



**Promoting Innovation in the Pulp & Paper Industry
Collaborative Development of New Technologies**

**National Nanotechnology Institute &
USDA Forest Service**

Commercial Pathways for Nanocellulose Materials

May 20-21, 2014

Beth A. Cormier – on behalf of Agenda 2020 Technology Alliance

Overview

- What is Agenda 2020
- Current outlook for nanocellulose applications in paper and board
- Avoiding the value of death – a call to action

Agenda 2020 Technology Alliance

- Agenda 2020's mission . . .
 - Identify R&D priorities that can help transform the industry – breakthrough R&D, not incremental
 - Promote and facilitate collaborative R&D programs that address the industry's technology priorities
 - Seek funding to support R&D programs
- Partnership – Industry/Government/Universities
- Incorporated as independent non-profit in 2011
 - Started 1994 – Became self-supporting in 2005
 - Located with AF&PA in DC

Agenda 2020 – Members and Partners - 2013/2014

MEMBER COMPANIES

American Process, Inc.	MeadWestvaco
Andritz	Metso
Arborgen	Nalco
Fibria	NewPage
Imerys	Sappi
International Paper	Verso Paper
Kadant	Xerium Technologies
KapStone Paper	

PRIORITY AREAS FOR ADVANCED TECHNOLOGIES

- Getting higher value from woody biomass and wastes
- Next-generation chemical pulping
- Cellulosic nanomaterials
- Energy-efficient black liquor concentration
- Reuse of process waters
- Energy-efficient papermaking – a drier web to the paper dryers

AFFILIATES AND PARTNERS

American Forest & Paper Association
Bioenergy Deployment Consortium
NCASI
TAPPI
National Network for Pulp & Paper Tech Training
U.S. Endowment for Forestry and Communities
U.S. Forest Service
U.S. Forest Products Laboratory
U.S. Department of Energy
Advanced Manufacturing Office
Bioenergy Technologies Office
Oak Ridge National Laboratory
Auburn University – Alabama Center for Paper & Bioresource Engineering
Georgia Tech – Institute of Paper Science and Technology
Georgia Southern University – Herty Advanced Materials Devt Center
North Carolina State University
SUNY College of Envir Science and Forestry
University of Maine
University of Quebec – Trois Rivieres– CIPP
Pulp and Paper Education and Research Alliance

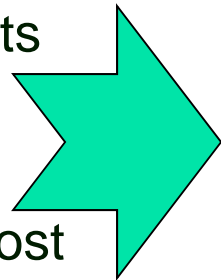
Agenda 2020 Perspective

- Within paper/board and packaging, what applications provide the most promising commercialization potential for nano-cellulose materials in the next 3-5 years
- What are the 2-3 key enablers for commercialization
- What are the 2-3 key inhibitors for faster commercialization

Agenda 2020 Members/Partners – Responses

Feature and Benefits

- High strength at lower weight
- Unique barrier properties for oil, water, air
- Unique surface treatments
- Lower porosity, better surface holdout
- High strength for lower cost paper composites
- Renewable material replacement for fossil based material

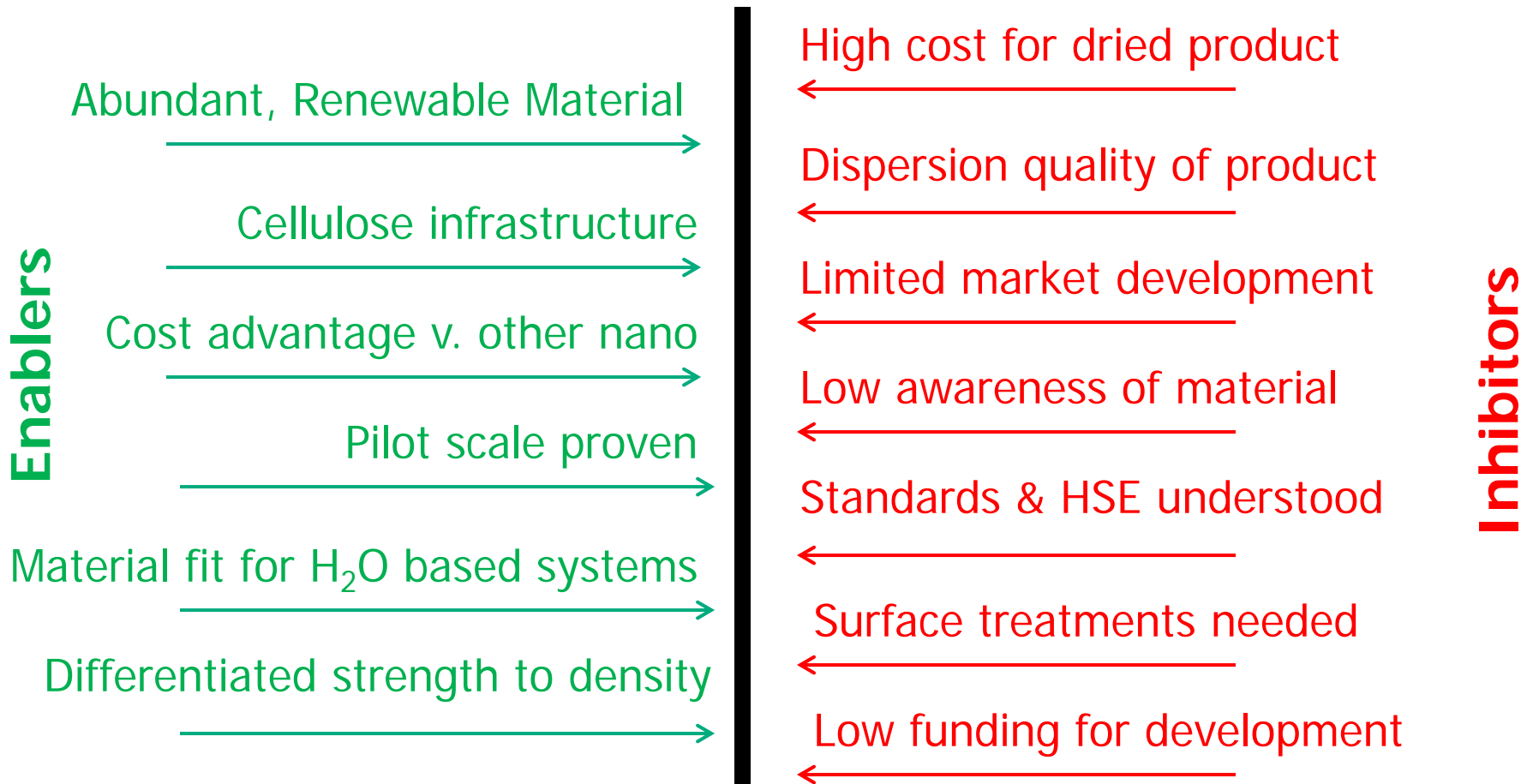


Paper/Board & Packaging Applications

- Enhanced, oil, water and air barrier properties for packaging
- Renewable packaging material replacing plastic
- Light weight, high strength packaging materials
- Higher strength fiber form for lower cost
- Improved functioning paper and board

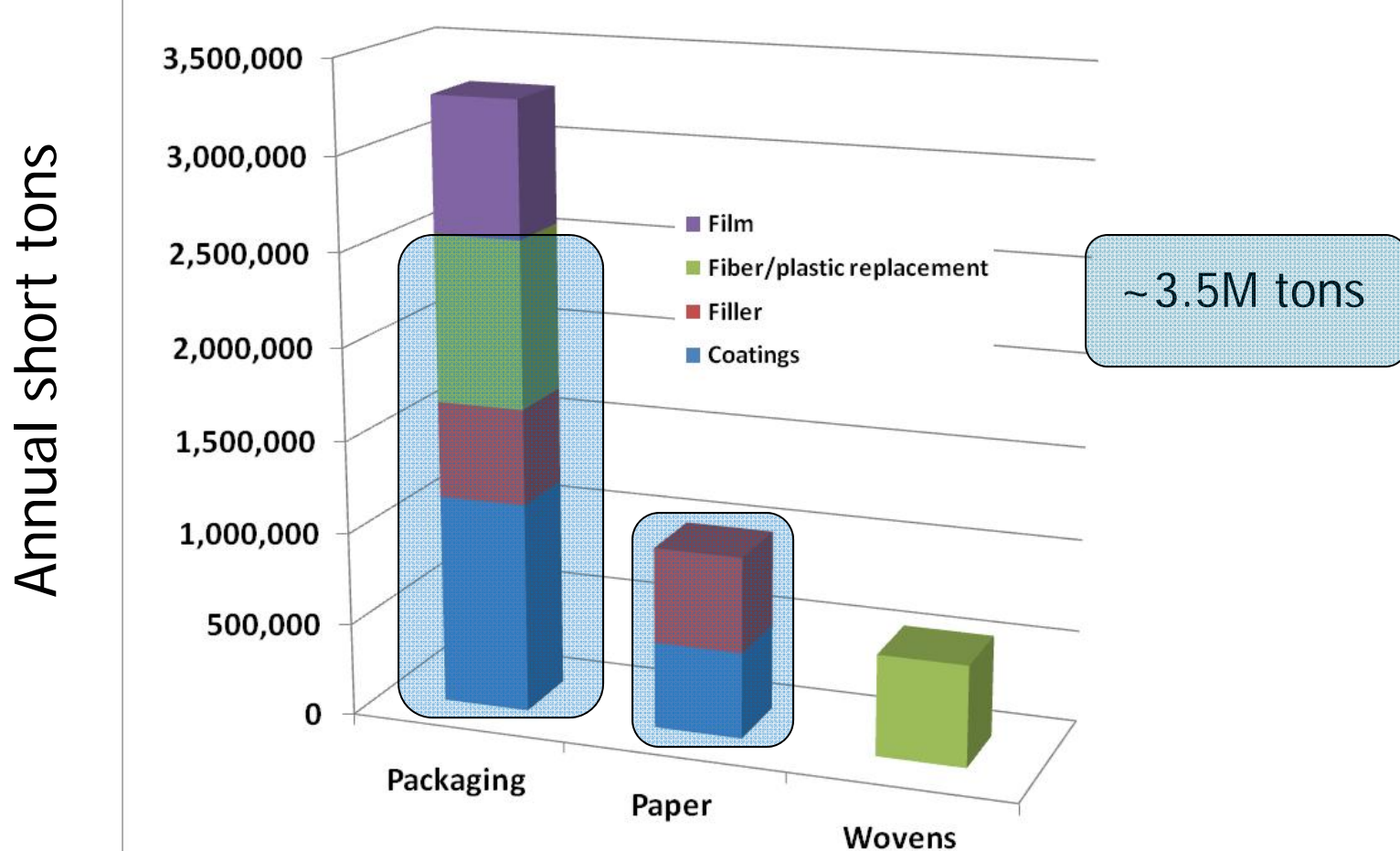
Enabling and Inhibiting Forces

Paper/Board and Packaging Lead Applications



Estimated nanocellulose material utilization - US

Source: Market Projections of Cellulose Nano-material Enabled Products – 2013; Cowie, J; Bilek, EM; Wegner, T; Shatkin J.



Public-Private Partnership Engagement Model

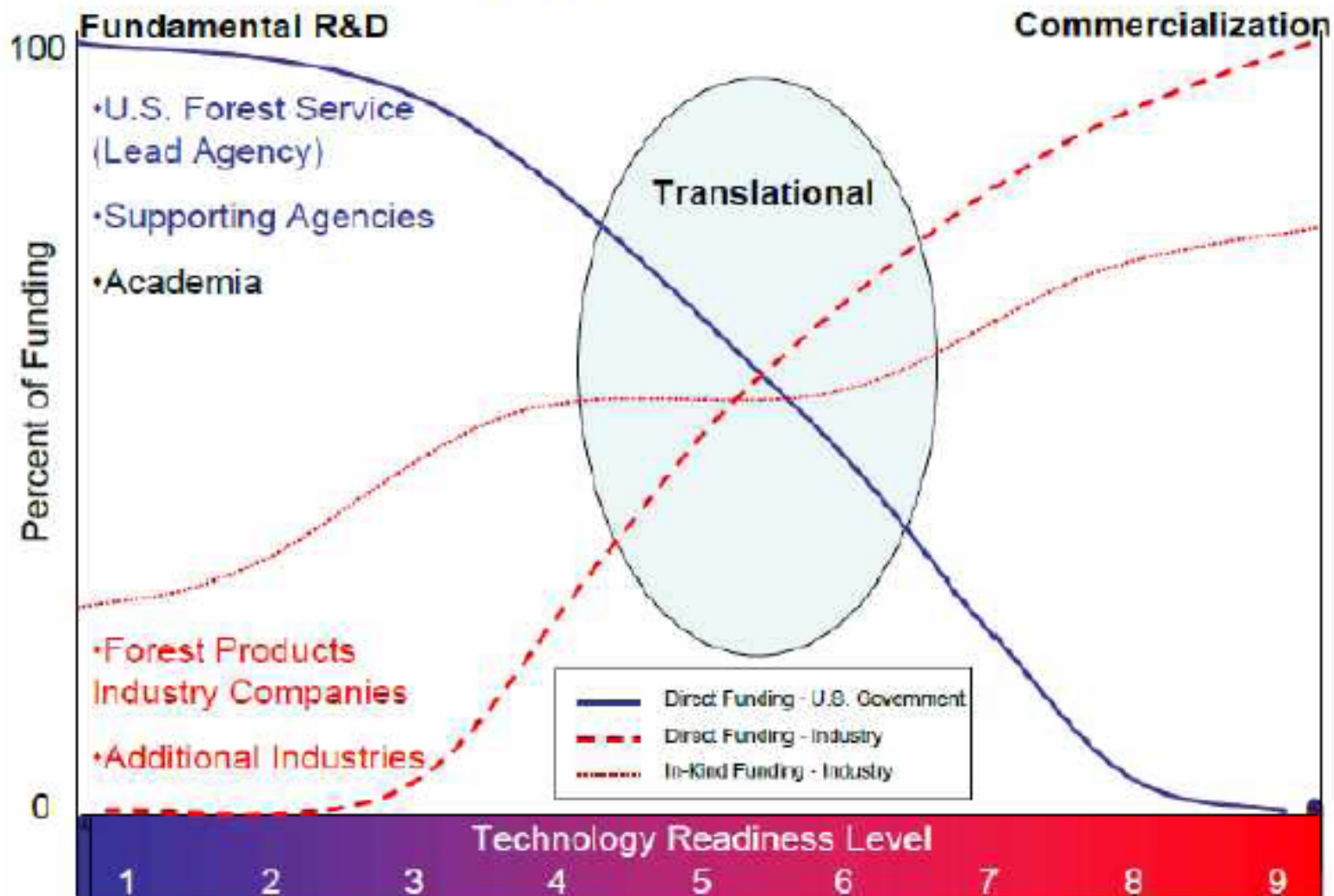
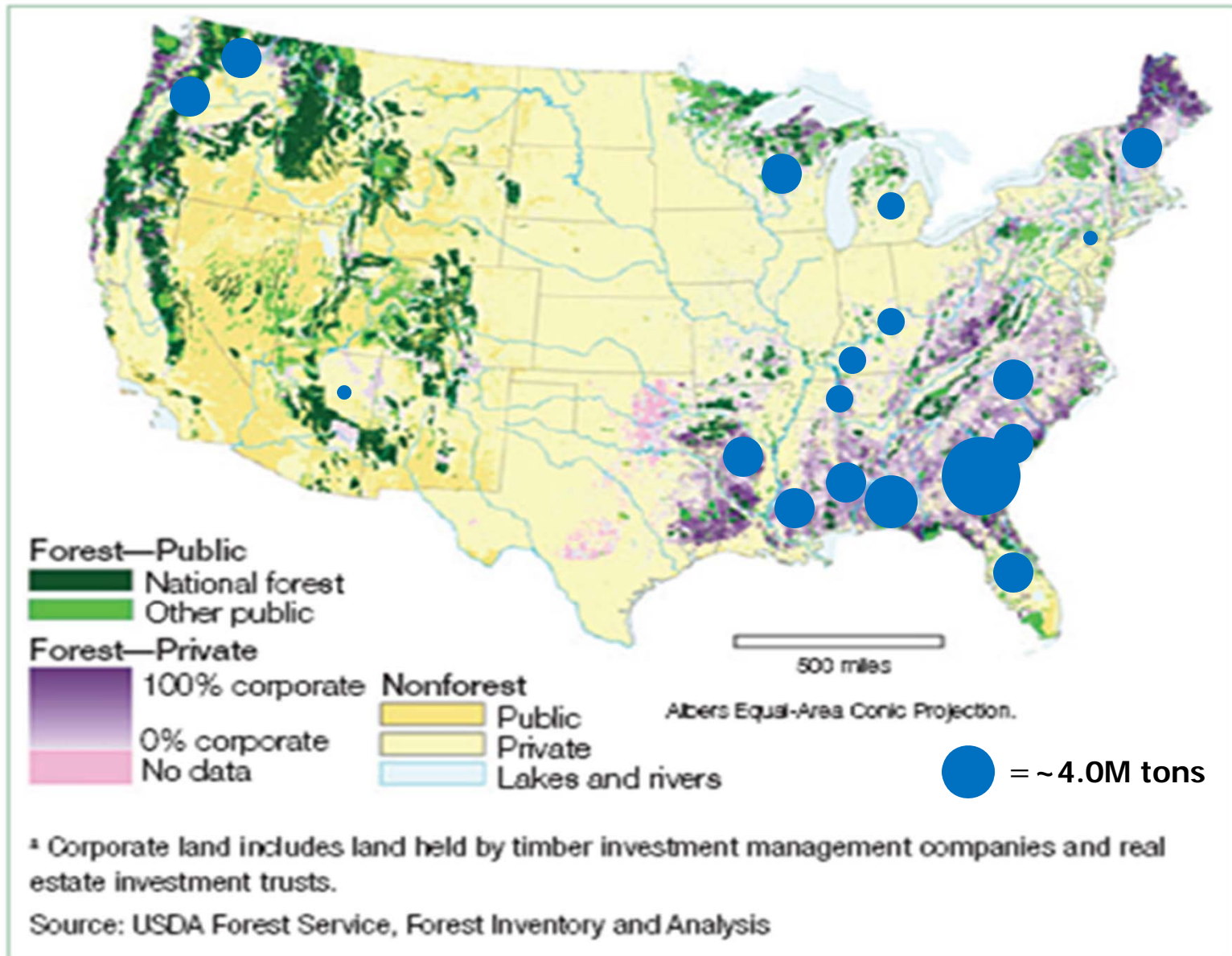
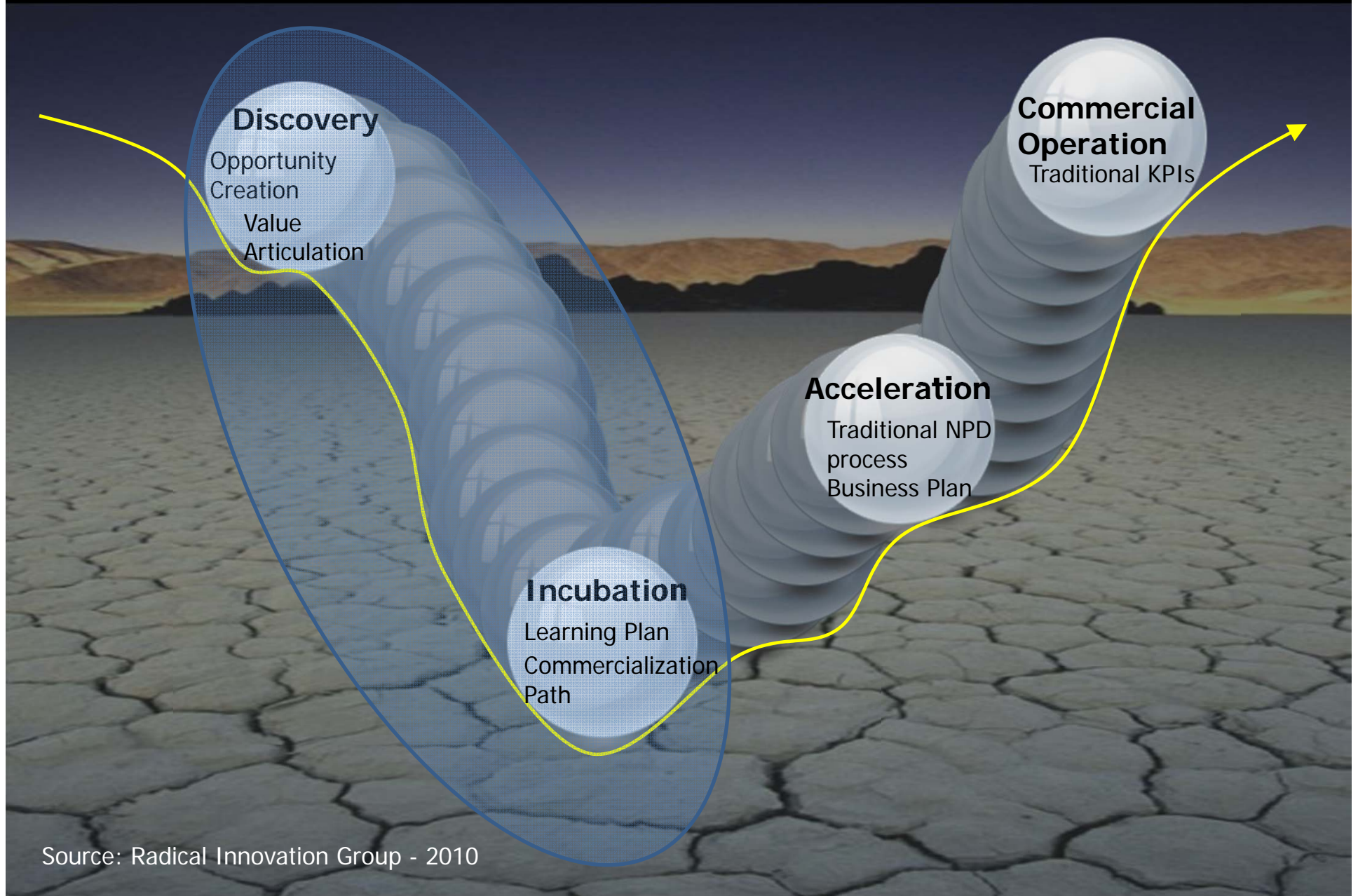


Figure 30. Forest land in the conterminous United States by ownership category, 2007.^a

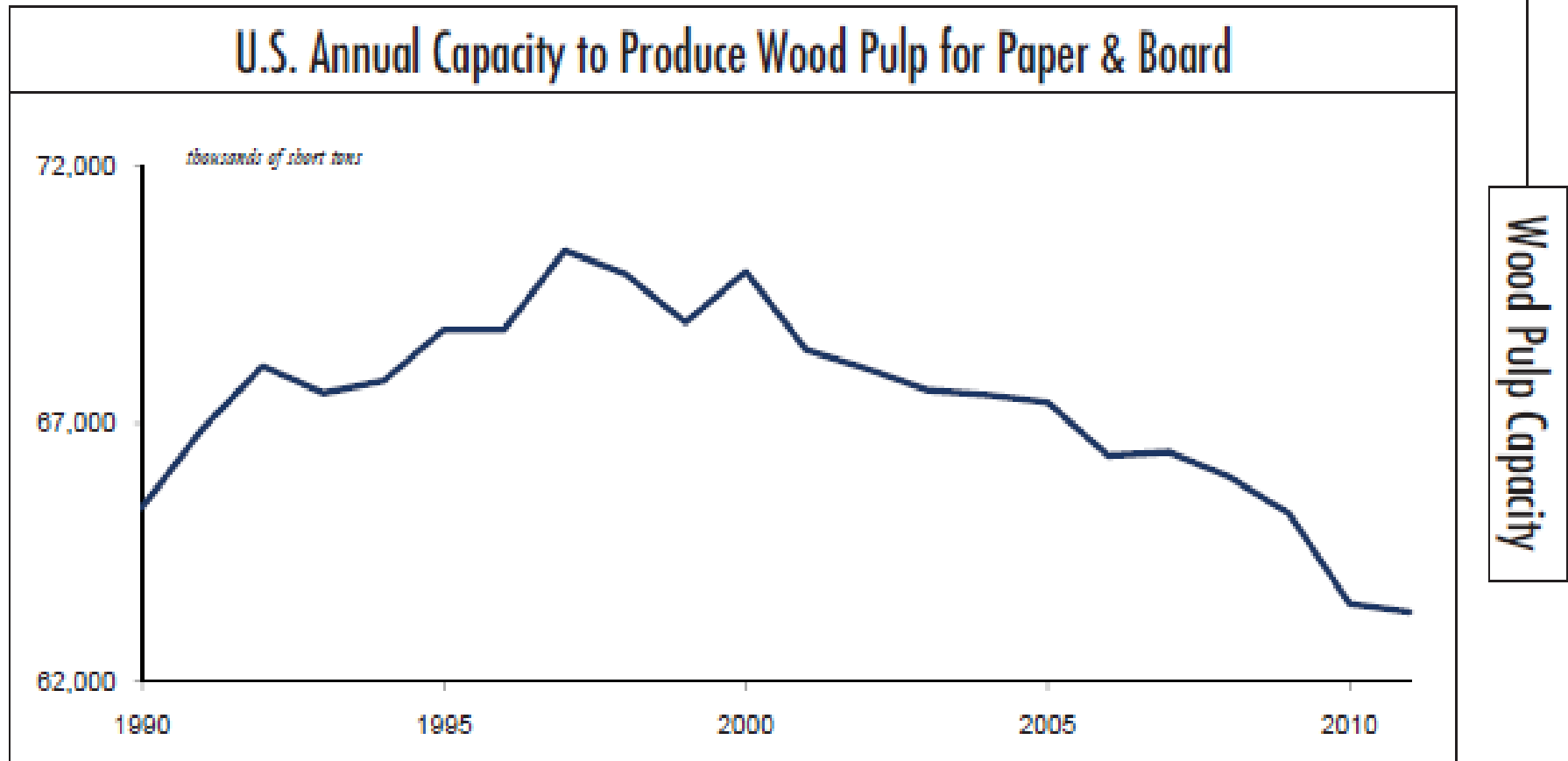


"The Valley of Death"



Source: Radical Innovation Group - 2010

Annual US capacity to produce wood pulp



Source: AF&PA's Paper, Paperboard and Wood Pulp Capacity Survey, various issues to Spring 2011

In summary

Technical Challenges

- Better understand particle characteristics and dispersion
- Cost effective ways to de-water material for broader application
- Liberating CNC cost effectively for broader market application
- Address HSE aspects of new materials

Commercial Challenges

- Industry partners for streamlined co-development
- Increased access to CNC and CNF materials for development
- Industry coordination and federal research funding to move through the “value of death”

Thank You

For More Information

Ron Brown, President & Executive Director
Agenda 2020 Technology Alliance
ron_brown@agenda2020.org
202-463-2742

Beth A. Cormier, Chair
Agenda 2020 Technology Alliance
VP-Research, Development & Innovation, SAPPI
beth.cormier@sappi.com



Transforming the forest products industry through innovation

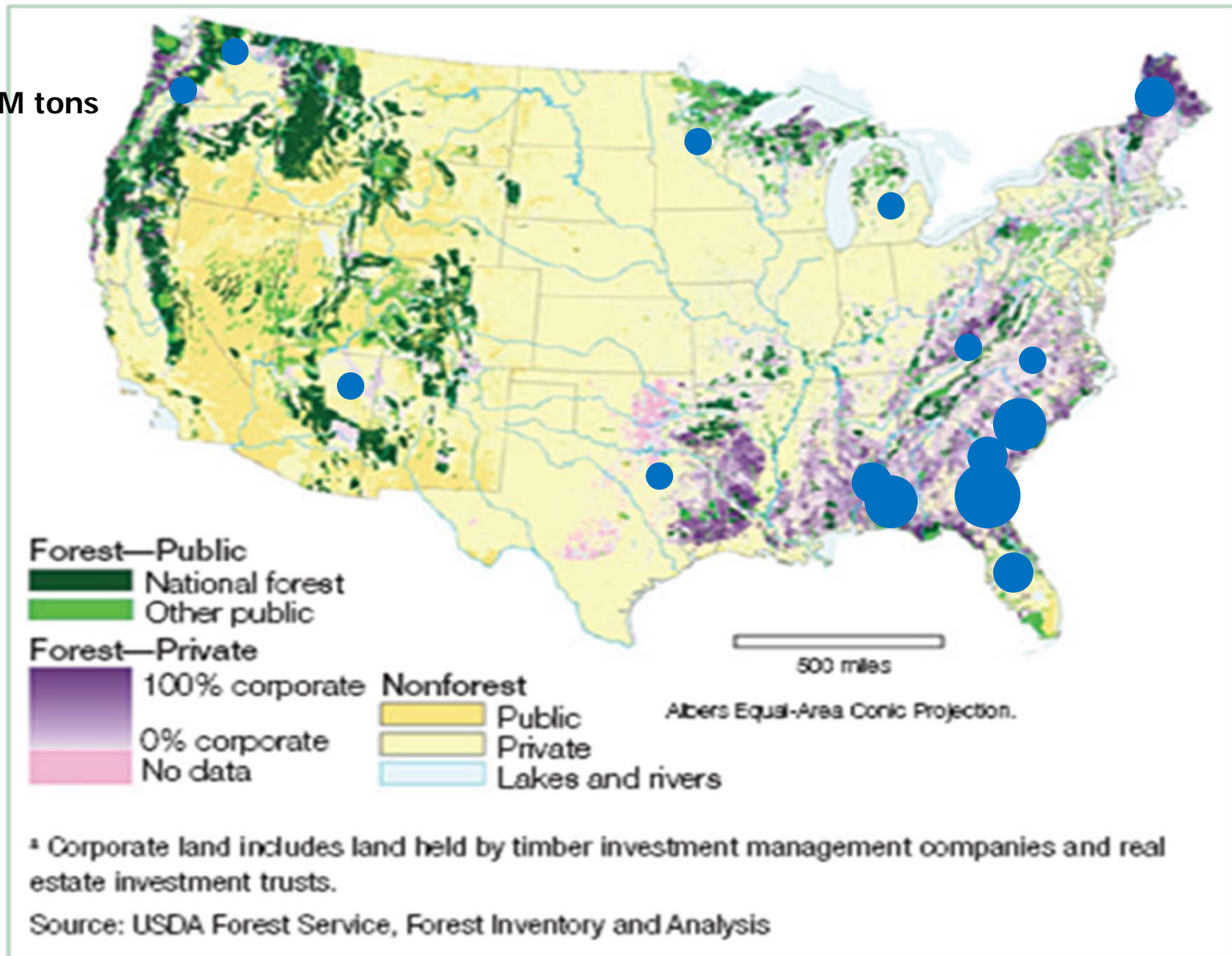
Back-up



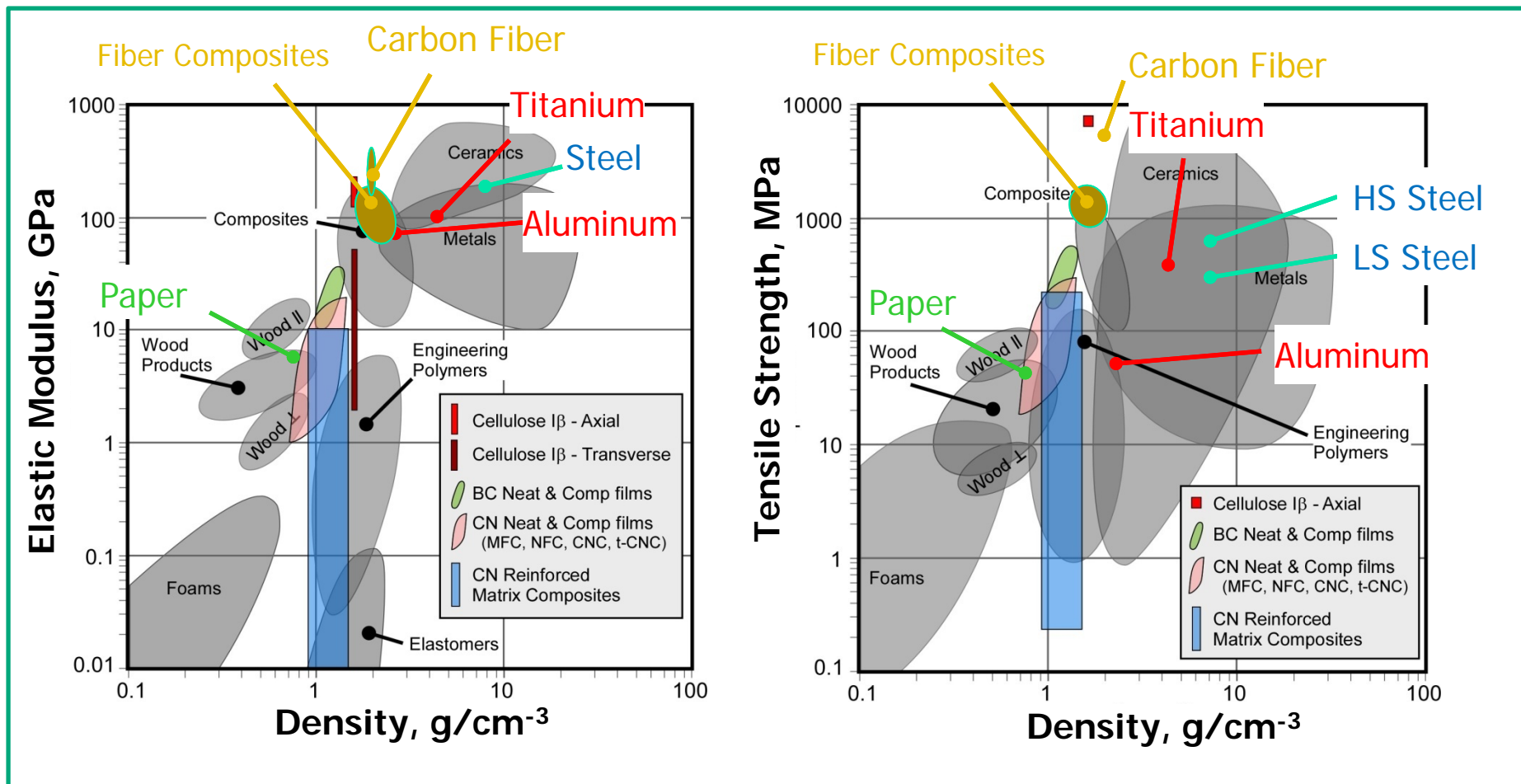
Transforming the forest products industry through innovation

Figure 30. Forest land in the conterminous United States by ownership category, 2007.^a

● = ~1.0M tons



Mechanical Properties - Nanocellulose



Nanotechnology to Enable New Products and New Product Features – Forest Products Industry Technology Roadmap 2010

Table 9.1. Technology Objectives for Product Features

Create New Bio-Based Composites and Nanomaterials	Develop bio-based composites and nanomaterials that leverage the unique properties of biomass and provide features desired by customers
Achieve a 20–50% Improvement in Performance/Weight Ratio of Paper and Packaging Products without Compromising Performance Properties	Increase the performance-to-weight ratio of paper and packaging products by 20–50% through the development of new technologies and techniques
Develop New Paper Features—Optical, Electronic, Barrier, Sensing, Thermal, Surface Texture—that Take Advantage of Advances in Nanotechnology	Modify existing and/or create new paper characteristics to increase product capabilities and value, and develop commercial applications of promising advances in nanotechnology
Develop New Forms of Biomass-Based Packaging	Develop sustainable biomass-based packaging competitive with existing packaging technologies
Separate Biomass Into Basic Components, Preserving Nanoscale Properties of the Components	Investigate and develop technologies and methods to deconstruct biomass into fundamental components for commercial use, without disrupting nanoscale properties
Develop New Printed Functionalities to Make “Smart” Surfaces on Paper, Paperboard, and Wood Products	Develop technologies to add “smart” functions via printing to surfaces of paper and paperboard and wood products

http://www.agenda2020.org/PDF/Forest_Products_Industry_Tech_RM-043010.pdf

Collaborative R&D – Nanocellulose: New Projects Influenced by Agenda 2020

Cooperative Nanotechnology Research Program US Forest Service Forest Products Laboratory

- \$1.8 million in FY2011– gained through work of Agenda 2020
- 12 proposals reviewed by Agenda 2020 and USFS FPL
- 8 project grants approved in July 2011:
 - Oregon State – nanocellulose composites modeling
 - Penn State – nanocellulose composites with wet strength and barrier
 - Purdue – advanced nanocellulose composites
 - Georgia Tech – nanocellulose composites for aerospace
 - Georgia Tech (IPST) – nanocellulose barrier films
 - NC State – local thermal analysis of nanocellulose composites
 - NC State – nanofibrillated cellulose for aerogels
 - U Maine – nanocellulose surface modification and drying

Federal R&D Funding Is Available

\$140 billion/year	U.S. government spending on R&D
\$340 million/year	Forest products industry's share of non-defense R&D based on GDP
< \$100 million/year	Actual funding for our industry

U.S. forest products industry must better coordinate to earn the funding



Transforming the forest products industry through innovation

