What is a tree?

NER.COFE 2017

PROPERTIES OF WOOD-BASED COMPOSITES

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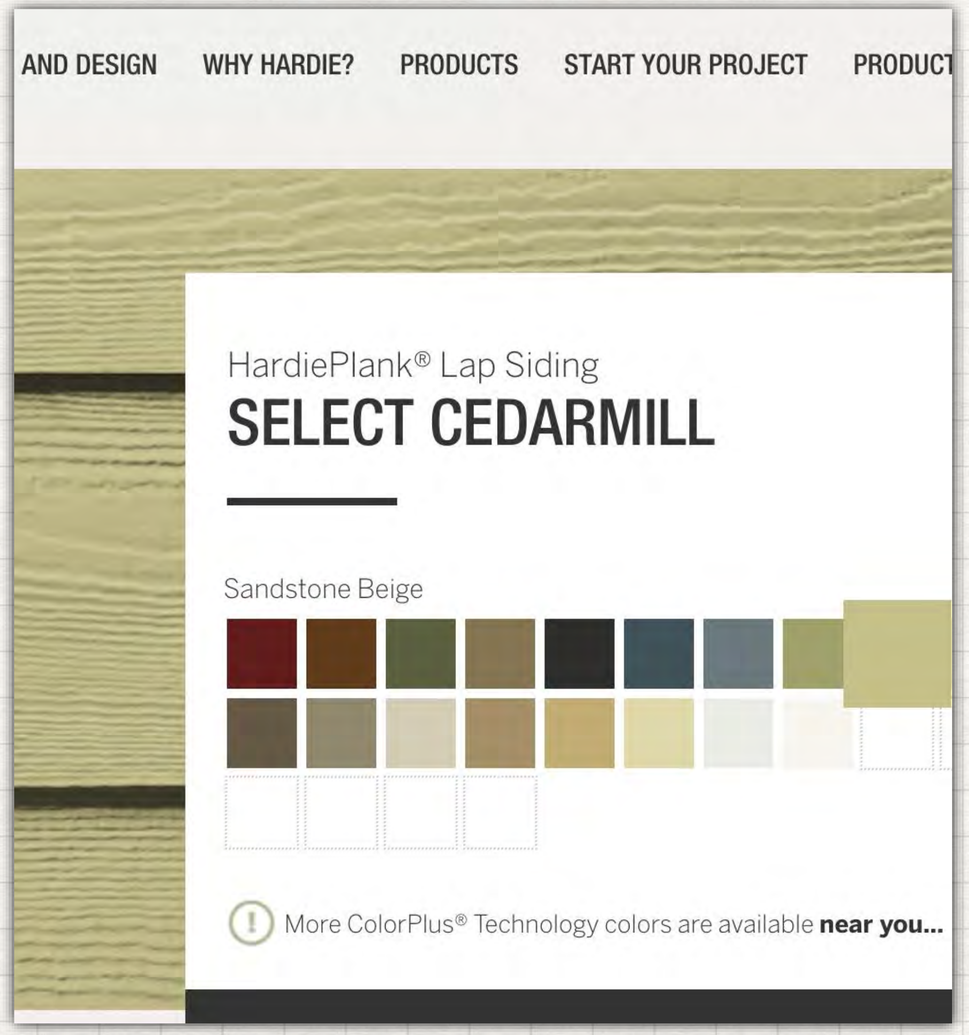
OBJECTIVES

- Overview of wood-based composites produced - with focus on facilities in Maine and the region
- Develop understanding of resources needs for different wood-based composites
- A look ahead at new wood-based composites

WHAT IS A COMPOSITE?

- A composite material is comprised of two or more distinct materials joined together which exhibit properties superior to either of the materials used alone.
- Increased range of sizes and forms relative to base materials.



CLASSIFICATION OF COMPOSITE MATERIALS

COMPOSITE MATERIALS

FIBER-REINFORCED

PARTICULATE COMPOSITES

Fibers are completely encased by a “mat of plastic, cement, metal, or ceramic

SINGLE-LAYER

MULTIPLE LAYERS

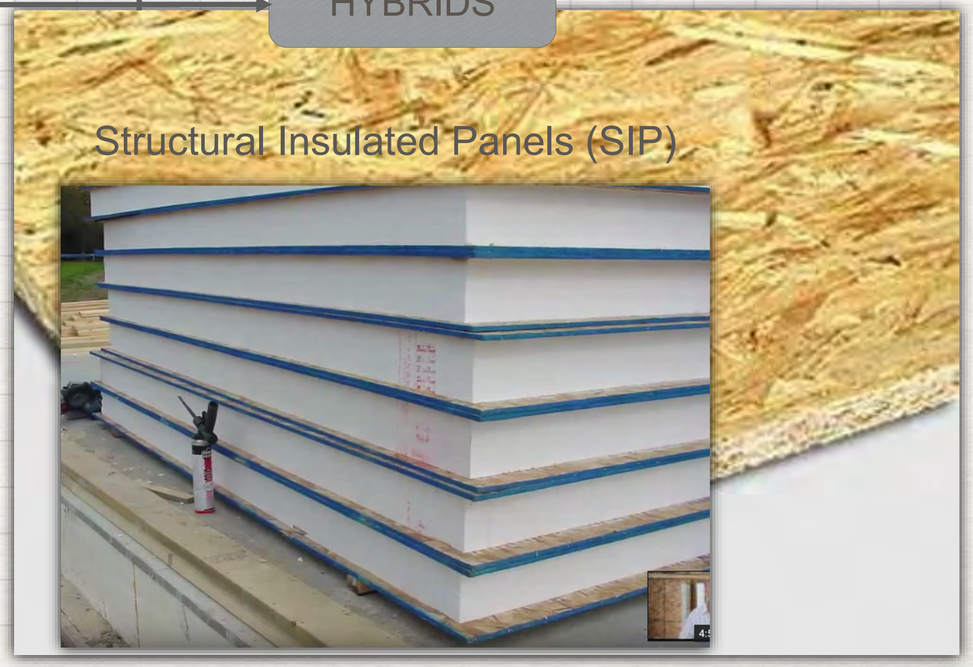
Fibers or particles -welded” by an adhesive

LAMINATES

HYBRIDS

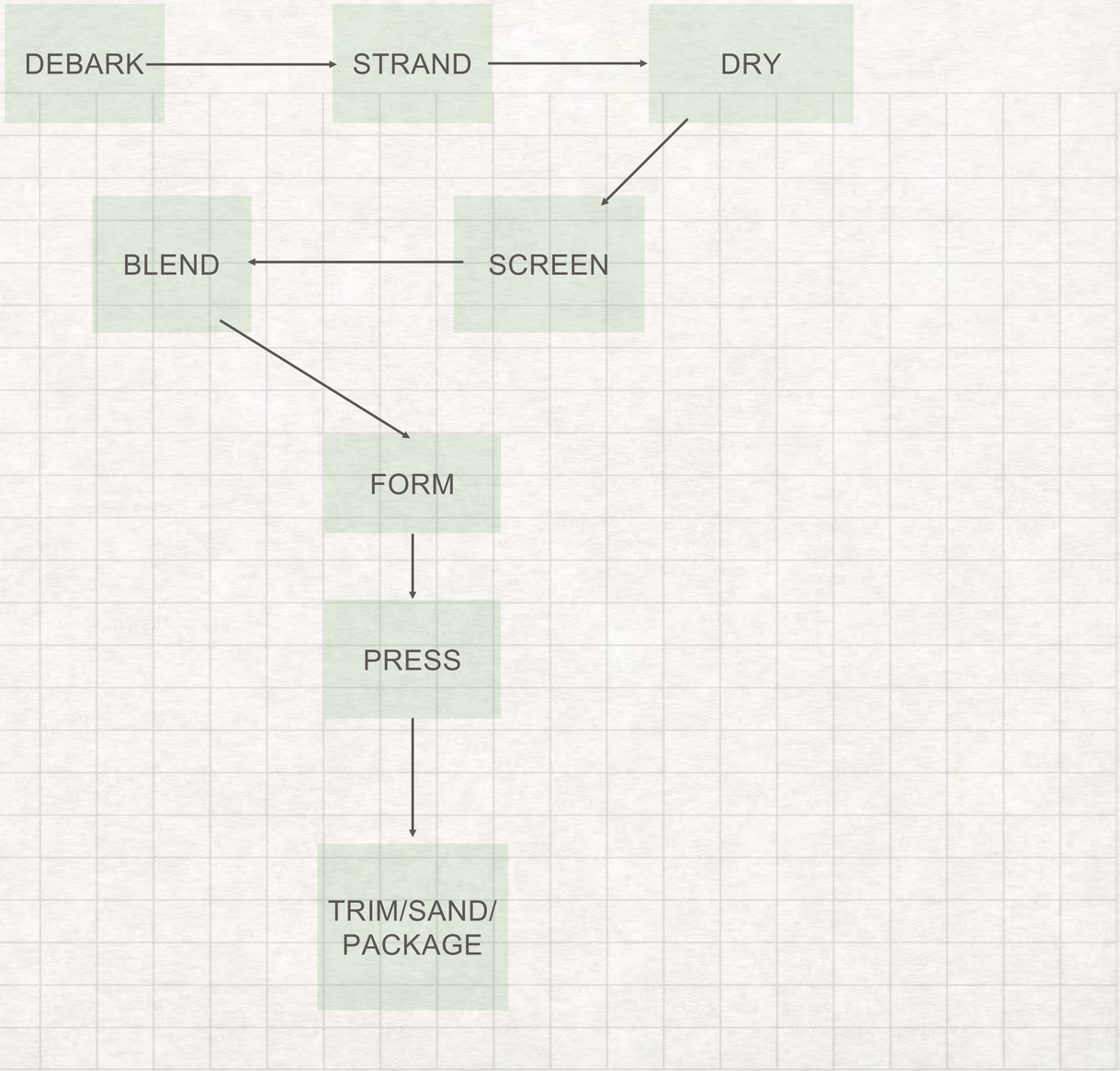
Glu-laminated Beams

Structural Insulated Panels (SIP)



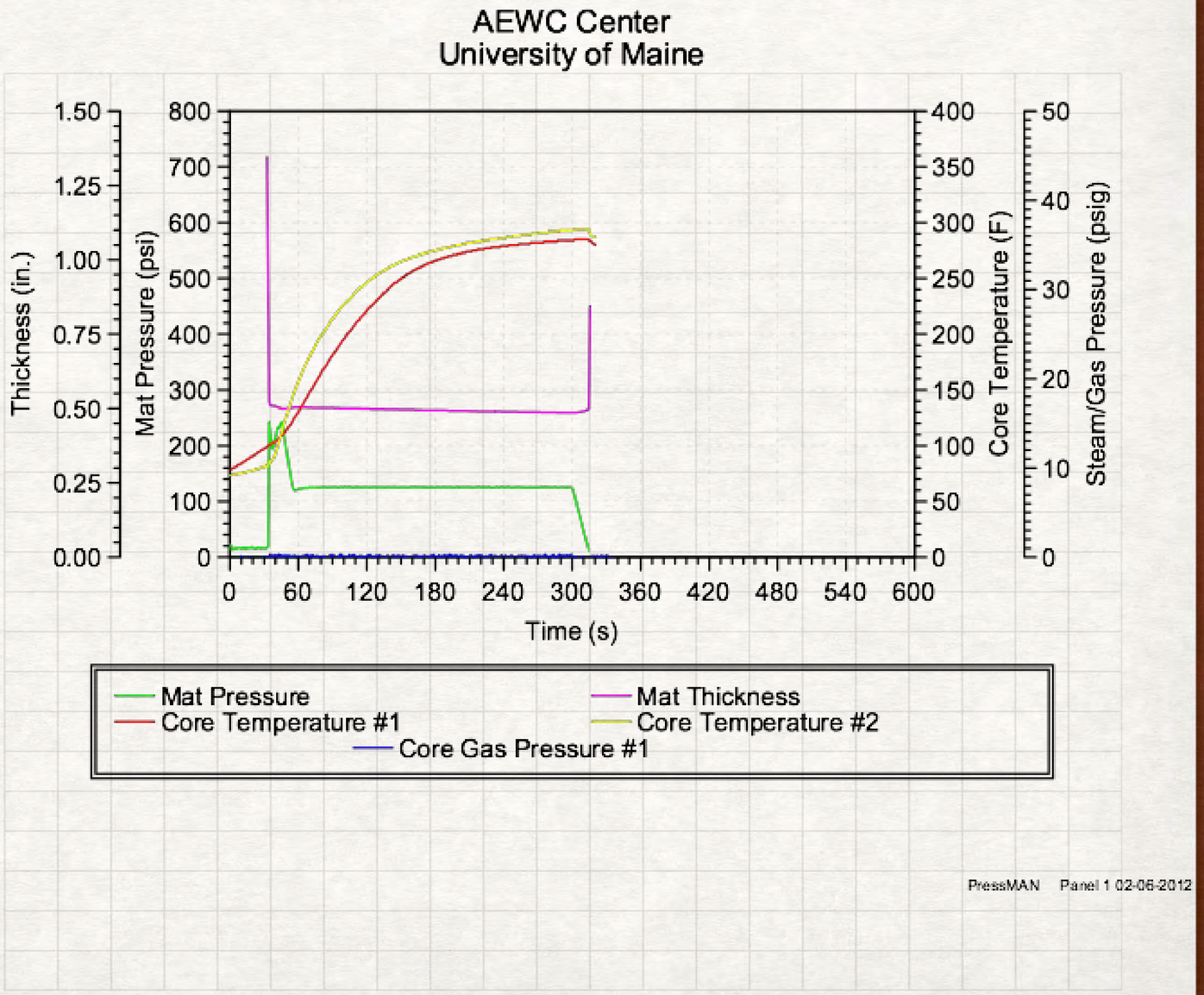
HOW ARE COMPOSITES MADE?

- No bark is good bark
- Make smaller sized “particles” from a tree (veneer, particles, lumber, fibers, …)
- Remove moisture
- Add adhesive, other chemicals
- Press composite (typically) with heat and pressure to densify final product



HOW ARE COMPOSITES MADE?

- Adhesives are typically thermoset.
- Polymers in WPC are typically thermoplastic.



COMPOSITES CAN USE

- High quality logs
- Low quality logs
- Pulpwood
- Softwoods
- Hardwoods
- Mill residue

- No bark is good bark

Veneer	Lumber
1/8”, 3/16”, 1/4”	2” x

Particle	Length	Slenderness Ratio
Wood Fiber	1-3 mm	~ 100
Wood Flour	-40/+60	4-6
Strands	4 - 13 inch	50 -> 300

STRUCTURAL WOOD-BASED COMPOSITES

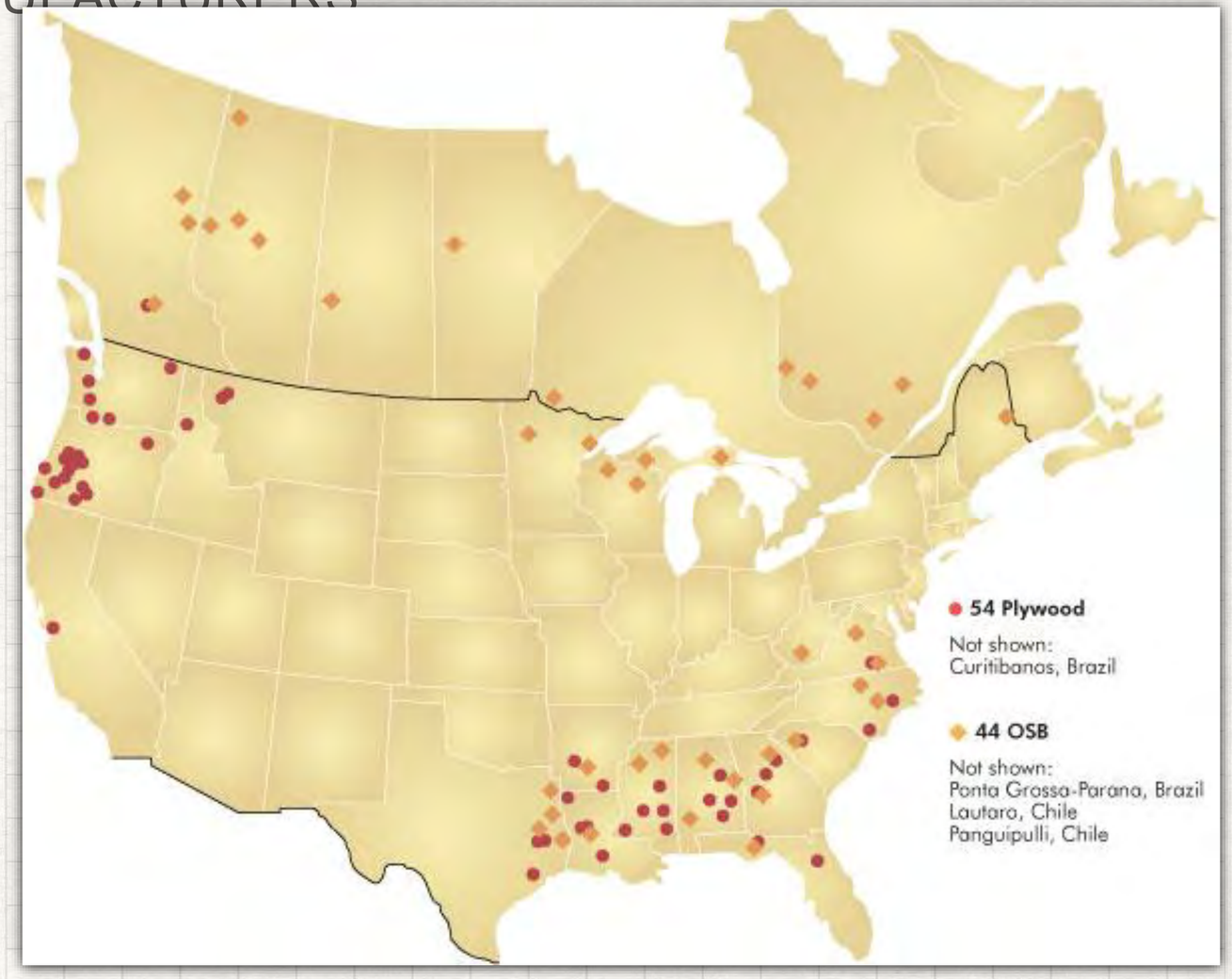
- Glulam
- I-Joist
- OSB
- Plywood
- Rimboard
- Structural Composite Lumber (SCL)
- Cross-Laminated Timber (CLT)

INTERIOR WOOD-BASED COMPOSITES

- Particleboard
- Medium Density Fiberboard (MDF)
- Hardboard
- Engineered Wood Siding and Trim
- Decorative Surfaces

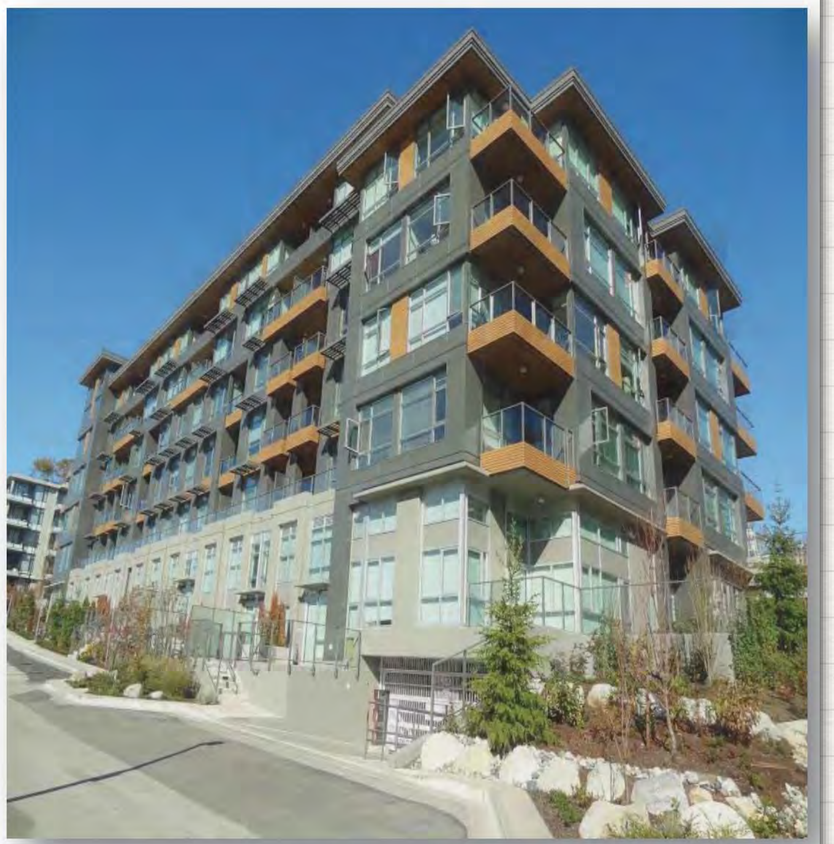
WOOD BASED COMPOSITES MANUFACTURERS

- JM Huber - OSB @ Easton, ME
- LP Building Products - OSB & LSL @ Limerick, ME
- DuraLife - WPC @ Biddeford, ME
- Columbia Forest Products - Veneer @ Presque Isle, ME
- Moosewood Millworks - Laminated Flooring @ Ashland, ME
- Arauco - Particleboard @ St. Stephen, NB
- Foard Panels - SIP - West Chesterfield, NH



Midrise Wood Frame Construction in Canada: the Journey…

- 2009: BC Building Code
  revised to increase height limit for wood-frame construction from 4 to 6 storeys
- 2013: Régie du Bâtiment du Québec (RBQ)
- 2015: Ontario Building Code
- 2015: Alberta Building Code
- 2015 National Building Code of Canada

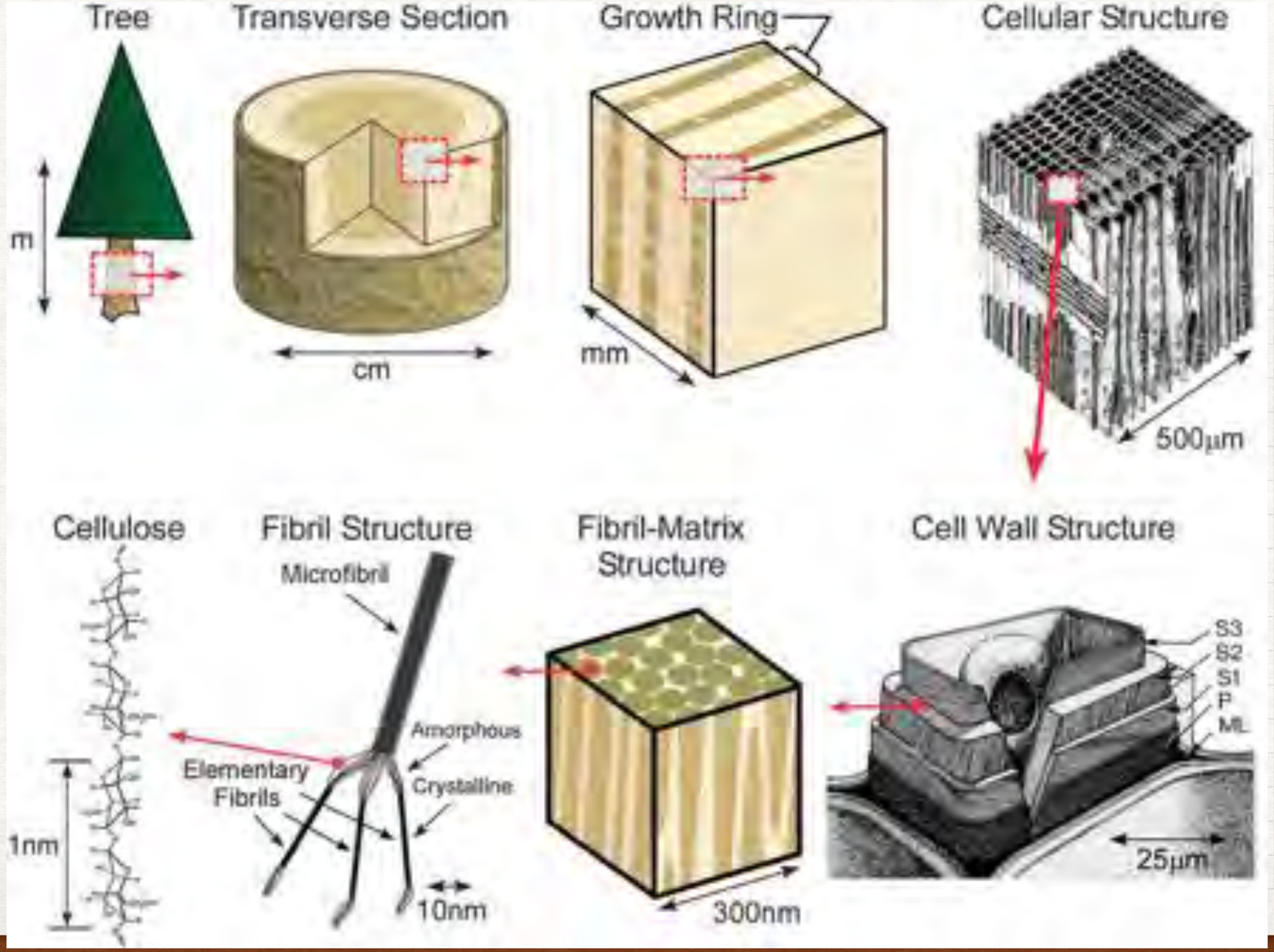


Expecting 1000's of midrise buildings in Canada next few years!!

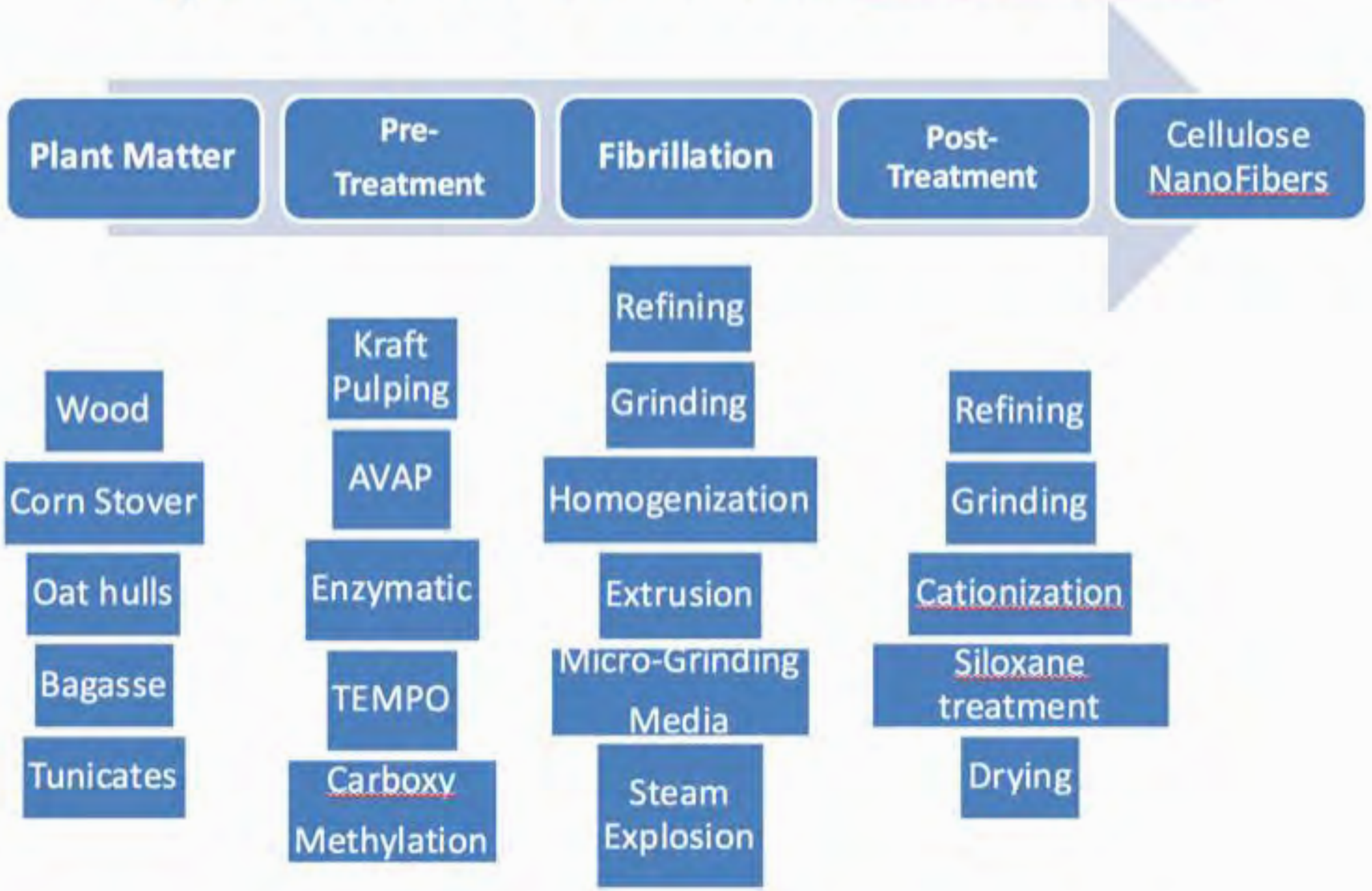
FPInnovations

EMERGING COMPOSITES

NANOCELLULOSE AS THE PARTICLE



Preparation of Cellulose NanoFibrils



Cellulose Nanofibrils (CNF) Capacity 2015

(kg/day)

Paperlogic, USA	2,000
University of Maine, USA	1,000
Borregaard, Norway	1,000
American Process	500
Nippon Paper, Japan	150
Innventia, Sweden	100
NamiCell, France	100
Oji Paper, Japan	100
Stora Enso, Finland	Pre-commercial
UPM, Finland	Pre-commercial
FPInnovations, Canada	Pilot
Norske Skog	Pilot
Daicel, Japan	Lab
Luleå University of Technology, Sweden	Lab
US Forest Products Laboratory, USA	Lab

Additive Manufacturing

- Filaments
- Composites
- Powders
- …

Foams

- Acoustic
- Structural
- Thermal
- …

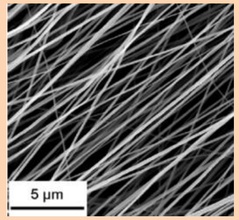
melodea

Paakko et al., Soft Matter, 2008

Continuous Fibers

- Reinforcement
- Textiles
- Woven
- …

Dong et al., 2012



Building Products

- Wallboard
- Sheathing
- Panels
- …

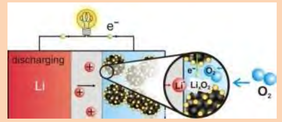
Flexible Electronics

- Self Powered
- Display
- Solar
- LED
- …

Yano et al.

Separators/Barrier

- Filtration
- Batteries
- Pumps
- …

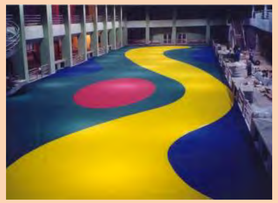


Rheology Modifier

- Cosmetics
- Food
- Adhesives
- …

Coatings

- Epoxy resins
- Paints
- Sealants
- …



Oil & Gas

- Drilling Muds
- Frac Fluids
- Clean-up
- …

Courtesy Dr. Robert Moon USFS

1865 THE UNIVERSITY OF MAINE

SUMMARY

- Composites refer to a broad spectrum of materials, produced in a variety of ways, with a broad set of markets.
- Advantages include unique properties, wide variety of sizes and appearance, uniform behavior.
- Relatively low amount of composite production in Maine relative to other regions of North America (?resource driven?)