAINE DEPARTMENT OF
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Clean Energy Partnership – UMaine Building Science



Justin Lapp
Mechanical
Engineering
Project PI



Ling Li
Forrest
Resources
Co-PI



Will Manion
Construction
Eng. Tech.
Co-PI



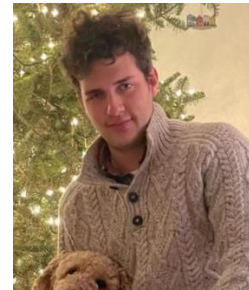
Sharon Klein
Economics
Co-PI



Alex Freiss
Mechanical
Engineering
Co-PI



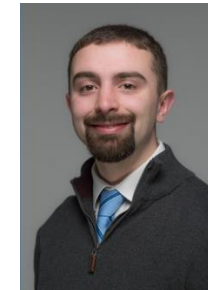
Drew Pickering
Construction
Eng. Tech.
Co-PI



Graham Freme
Construction
Eng. Tech.
Co-PI



Sheila
Edalatpour
Mechanical
Engineering
Co-PI



Kyle Rooney
Advanced
Manufacturing
Center
Co-PI



Renee Kelly
Assoc. VP
Strategic
Partnerships
Co-PI

- **New Undergraduate and Graduate Certificate Programs in Building Science**
- **New Course Development Supporting Building Science, Including Online**
- **Building Science Project and Internship Fellowships**

- **New Living Lab for Advanced Construction and Energy Efficiency**
- **Tuition Assistance and Course Programming for Working Professionals**
- **Industry Outreach and Engagement**

Success Stories So Far

Certificate Program
Currently Under
Review

Course #	Title	Req. for major	Pre-Requisites
Required Course			
CET 428	Introduction to Building Science	No	Junior
Electives (3 total required)			
Primary Electives (minimum 1 required)			
MET 391	Heating, Ventilation, and Air Conditioning	No	MET 233 or MET 433
CET 412	Sustainable Building Design and Construction	Yes	Junior
MEE 485	Innovative HVAC Systems Design	No	MEE 230 (C or better)
SFR 530	Wood Physics & Apps in Building Systems	No	Permission
MEE 486	Building Energy Modeling	No	MEE 230 (C) or MET 236 (C)
Supporting Electives			
CIE 438/538	Life Cycle Assessment	No	Senior
SFR 456/556	Physical and Mechanical Properties of Sustainable Materials	No	PHY 107
MEE 433	Solar Thermal Engineering	No	MEE 230 (C or better)
ECE 427	Electric Power Systems	No	ECE 210 (C- or better)
EET 460/560	Renewable Electricity and Energy Production	Yes	PHY 112, MAT 126
ECO 405/505	Sustainable Energy Economics and Policy	No	ECO 220 (C-) or ECO 180 (B-)
ECO 381	Sustainability Science, Policy, and Action	No	Sophomore
ECO 404/504	Behavioral Economics	No	ECO 220 (C- or better)

Expanded Course Offerings

Course Number	Fall 2025 Course Descriptions	Current Enrollment
MEE 498	Innovative HVAC Systems Designs	11
SFR 456	Physical and Mechanical Properties of Sustainable Materials	4
CET 412	Sustainable Building Design and Construction	30
CET 498	Building Science	10
ECE 427	Electric Power Systems	42

Course Number	Spring 2026 Courses Descriptions
MEE 433	Solar Thermal Engineering
CET 412 (online)	Sustainable Building Design and Construction
CIE 498	Life Cycle Assessment
EET 460 (online)	Renewable Electricity and Energy Production

Student Fellowships

Type	Dates	Student	Funding	Description
Internship	Summer 2025	Karun Varghese	\$1,100	Internship with UMaine Advanced Structures and Composites Center helping to scale 3D printed housing.
Internship	Summer 2025	Jacob Dube	\$2,500	Internship with Trane technologies technical sales of building equipment, controls, and automation hardware.
Project	Summer 2025	Zechariah Hoeft	\$4,945	Development of Sustainable House Wrapping
Project	Fall+Spring 2025	Neil Underwood	\$5,000	Evaluation of Post-Construction Forest Products As Feedstock for Wood Fiber Insulation
Project	Fall+Spring 2025	Juhayer Islam	\$5,000	Autonomous Indoor 3D Reconstruction with UAVs
Project	Fall+Spring 2025	Aidan Shields	\$3,435	Temperature Dependency Measurements of R-Values
Project	Fall+Spring 2025		\$3,000	A multi-use, community-centered ecological laboratory at Braeside

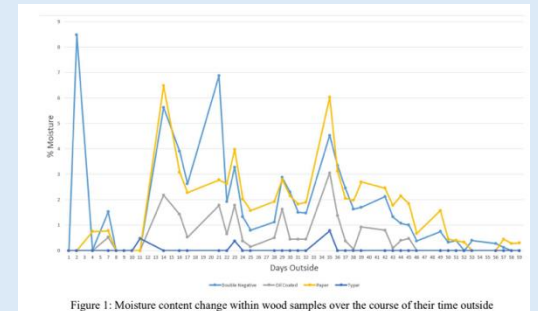
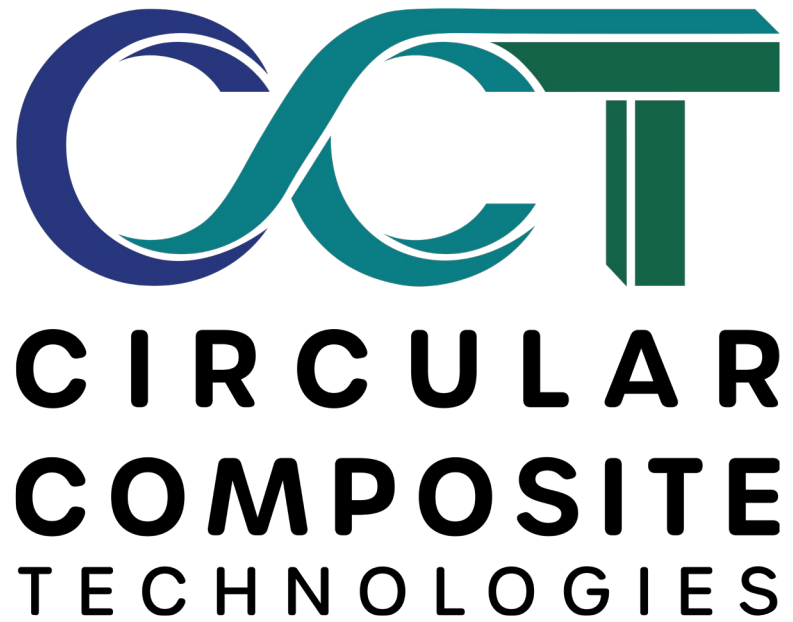


Figure 1: Moisture content change within wood samples over the course of their time outside

University of Maine – Research & Innovation



MAINE DEPARTMENT OF
Energy Resources



circularcomposite.tech

**Novel fiber-reinforced thermoplastic feedstocks
from recycled and bio-based materials**

Reed Miller
CFO



Andy Gifford
CTO



Roberto Lopez-Anido
CEO





By American-Made Program

372 ☆

Wind Turbine Materials Recycling Prize

Developing a cost-effective and sustainable recycling industry for fiber-reinforced composites and rare earth elements in wind turbines.

American Made Wind Prize Winner

Enabling the launch of CCT's Wind Turbine Blade Composite Innovation

Sustainable recycling product from retired wind turbine blades.

- Phase 1: UMaine research as WIND REWIND
- Phase 2: Formed CCT startup to commercialize



HABIB DAGHER
EXECUTIVE DIRECTOR
ASCC



LINDA SILKA
SENIOR FELLOW
MITCHELL CENTER



AMRIT VERMA
ASSISTANT PROFESSOR
MECHANICAL ENGINEERING



JOHN ARIMOND
BUSINESS DEVELOPMENT
MANAGER
MECHANICAL ENGINEERING



ROBERTO LOPEZ-ANIDO
PROFESSOR
STRUCTURAL ENGINEERING



ED PILPEL
POLYSTRAND PRESIDENT
MECHANICAL ENGINEERING



REED MILLER
ASSISTANT PROFESSOR
ENVIRONMENTAL ENGINEERING



ANDREW GIFFORD
LEAD, PROCESS DEVELOPMENT
& SENSORS
ASCC



AMANDA COLLAMORE
EDUCATION &
OUTREACH MANAGER
TIDC

Circular solutions for challenging problems

Upstream:

- Wind energy at end-of-life
- Plastic marine debris (planned)



Downstream:

- Transportation infrastructure
- Construction, housing, furniture...



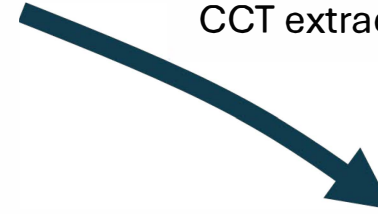


EoL wind turbines are decommissioned



Blades are cut, transported, shredded

CCT extracts fibers



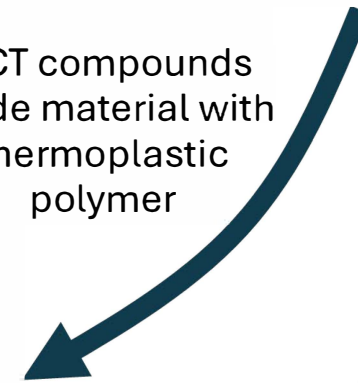
Print large objects with large-format additive manufacturing



CCT recycles EoL objects



CCT compounds blade material with thermoplastic polymer



Significant Progress Made, More to Come!

- Partnerships
- Technology license
- Startup programs
- Prototypes & contracts



Questions?!

roberto@circularcomposite.tech
andrew@circularcomposite.tech
reed@circularcomposite.tech

**Novel fiber-reinforced thermoplastic feedstocks
from recycled and bio-based materials**



NuTerra

Making new ground



Aaron Gallant, PhD, PE
Civil and Environmental Engineering
Primary Investigator / Team Lead



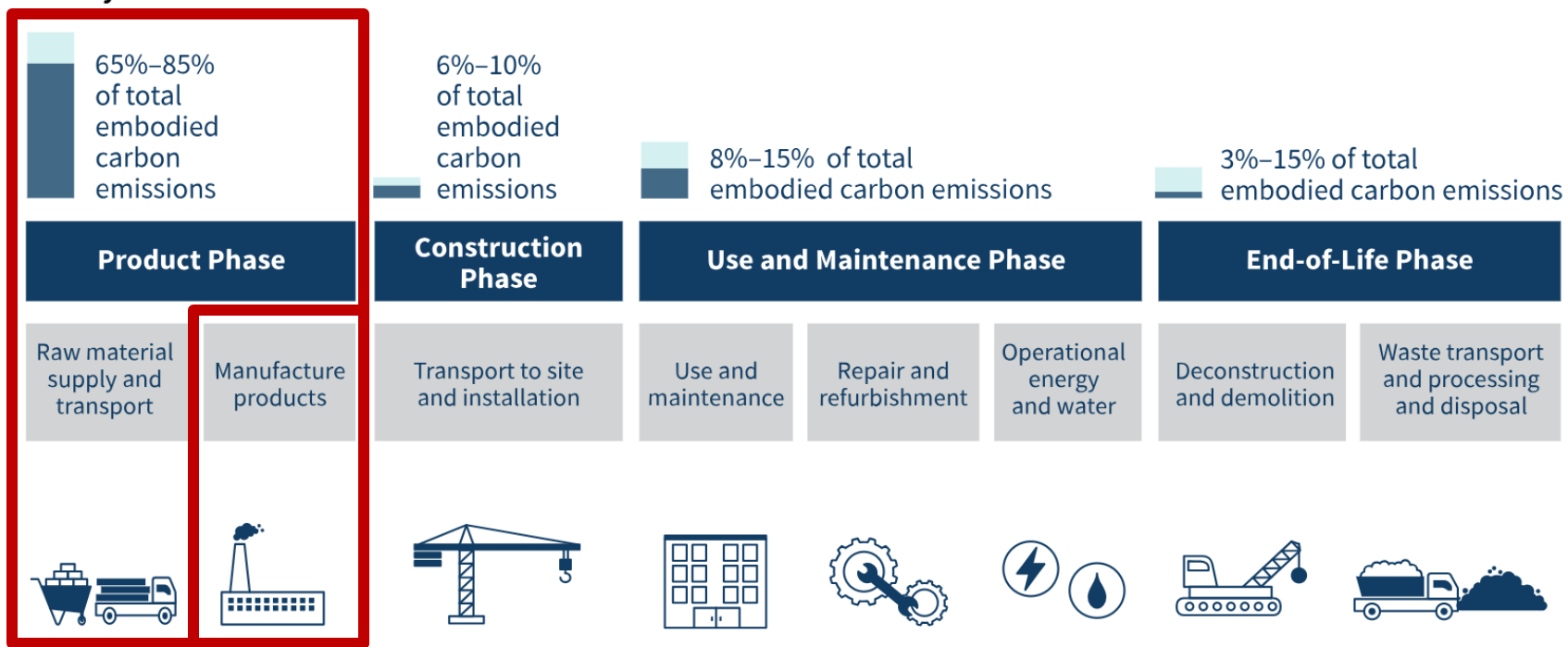


Production of cementitious materials
accounts for 8% of global GHG emissions
(~ emissions from 380,000,000 cars)



Embodied carbon is the CO₂ generated from **materials** we use in construction and “locked in” throughout a facility’s life

Life-Cycle Assessment Phases



Source: RMI

GHG Emissions ↑

Materials

Additional

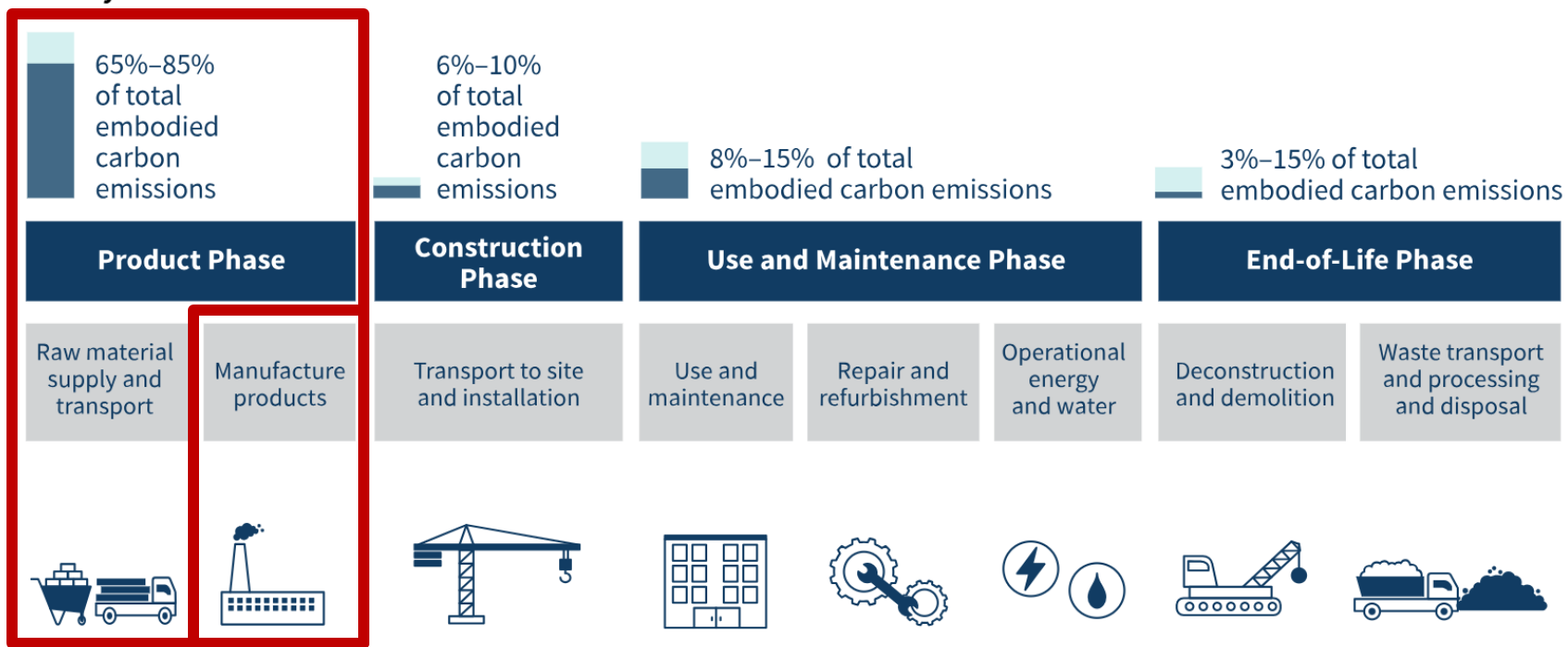
Materials

New Directives and Laws in U.S. and Europe:

- Mandate public GHG reporting
- Transparency to investors, who can
- Evaluate risks due to stricter climate regulations
- **Require tracking across the value chain**

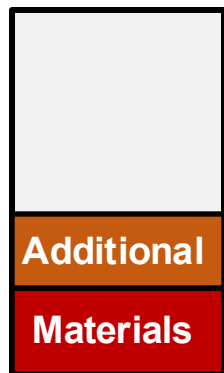
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Life-Cycle Assessment Phases



Source: RMI

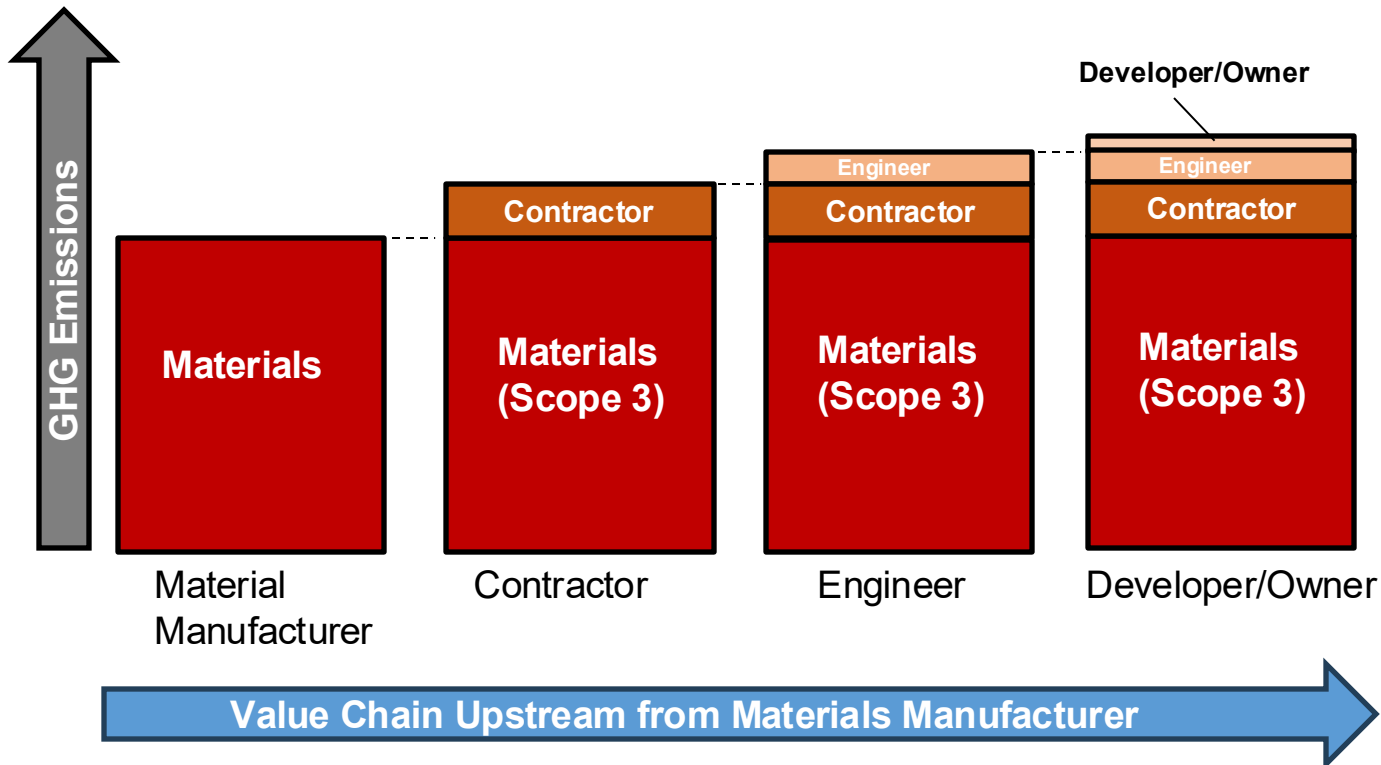
GHG Emissions ↑



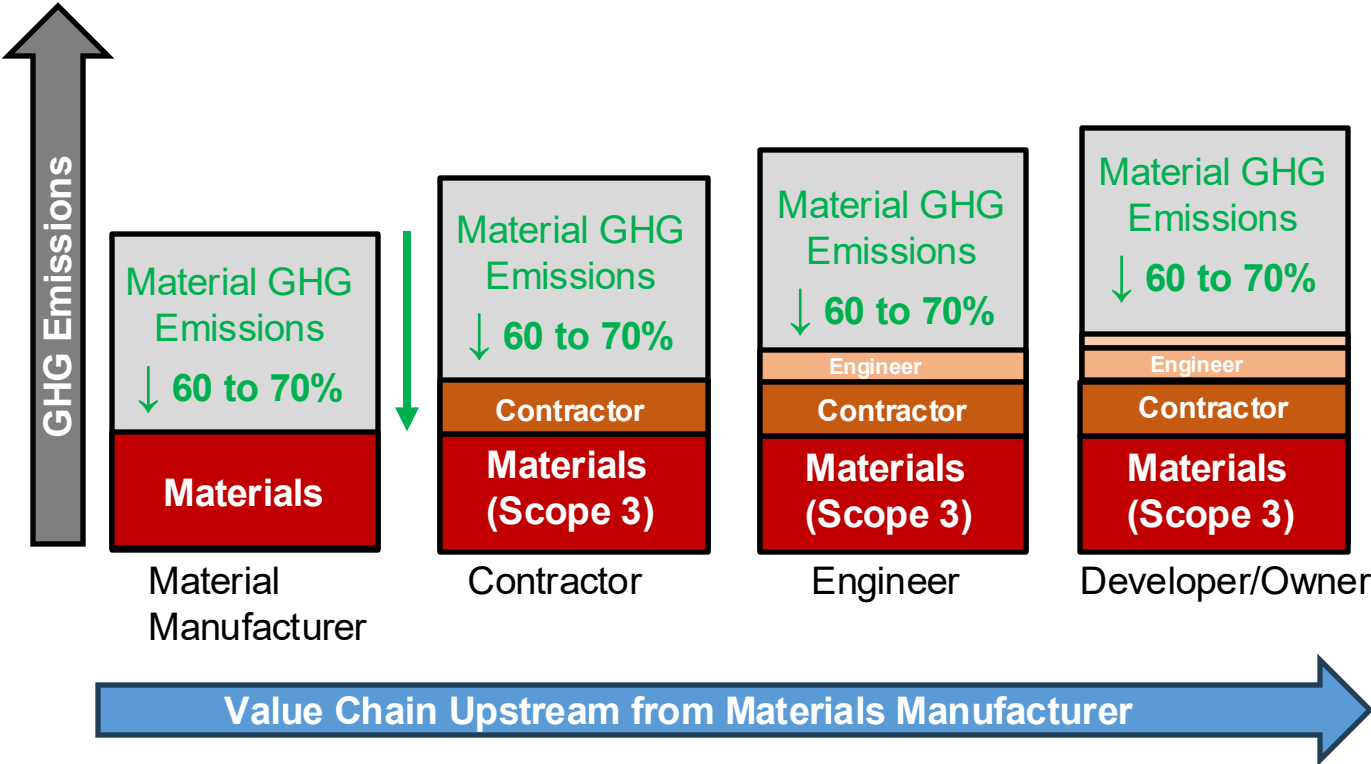
New Directives and Laws in U.S. and Europe:

- Mandate public GHG reporting
- Transparency to investors, who can
- Evaluate risks due to stricter climate regulations
- **Require tracking across the value chain**

Greenhouse Gas (GHG) Reporting Across Value Chains and Transparency Requirements are Expanding Globally



Carbonation has the potential to substantially reduce the embodied carbon associated with materials

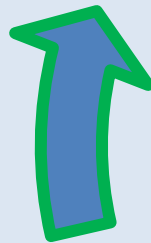


Stabilize weak soils **and** put carbon back in the ground—**where it belongs**.



Cement Soil &
Sequester Carbon
(CaCO₃)

Quarry
Limestone
(CaCO₃)



Mix & Add
CO₂
(to the ground)

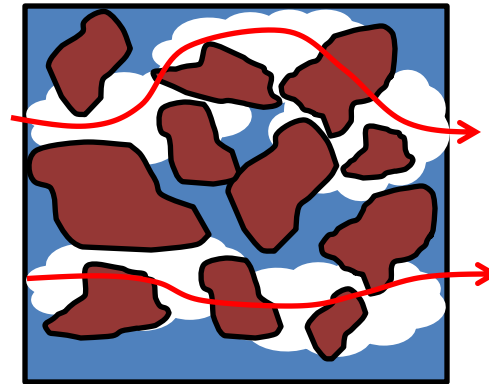
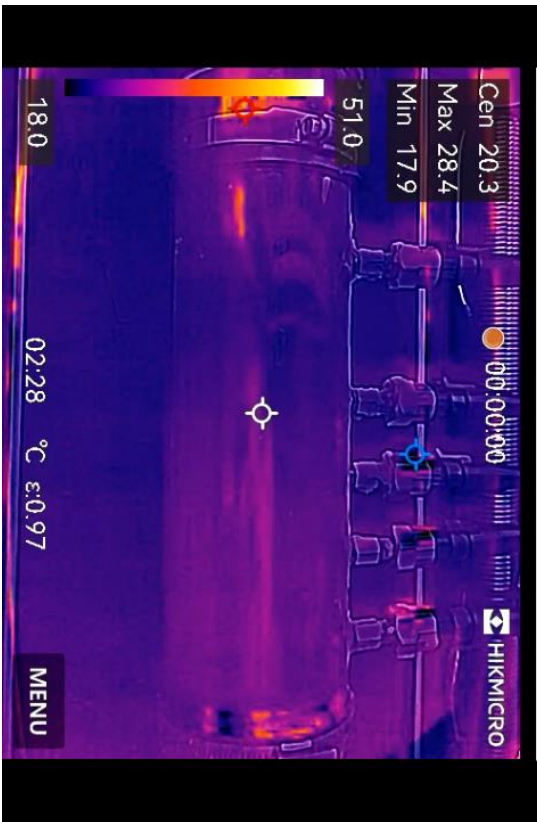
Lime/Cement
Production
(CaO & CO₂)

~8 % CO₂ emissions

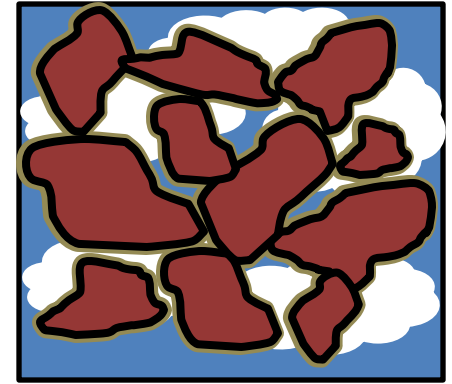


“Mineralization of CO₂ is a key approach to carbon management, both to geologically store carbon and to produce inorganic carbonate solids which can be used in various ways, including to support the defossilization of the built environment.”

We understand the parameters of functionality to harness accelerated carbonation for soil stabilization



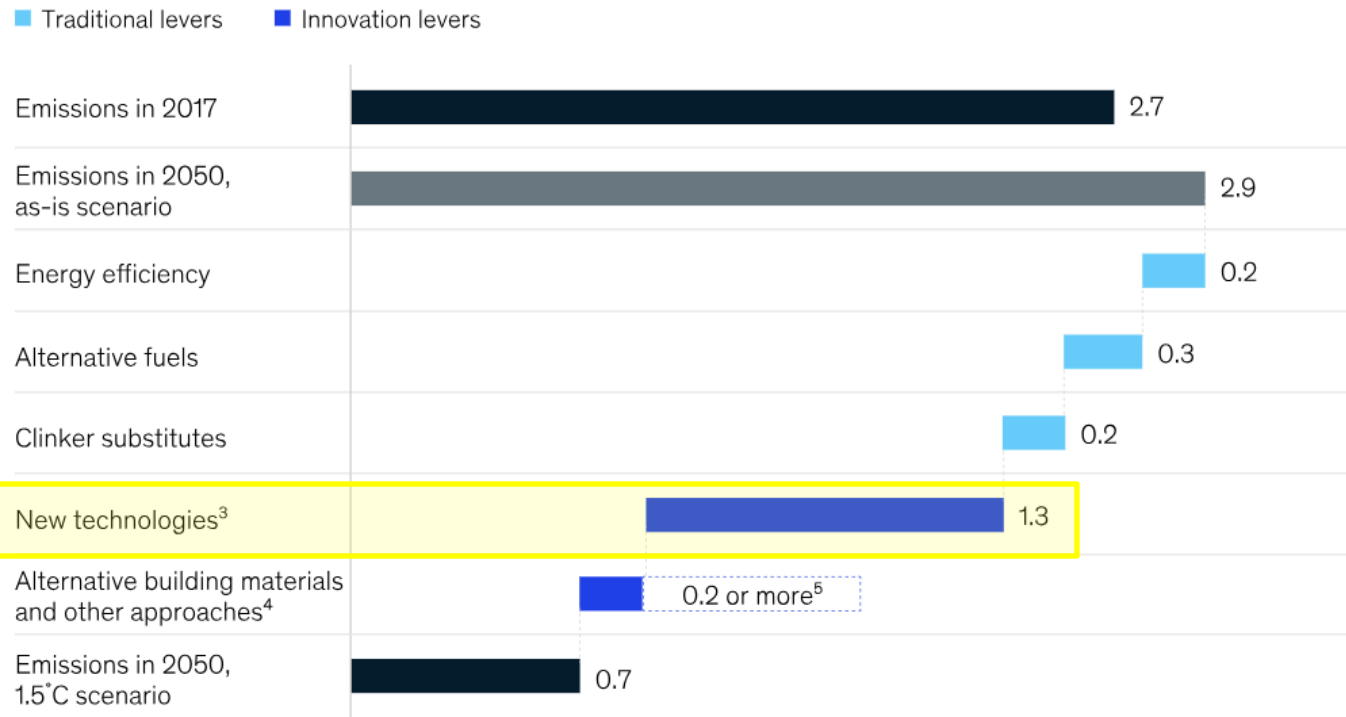
*CO*₂ gas flow through soil



*CaCO*₃ precipitates and forms a binder

The cement industry could cut three-quarters of its CO₂ emissions by 2050.¹

Potential CO₂ emissions and reductions,² GtCO₂ annually



¹ Figures are global estimates for emissions potential, taking all potential levers into consideration.

² Effect might be smaller or larger depending on speed of shift.

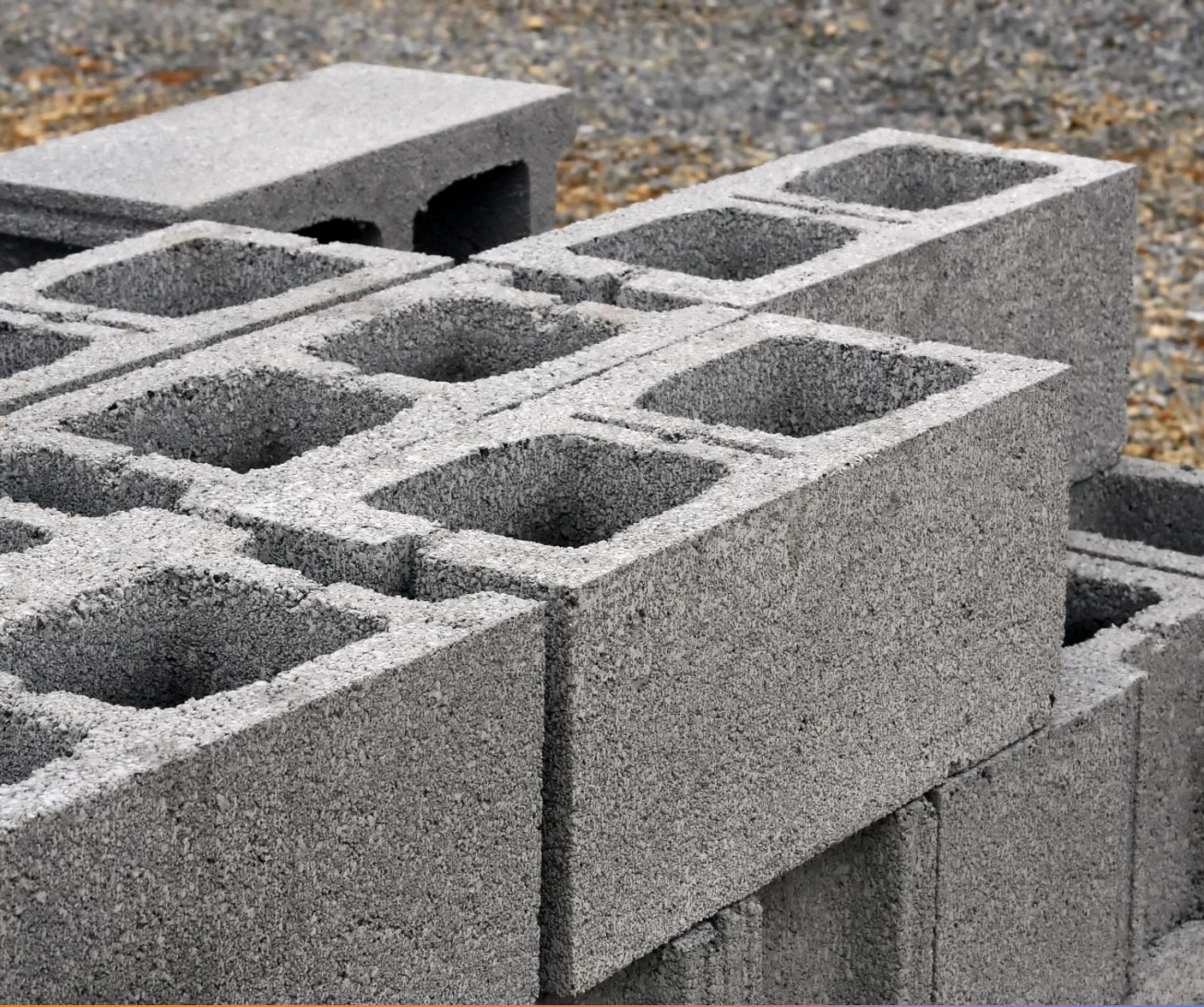
² Effect might be smaller or larger depending on speed of shift.

³ For example, carbon capture, use, and storage; carbon-cured concrete; 3-D printing.

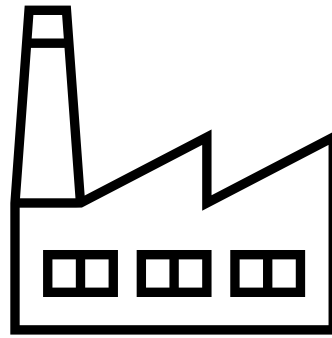
⁴ For example, cross-laminated timber, lean design, prefabricated/modular construction, building information modeling.

⁵ May 2019, freemovegroup.com, The Global Cement Report, 10th edition, Cemnet, cemnet.com, Umweltbundesamt (German Environment Agency), McKinsey 1.5-degree-pathway model; McKinsey Cement Demand Forecast Model

From: <https://www.mckinsey.com/industries/chemicals/our-insights/laying-the-foundation-for-zero-carbon-cement/>



Concrete Blocks



Carbon curing process integration

Batch & Mix → Mold and Stack



Cure

Raw Materials



Cement or Lime

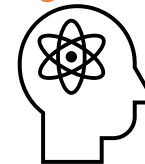


Aggregate



CO₂

CO₂ Mineralized in Building Materials

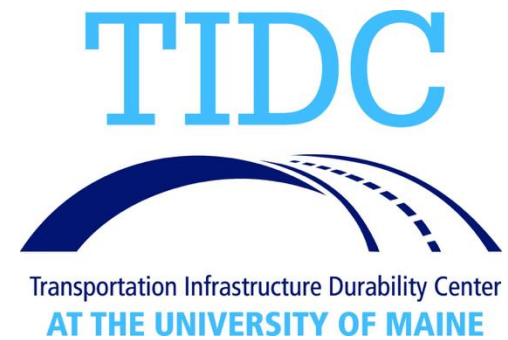




We see accelerated carbonation applied in other settings also



Thank You



The funding provided for this research by the **Transportation Infrastructure Durability Center** at University of Maine under grant 69A3551847101 from the **U.S. Department of Transportation's University Transportation Center Program** is greatly appreciated.



Clean Fuels R&D at UMaine

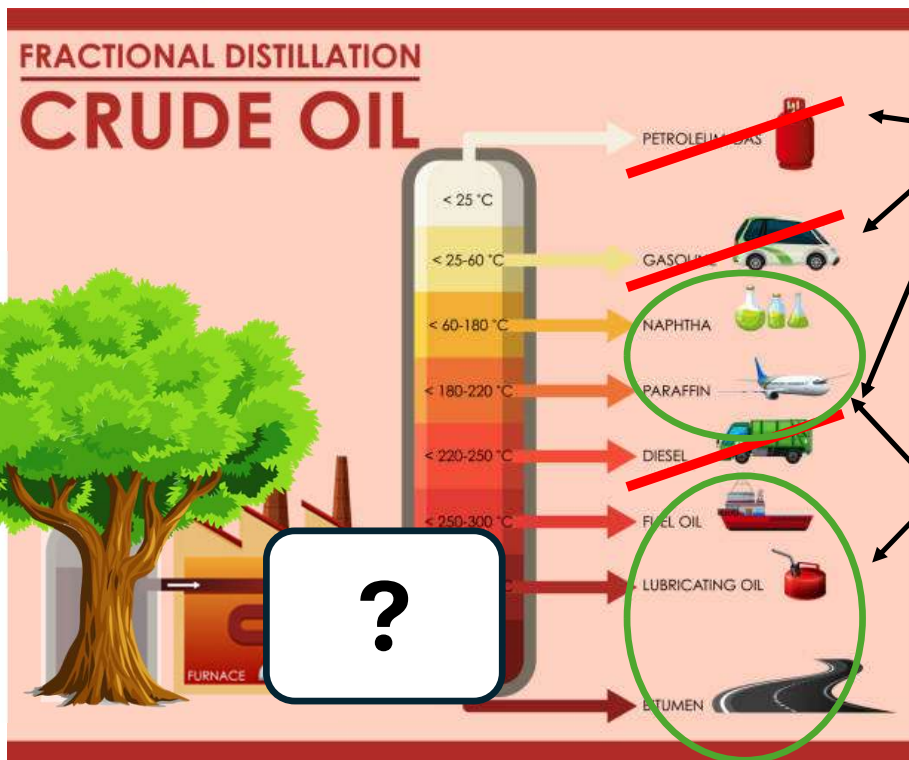
M. Clayton Wheeler, Ph.D., P.E.
*Director, Forest Bioproducts
Research Institute*

Thomas J. Schwartz, Ph.D., P.E.
*Assoc. Director, Forest Bioproducts
Research Institute*

Clean Energy Partners Advisory Group

November 12, 2025

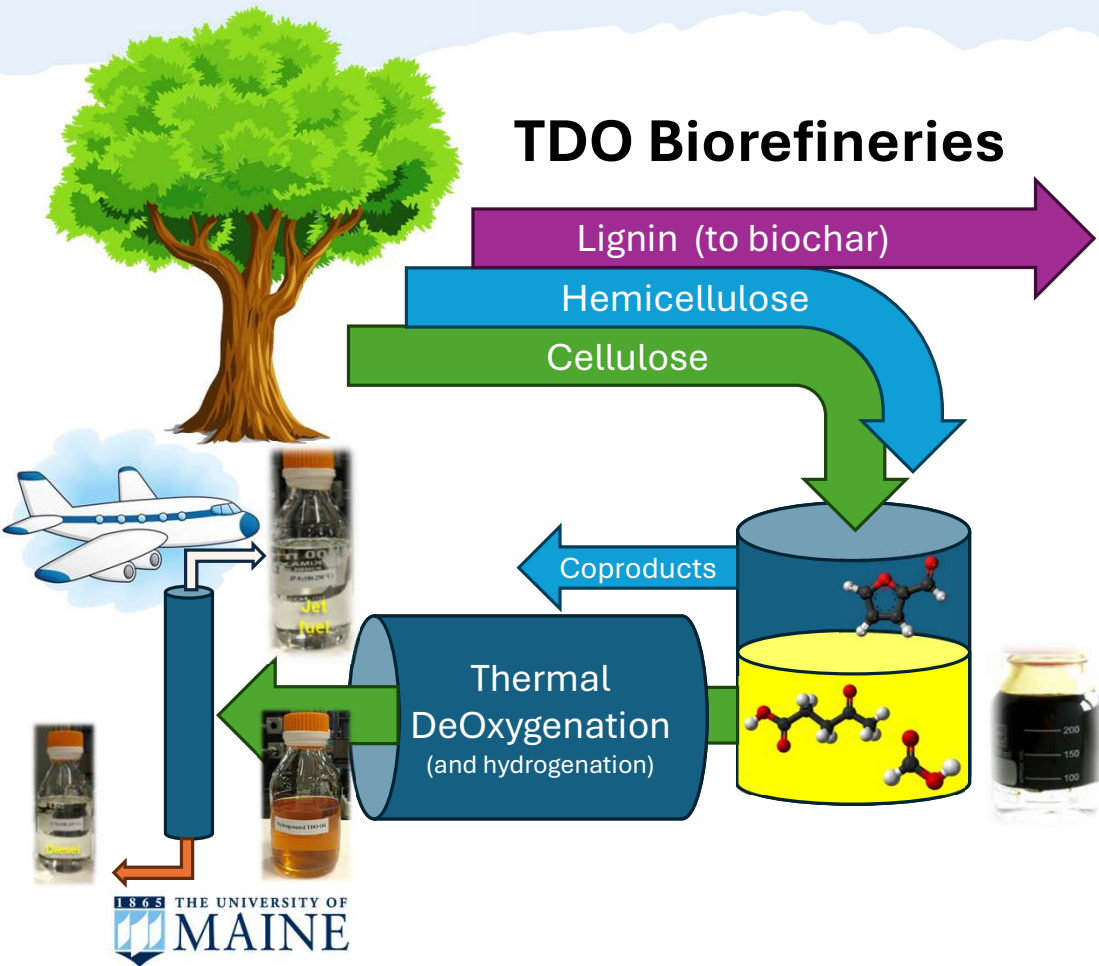
Producing clean fuels and chemicals



(Relatively) easily electrified!

Hard to “decarbonize” ... need that carbon!

SAF R&D at UMaine

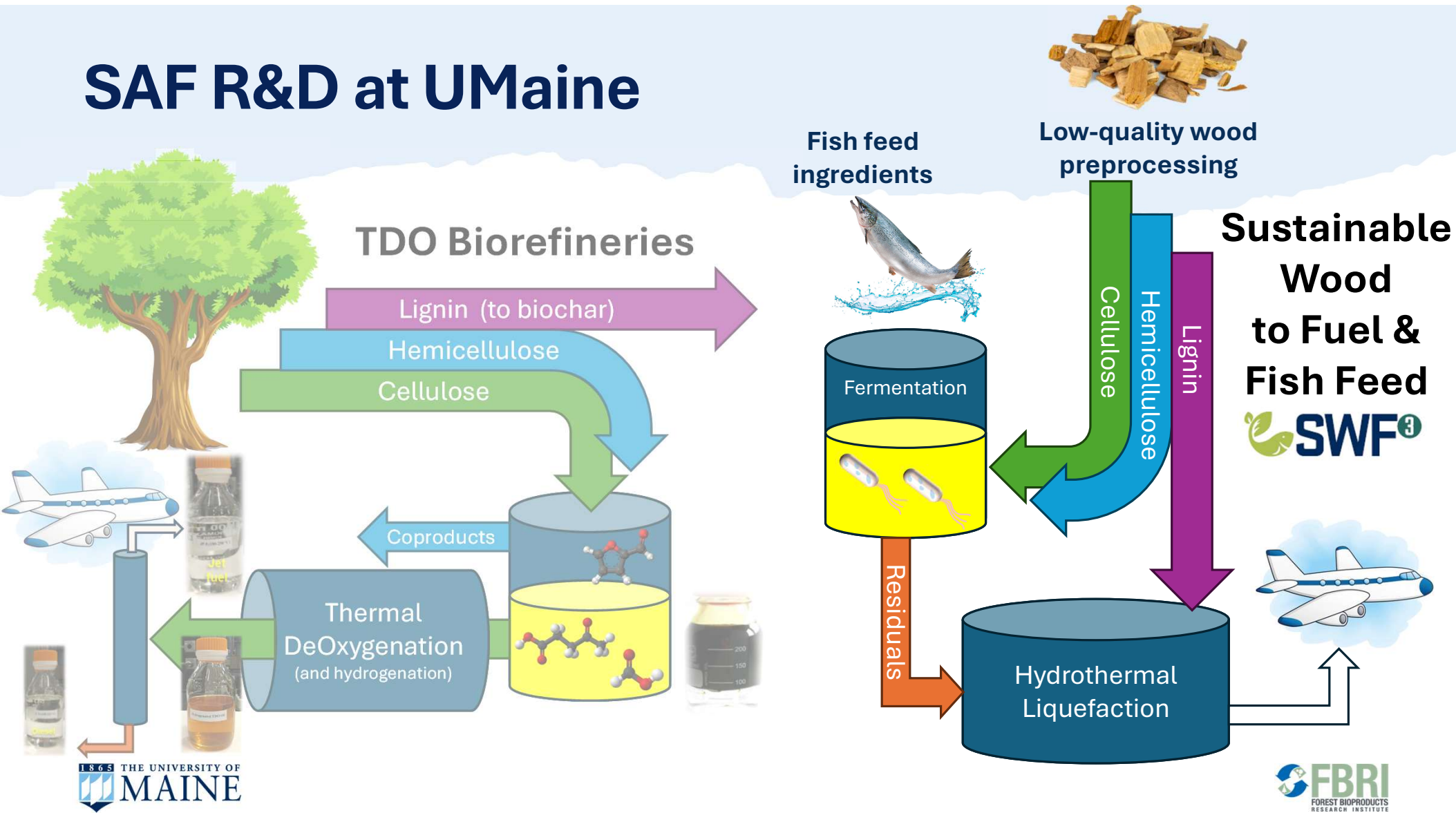


1 tpd Biomass to Bioproducts Pilot Plant (B²P²)



0.1 tpd Synthetic Crude Oil Pilot Plant (SynCOPP)

SAF R&D at UMaine



About UMaine's FBRI & TRC



UMaine's Forest Bioproducts
Research Institute – Est. in 2009 via
NSF & DOE funding

About UMaine's FBRI & TRC

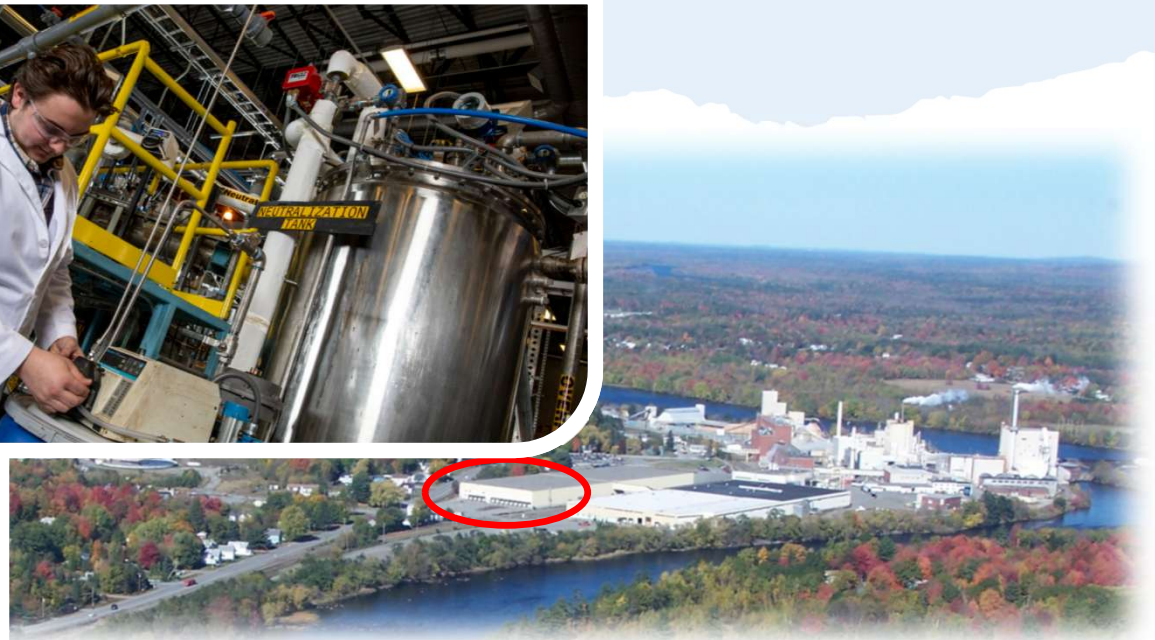


UMaine's Forest Bioproducts
Research Institute – Est. in 2009 *via*
NSF & DOE funding



FBRI Technology Research Center –
Est. in 2013 *via* State of Maine
funding

About UMaine's FBRI & TRC



FBRI Technology Research Center –
Est. in 2013 via State of Maine
funding



Clean Energy Partnership – Technical and Commercial
Development



November 2025

INTRODUCTION



Biofine Developments Northeast – Founded 2019

- Continuous Conversion Process of Lignocellulose into High Value Bioproducts
- Demonstrated at UMaine – FBRI B2P2 Pilot Plant
- 25+ US and International Patents

Transformational Energy & Carbon Market Opportunities

- >\$30B Beachhead TAM for Primary Product – EL100 (heating fuel)
 - Price Competitive with Fossil Fuels
- Puro.Earth qualified biochar carbon removals
- CO₂ Savings = 40k – 400k mt per year @ industrial scale

Massive Feedstock Supply Available

- Forestry, Post Consumer Paper (MSW) - D7 RIN Eligible
 - Estimated 17 million mt/year in Maine alone
 - No Current Market for Residuals – Critical for ME Forest Health

Offtake Partnerships for Rapid Market Adoption

- Sprague - Largest Heating Oil Wholesaler in Northeast USA
- Puro.Earth Carbon Exchange (NASDAQ)
- Harcros Chemical – Global Chemical Distributor for other co-products



“Biofine is the most significant development for our industry that has occurred, in my opinion.”

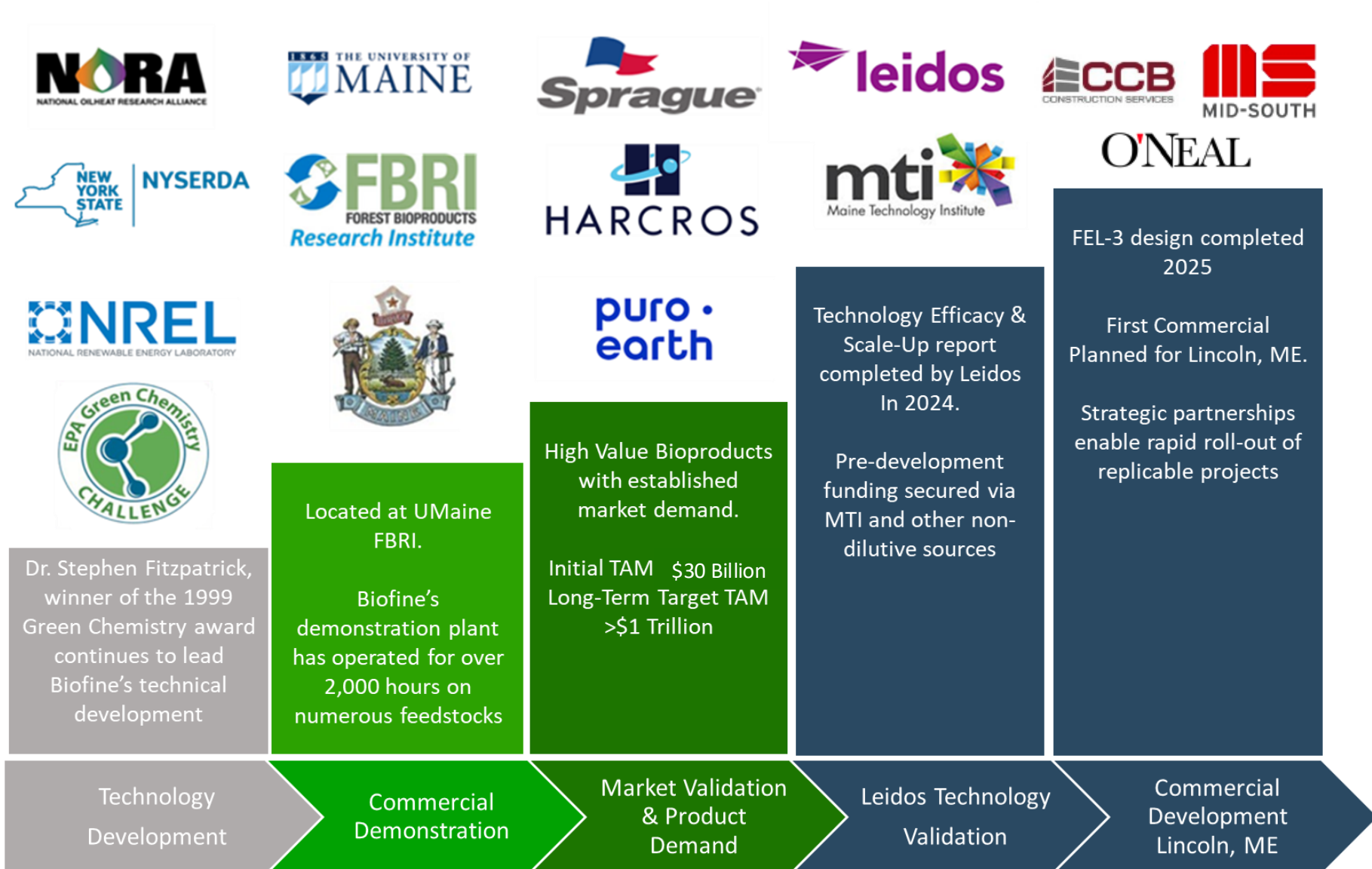
Sean Cota, President, National Energy & Fuels Institute

TECHNICAL / COMMERCIAL VALIDATION



Over 25 years, Biofine has developed the technology, products, and markets to enable deployment of industrial scale biorefineries. FOAK currently in development at Lincoln, Maine.

UMaine continues to play a vital role in development efforts via B2P2 plant operations, laboratory services and testing for new product development, and also a field study at UMaine Presque Isle that is the subject of a published paper on EL as a heating fuel.





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Discussion & Input from the Public



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Thank You and Next Steps

- Share feedback on initiatives and next meeting
- Post your open positions on the Maine Clean Energy Jobs Network: mainecleanenergyjobs.com/
- Sign up to host clean energy interns through the ReMaine Program: careerequity.com/remaine/
- Subscribe to news and updates from the Clean Energy Partnership: maine.gov/energy





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Thank You

tagwongo.obomsawin@maine.gov
maine.gov/energy

Visit our new job board:
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