Next Generation Nano-structured Material Derived from Ocean Waste

Corporate Presentation – May 2024

Executive Summary

Neptune Nanotechnologies Inc. is an early-stage tech Startup active in the bio-nano material space. Specifically, we are commercializing a technology that can convert organic fishing waste into ultra-high value nanocrystals. These nanocrystals are stronger than steel, lighter than plastic, entirely bio-based, non-toxic, biocompatible, and biodegradable. They function as physical additives where a small quantity of nanocrystals added can drastically increase the strength, stiffness, crack resistance and barrier properties of the underlying material. We own proprietary IP, have a strong team lead by a Forbes 30 under 30 founder and we closely collaborate with leading research institutions such as the University of Toronto and York university.

We have identified packaging films and epoxies as two areas of our focus:

High strength, low permeability, and recyclability are three of the most important properties for plastic packaging films. However, there are no solution on the market today that has all three. The current market products optimize for high strength and low permeability using multi-layer mixed-material plastics which cannot be recycled. Over time, those plastics break down into toxic-laden microplastics that further harm ecosystems and human health. Moreover, producing multi-layer plastic film is a costly and energy-intensive process that requires multiple types of adhesives, chemical additives and solvents and generates harmful GHG and VOC emissions.

Leveraging the technological advantages of chitin nanocrystals, specifically the high strength, impenetrable crystal structure and large specific surface area. Neptune have developed a single layer recyclable film solution containing 1% chitin nanocrystal that can simultaneously improve strength and reduce permeability by up to 4600%. Which directly addresses the recyclability problem as well as eliminating the uses of energy intensive processes and toxic chemical additives required by traditional multi-layer manufacturing processes.

Epoxies are widely used as the primary material in a number of mission critical industries such as aerospace, automotive, energy generation, oil & gas etc. Strength, toughness, cost, weight, and sustainability are five of the most important properties for epoxies. However, there are no solution on the market today that can satisfy all these conditions. Incumbent chemical additives use in epoxy industries today simply fails in terms of strength and sustainability. While upcoming legacy nanotechnologies are prohibitively expensive and still carry significant sustainability and toxicity risk.

Leveraging the superior strength of chitin nanocrystals and its nanoscale features, it can be used as an additive in epoxy that directly replaces traditional toxic chemical additives that grants both high strength and toughness. And due to its waste stream feed stock, chitin nanocrystals are significantly less expensive than legacy nanomaterials, offers superior performance and lighter weight which can enable in cascading life cycle benefits for both cost reductions and environmental value.

Neptune Nanotechnologies: Experienced Team

EXECUTIVE TEAM

Aaron Guan
Founder and CEO
- Serial entrepreneur
- Experienced in multiple rounds of million dollar plus raises
- Technology inventor with 7 granted patents
- Forbes 30 Under 30
- Board director of Society of Plastic engineers (SPE TPM&F)
- Rising Star by Plastic News

Winfield Ding
CFO
- CPA, CA
- CFO of Principle Capital Partners
- Former CFO of TSXV public company
- Serves as advisor to several prominent VCs and PEs

Dr. Sara Koul
Sr. Scientist
- PhD in Applied Chemistry from Delhi Technological University
- Former Sr. Scientist at Dow Chemicals
- More than a decade of experience in polymer and composite formulation

PARTNERS & ADVISORS

Dr. Hani Naguib
R&D Partner
- Professor at University of Toronto
- Canada Research Chair
- Director of TIAM

Dr. Alex Chen
Advisor
- Founder & CEO of ALCLE consulting
- Clean tech/deep tech business strategist

Dr. Sunny Leung
R&D Partner
- Professor at York University
- Director of M3 Labs
- Expert in nanostructured materials

Constance Wang
Advisor
- Communication and PR strategist
- Web & Social Media specialist

Matthew Diskin
Legal Council
- Partner at Dentons Law
- Expert IP attorney
- Expert corporate & litigation attorney
- Best Lawyers List Canada

Matthew Powell
IP Advisor
- Sr. Patent Agent
- Expert IP attorney
- IAM Best Lawyer List

Market Trends: Plastics Industry

PERFORMANCE

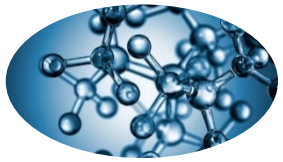
SAFETY

NON-TOXIC

SUSTAINABILITY

Better performance & better sustainability are both mega trends of the material sector

Traditional materials

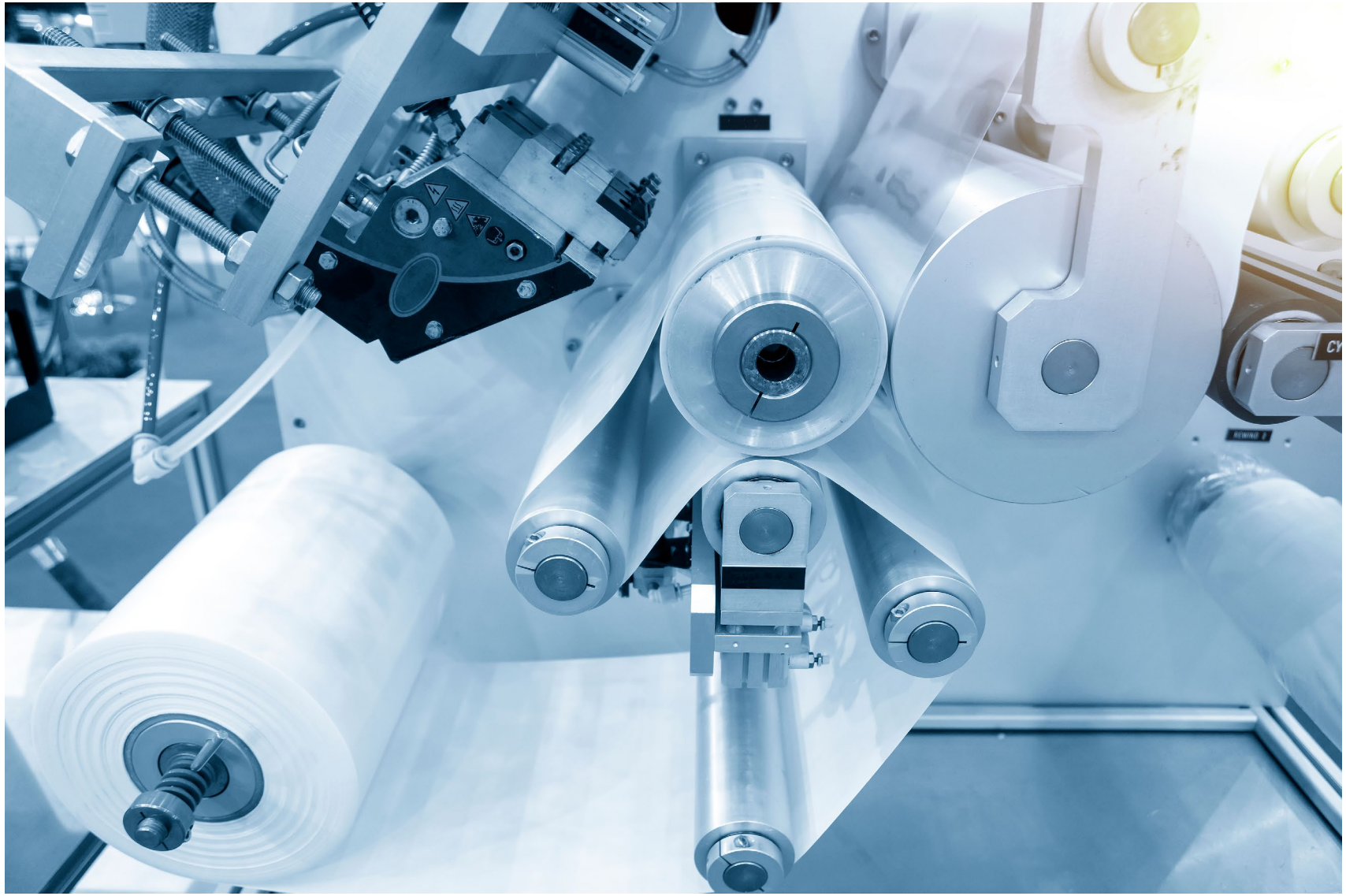


High performance but environmentally damaging

Environmentally friendly but poor performance

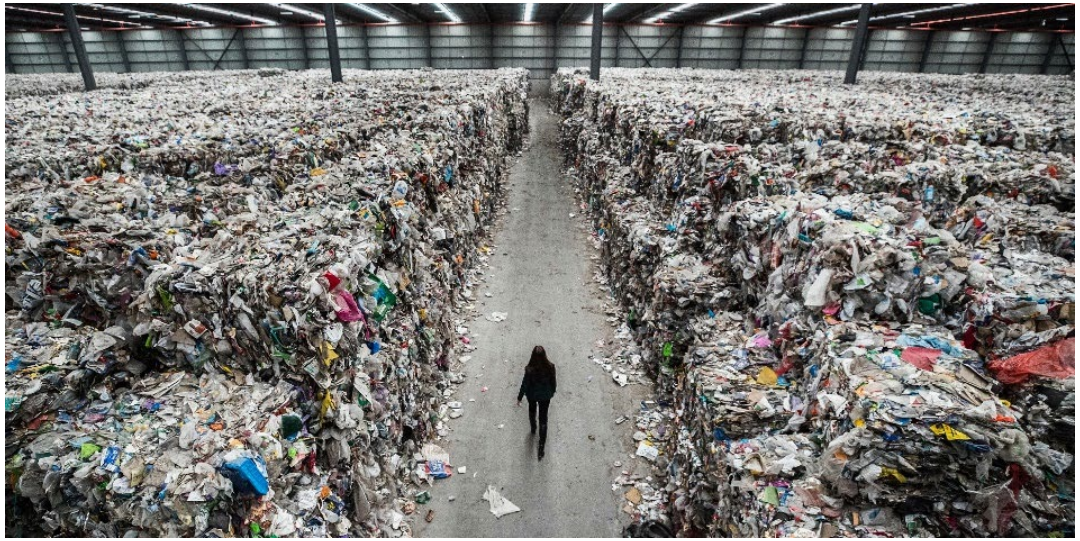
Green materials

Pillar 1: Plastic Packaging Applications

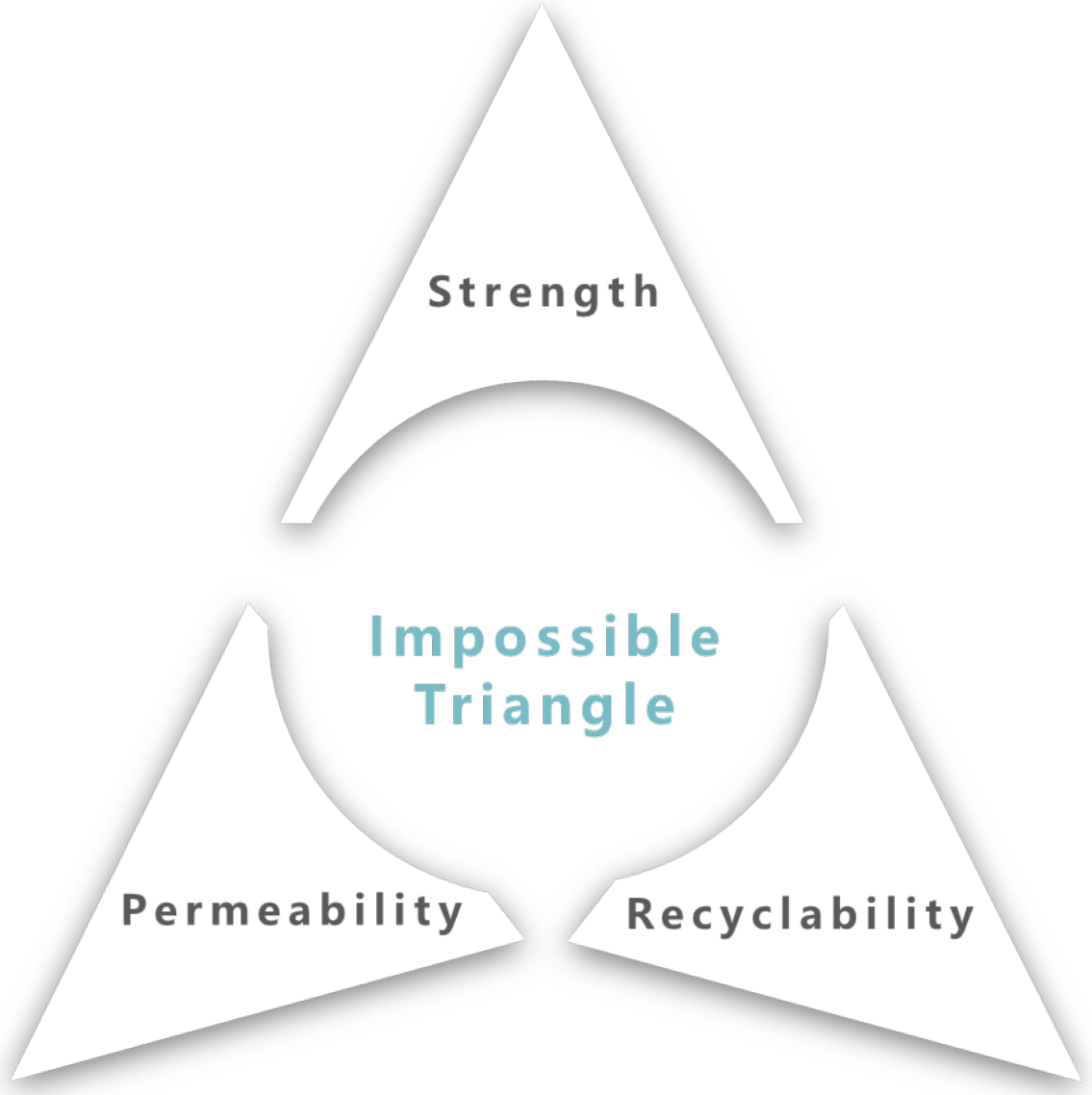


Pain Points: Environmental Threats

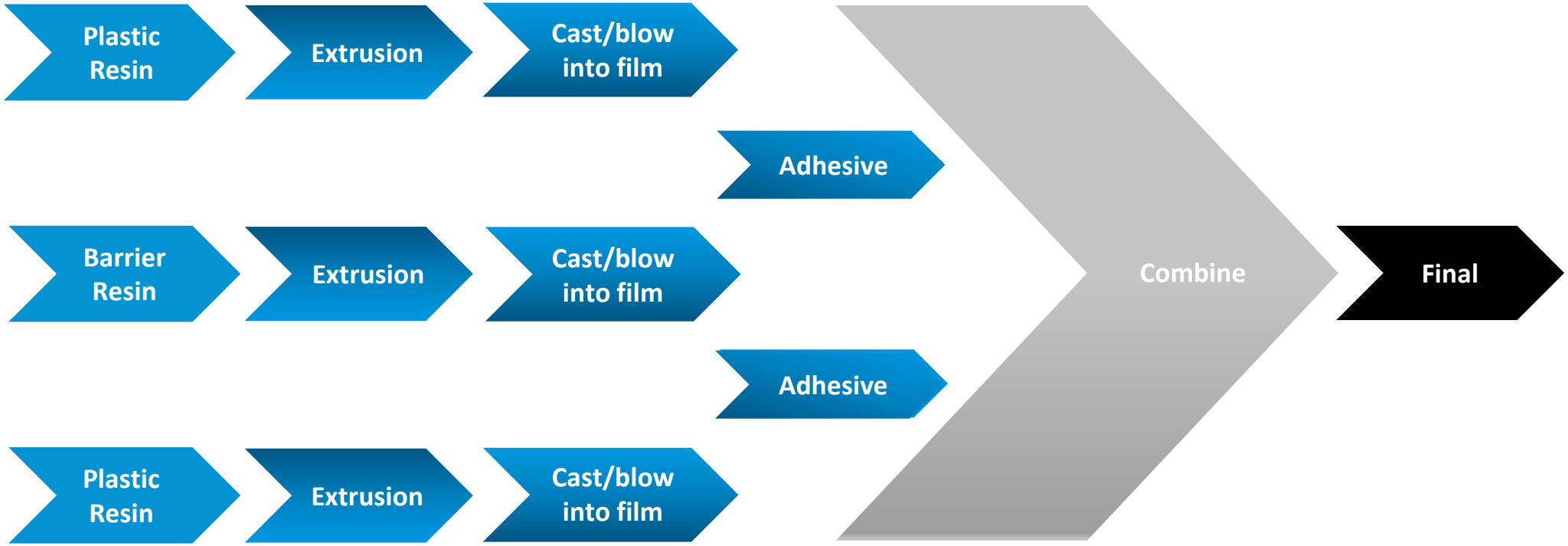
Serious environmental threats posed by plastic packaging



Pain Points: Performance vs Recyclability



Pain Points: Complex Manufacturing

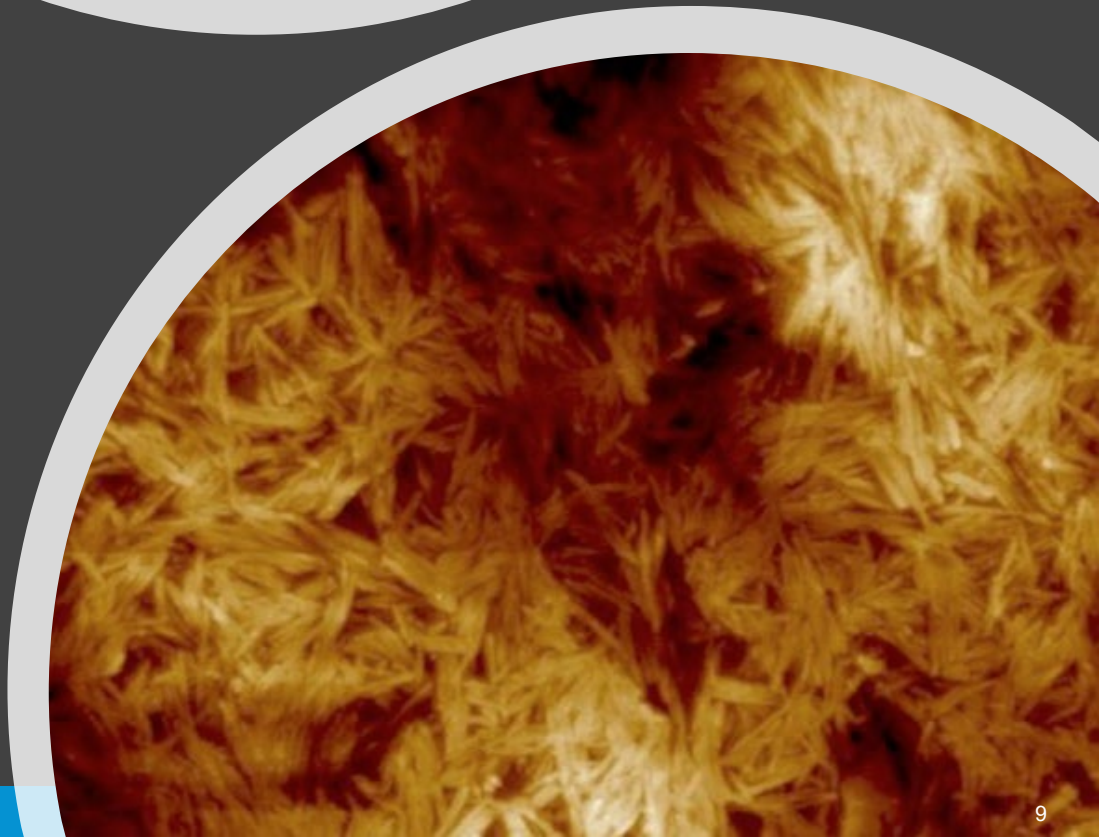


The above is the simplest multi-layer film consist of only 1 barrier layer, 2 skin layers and adhesives to combine the 3 layer.

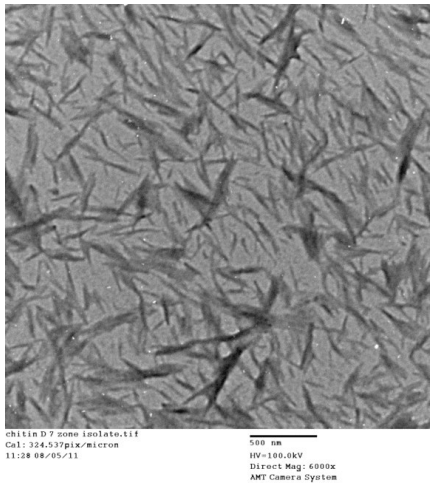
- Often films can go well beyond 10 layers
- Complex, Energy intensive, Toxic additives, VOC emissions

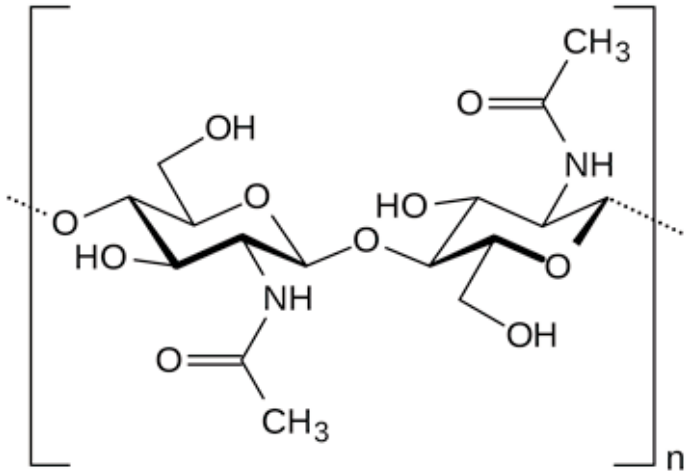
Our Solution:
Chitin Nanocrystal (CNW)

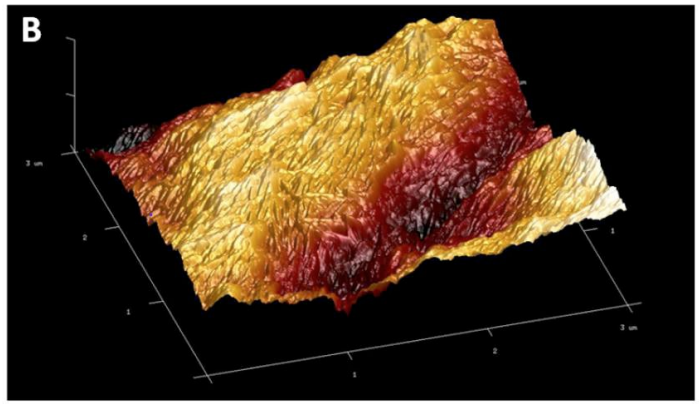
- Synthesized from renewable crustacean shells and fungal cell wall
  - Biobased, biodegradable, biocompatible & non-toxic
- A nano-scale single crystal 10,000X smaller than width of human hair
- Stronger than steel & lighter than plastic
- Used as physical additive, vastly improving material properties in a wide variety of applications
- Higher performance & lower cost than competitors

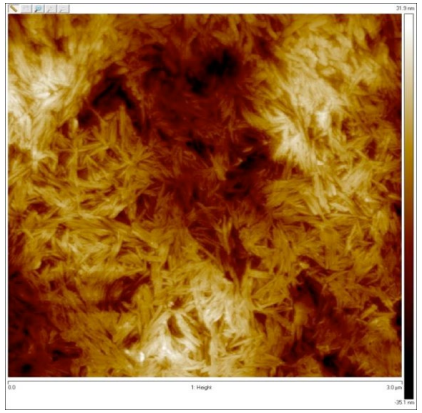


Continued Our Solution: Chitin Nanocrystal (CNW)







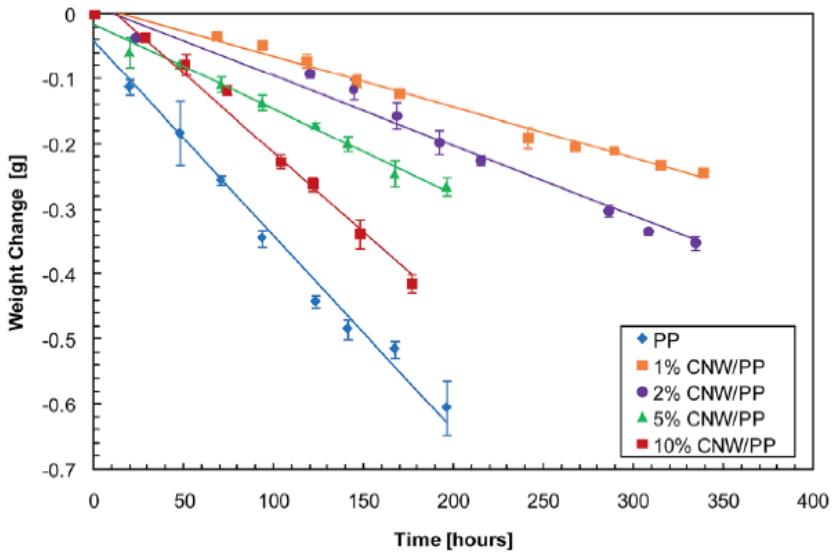


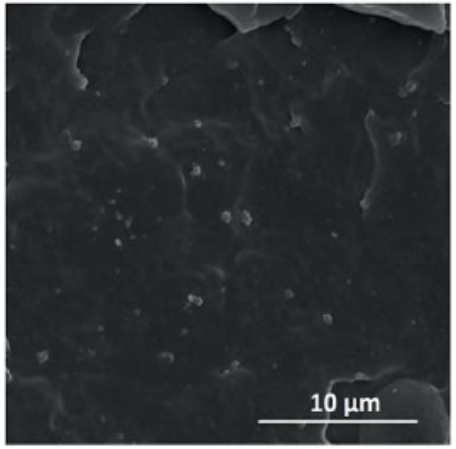
CNW nanostructure

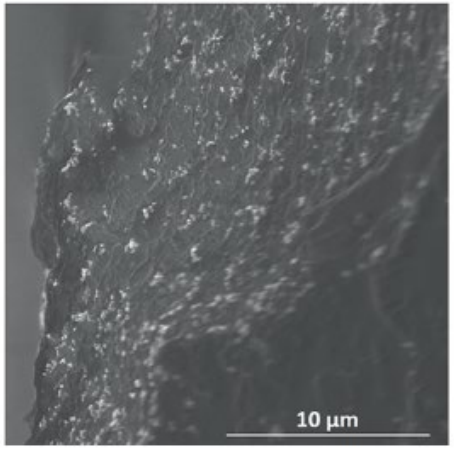
Length (nm)	200 - 500
Width (nm)	~20
L : D	(10-25) : 1
SSA (m^2/g)	~300

Technical Mechanism

- The typical plastic film is ineffective at preventing small molecule penetration
- The current solution on the market is to add barrier layers such as different polymers or metal coating to plastics
- CNW has fundamentally different mechanism.
- **CNW nanocrystal has tightly packed crystal structure that is very difficult to penetrate**
- **CNW also has very large specific surface area (over 300 m^2/g)**
- Adding CNW is akin to adding large amount of impenetrable surfaces to the plastic film
- Lab scale proven with SCI publication
- Pilot scale demonstrated with successful initial results



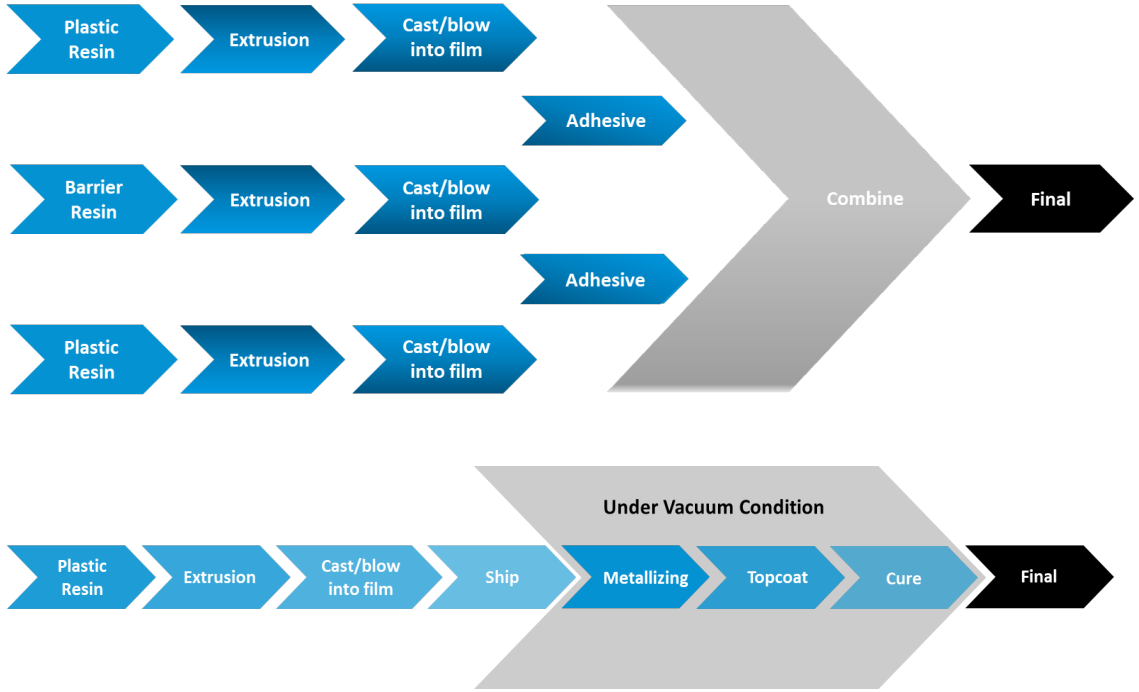




Continued Our Solution: Simple Manufacturing

OLD

Traditional multi-layer film process



NEW

CNW single layer film process

- Simple process
- Low Cost
- Low Energy
- No VOCs

Competitive Advantages

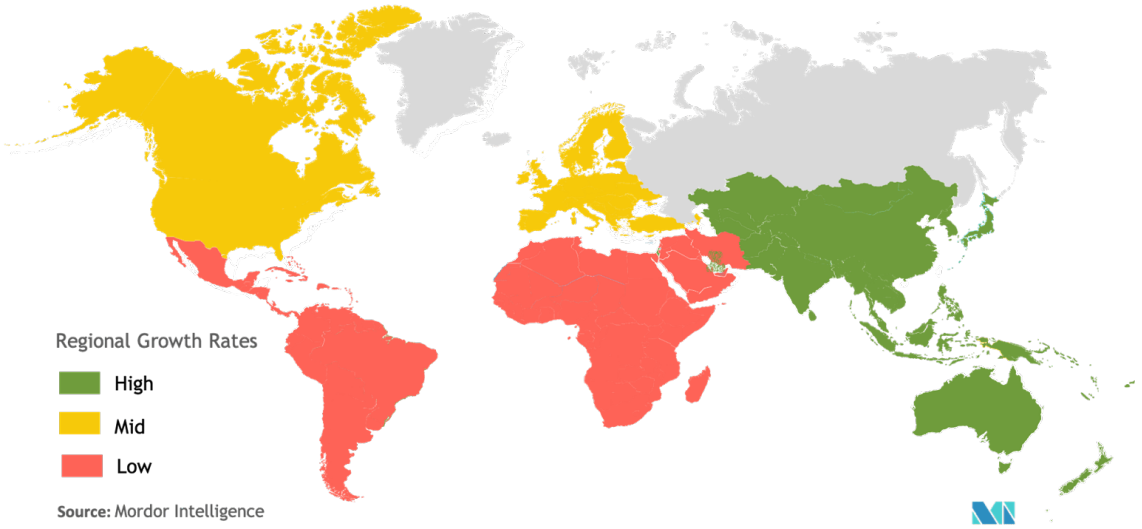
- Higher strength and barrier properties compared to single layer film
- Higher strength, recyclable, lower cost and much more environmentally friendly compared to multilayer and metal coated films

	Single Layer Film	Multilayer Film	Metal Coated Film	Nanocrystal Film
High Strength	X	X	✓	✓
High Barrier	X	✓	✓	✓
Recyclable	✓	X	X	✓
Low VOC	✓	X	X	✓
Low Cost	✓	X	X	✓
Low Manufacturing Complexity	✓	X	X	✓

Market: Films & Packaging

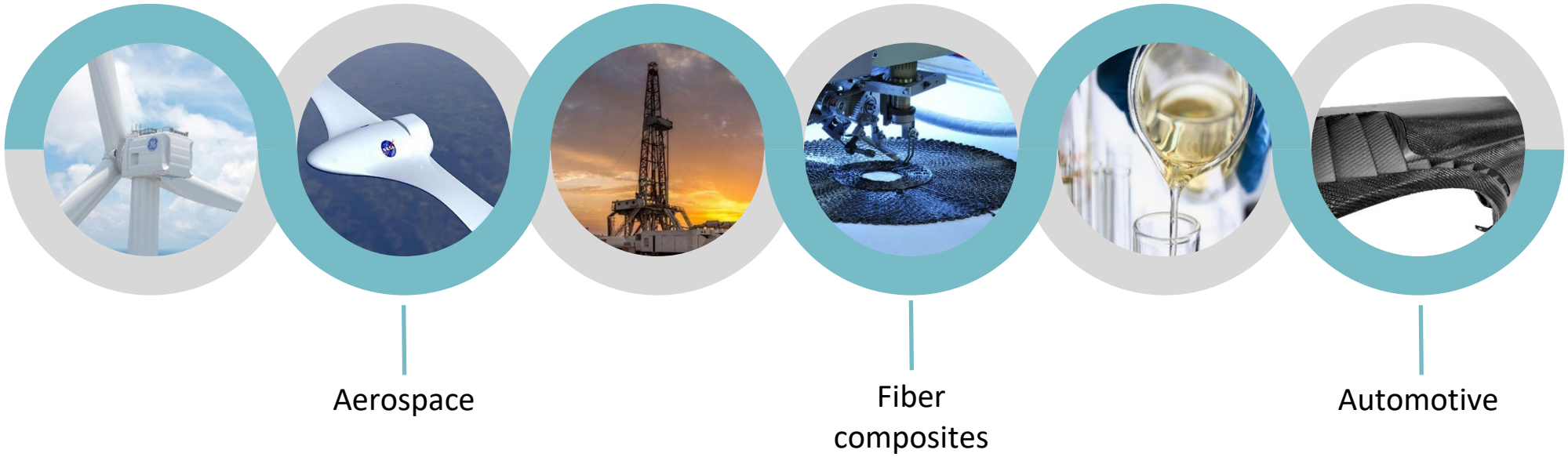
- Global plastic films TAM: >180 Billion USD with CAGR 3%
- Annual high barrier film demand > 1 million tons
- CNW nanocrystal concentrate demand 147k tons
- Estimated market pricing $30 USD / KG
- Estimated direct cost of production $6-8 USD / KG
- Direct TAM: 4.4 Billion USD

Plastic Film Market - Growth Rate by Geography (2020-2025)

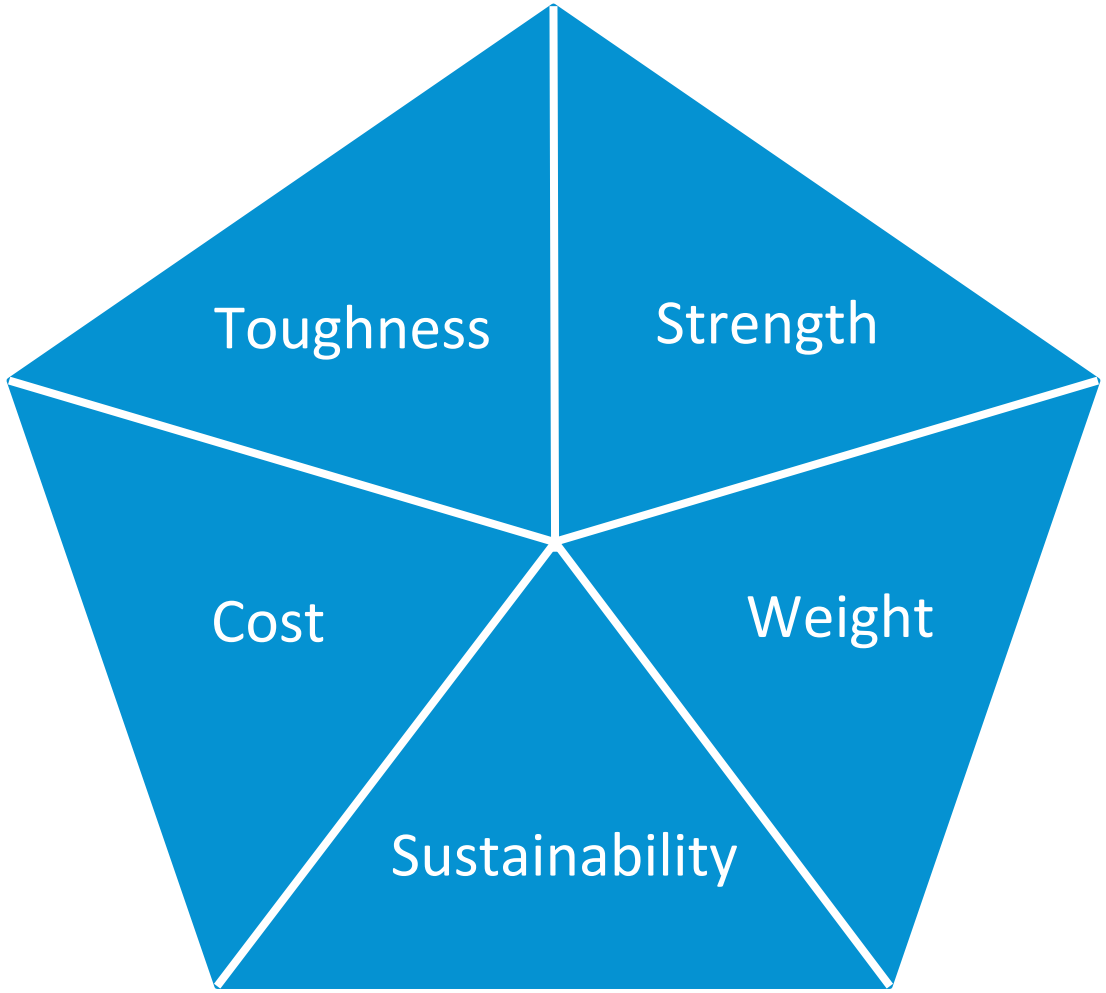


Pillar 2: Epoxy Applications

Epoxy Applications



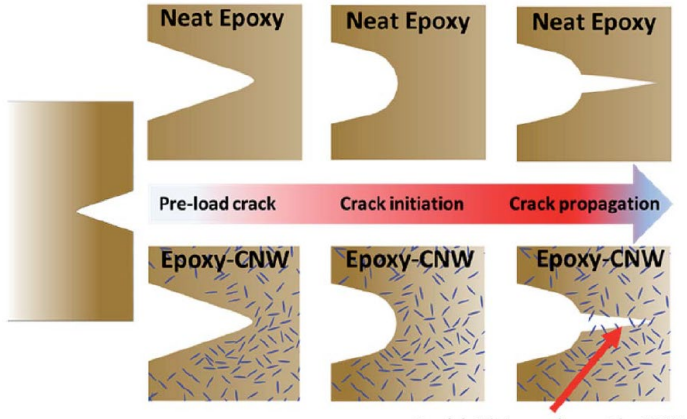
Pain Points: 5 Fundamental Properties of Epoxy



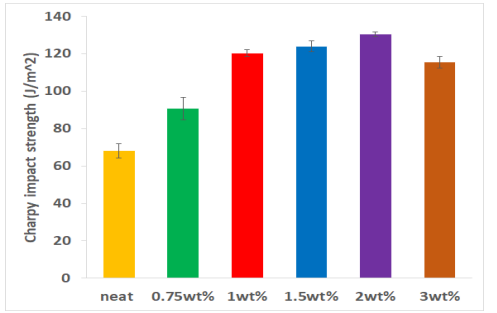
- There are no solution on the market today that can achieve all 5 (only chitin nanocrystals can)
- Incumbent chemical additive solutions lacks strength & sustainability
- upcoming conventional nanomaterial solutions lacks cost & sustainability

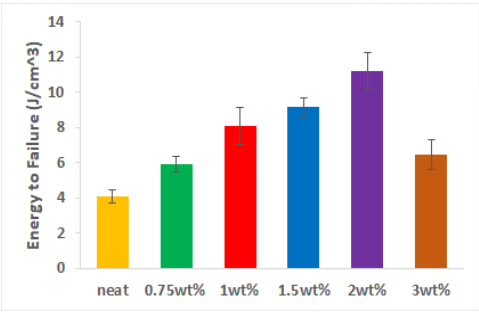
Epoxy: Technical Mechanism

- In epoxies, chemical additives are used to soften epoxies, this improves toughness but trades off strength and stiffness
  - For example, glass is strong and stiff but prone to cracking, rubber is weak (deforms easily) but does not crack
- CNW nanocrystal functions on completely different mechanism
- CNW directly improves strength due to its own superior material property
- CNW also acts as bridges that prevents micro-cracks from forming
- **1% CNW can simultaneously improve strength by over 35%, Strain Energy by 172%, impact toughness by 91%**



Crack bridging and arrest by CNWs





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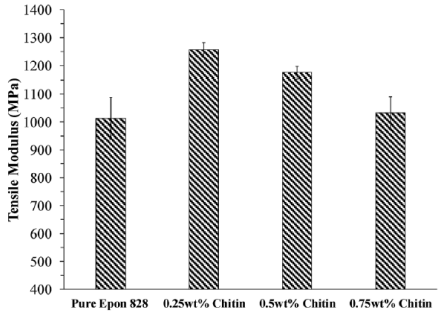

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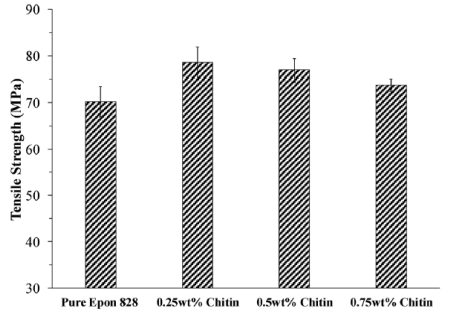


J. Wang, Z. Chen, Q. Guan, N. Demarquette, H.E. Naguib, ""Ionic Liquids Facilitated Dispersion of Chitin Nanowhiskers for Reinforced Epoxy Composites" Carbohydrate Polymers Volume 247, 1 November 2020, 116746
M. Anwer, J. Wang, Q. Guan and H.E. Naguib "Chitin nano-whiskers (CNWs) as a bio-based bio-degradable reinforcement for epoxy: evaluation of the impact of CNWs on the morphological, fracture, mechanical, dynamic mechanical, and thermal characteristics of DGEBA epoxy resin" RSC Adv., 2019, 9, 11063-11076

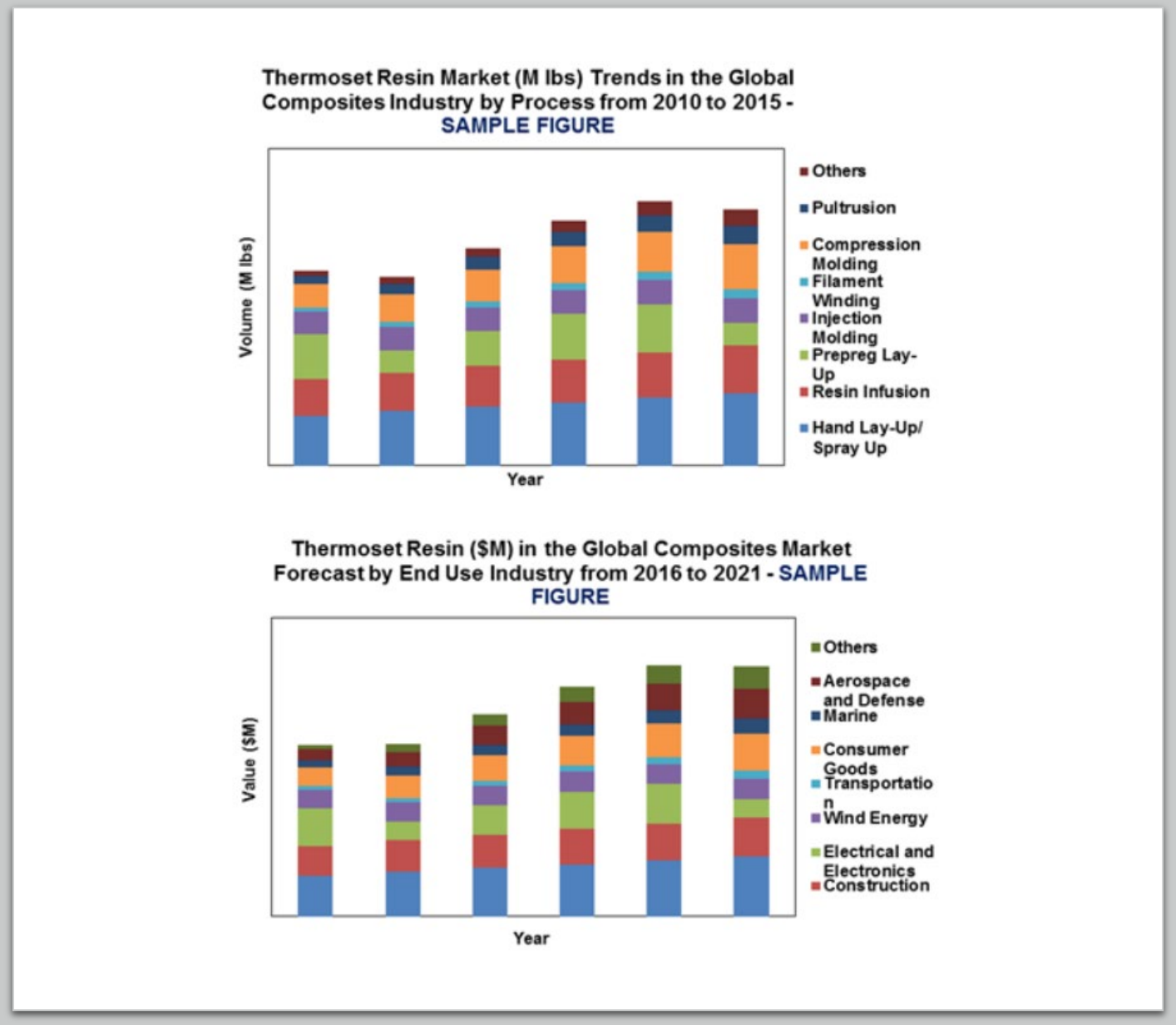
Competitive Advantages

- Higher strength, lower cost and no VOC emissions compared to chemical additives
- Significantly lower cost and zero toxicity compared to legacy nanomaterials

	Chemical Additives	Legacy Nanomaterials	CNW Nanocrystal
High Strength	X	✓	✓
High Toughness	✓	✓	✓
Low Cost	✓	X	✓
Low Weight	✓	✓	✓
Sustainability	X	X	✓

Epoxy Market:

- Annual Epoxy resin demand > 3 million tons
- CNW nanocrystal concentrate demand 160k tons
- Estimated market pricing $35 USD / KG
- Estimated direct cost of production $6-8 USD / KG
- Direct TAM: 5.6 Billion USD



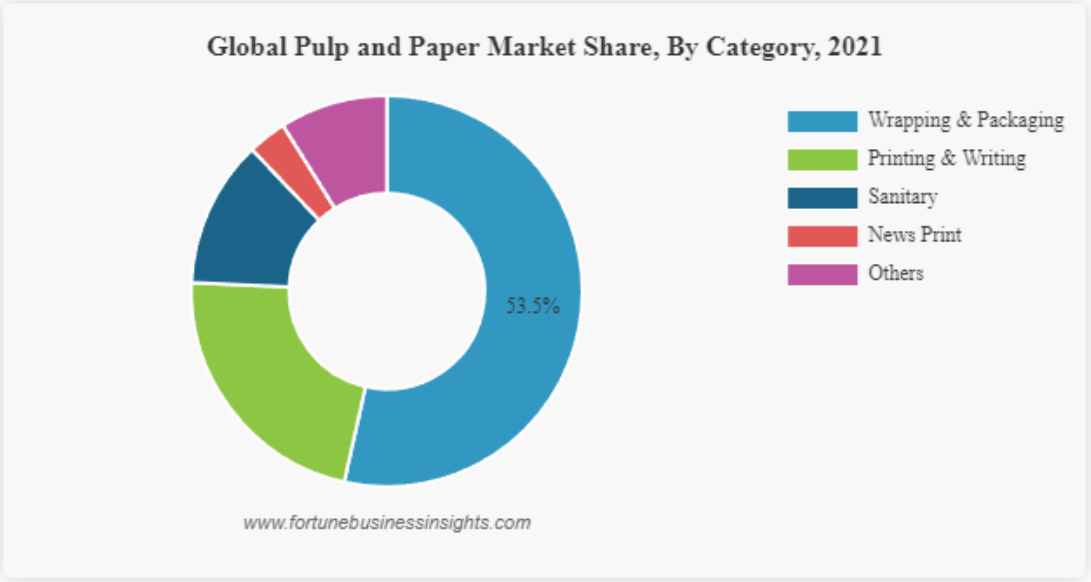
https://www.lucintel.com/thermoset-resin-in-composites-industry.aspx

Pillar 3: Pulp & Paper applications

Opportunities and Pain Points

- Global Paper Products Market exceeds $350 billion
- Paper products are mainly derived from renewable resources such as plants fibers and biodegradable
- Due to environmental regulations and policies, paper products are gradually replacing plastics in various applications.
- However, existing paper products have the following pain points:
  - Low strength and low rigidity
  - Suitable only for disposable products
  - Unable to meet the performance requirements of durable g
  - Prone to disintegration when exposed to water
  - Limited recycling capabilities (each recycling process causes irreversible damage to the paper fibers)

Neptune's Nanocrystals solves all these pain points!

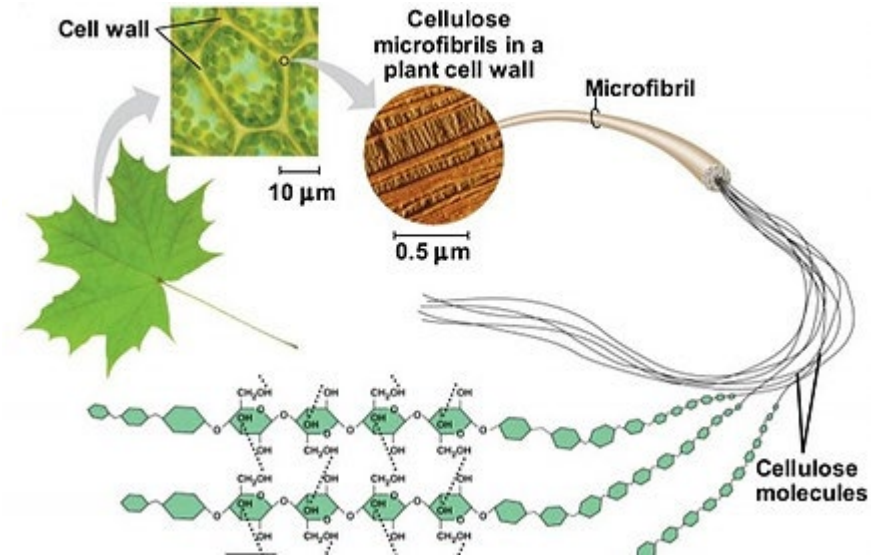


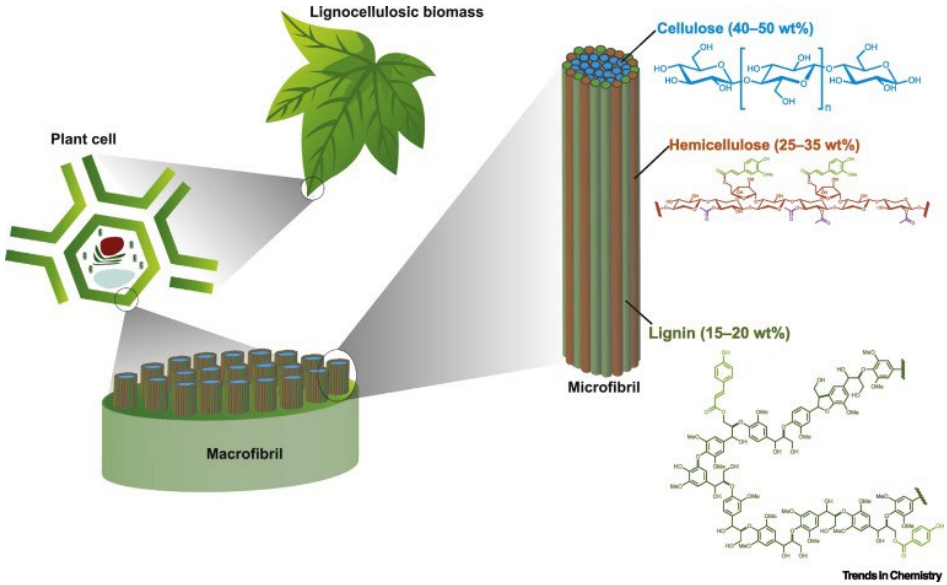
https://www.fortunebusinessinsights.com/pulp-and-paper-market-103447

Technical principle:

- Pulp mainly comes from plant fibers
- It consists of both cellulose fibers and lignin fibers
- The material properties of paper products are primarily derived from the structure and quality of the fibers.
- Our latest research has discovered: :
  - The CNW series of products can interface and bind to cellulose fibers.
  - This enables paper products to achieve a significant increase in stiffness and strength by over 3X
  - CNW enhanced products maintain high physical performance even in the presence of water.
  - The CNW series of products possess self-adhesive and self-repairing properties.
  - The application of CNW products is simple, requiring only proportional mixing (2-10%) to the pulp

Note: Due to the high compatibility between CNW and cellulose, it is more suitable for paper products with a higher cellulose content.

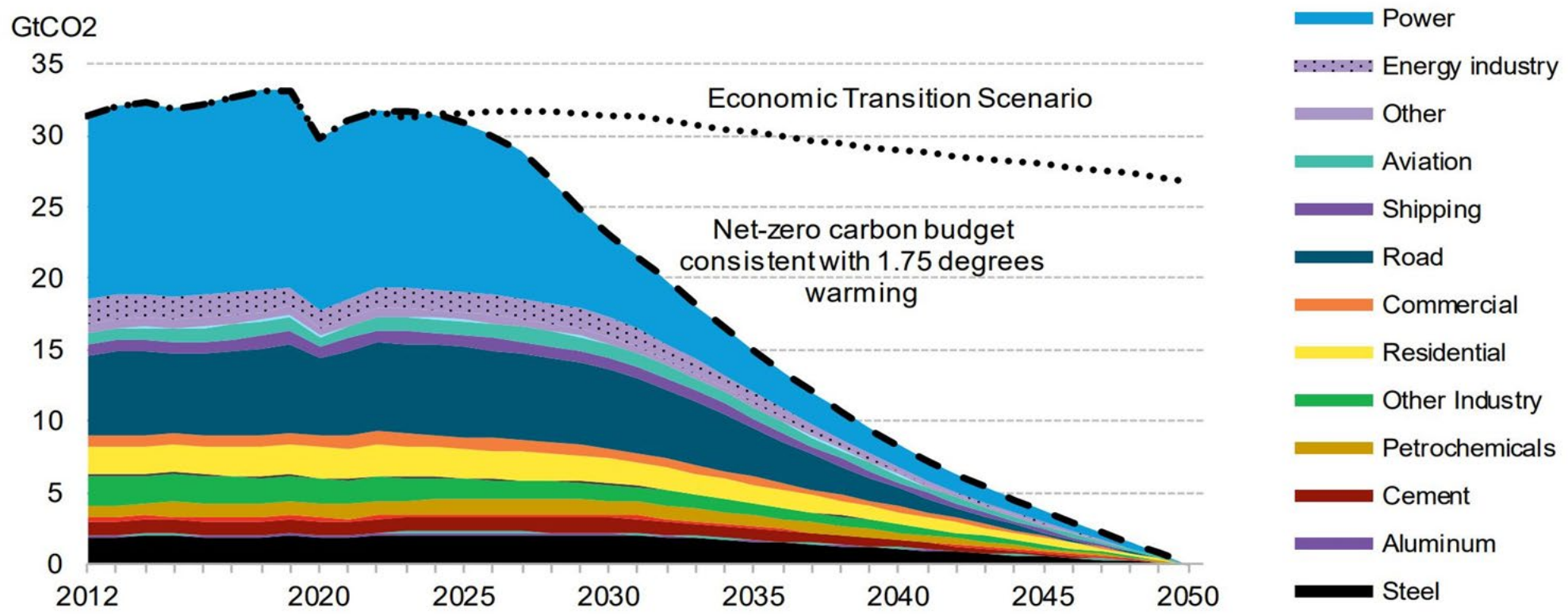




https://www.cell.com/trends/chemistry/fulltext/S2589-5974%2820%2930055-1
https://ecoworldonline.com/viscose-fabric-the-textile-made-from-cellulose/

Market Trend Recap: Net Zero Carbon Goal

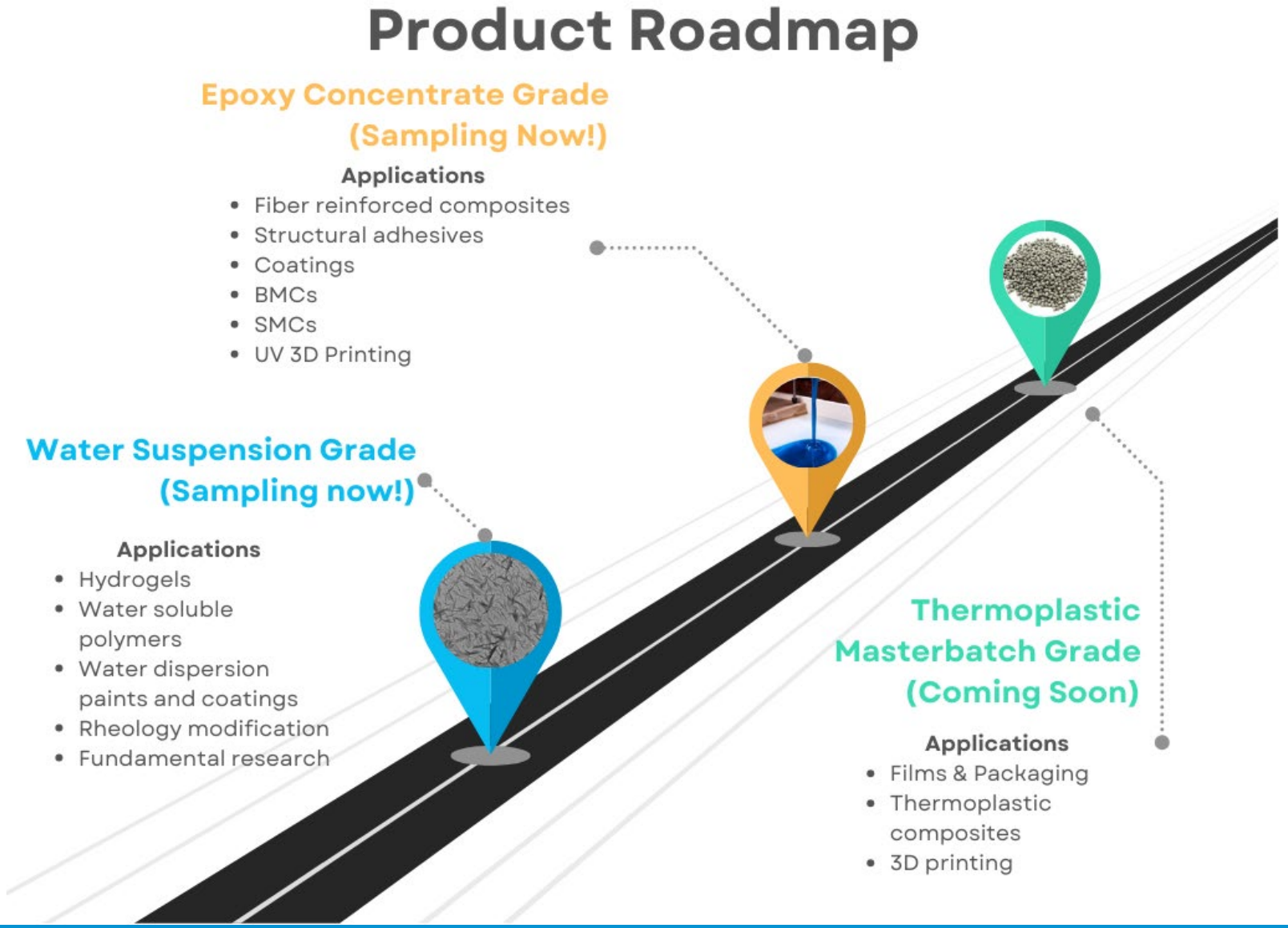
Energy emissions and net zero carbon budget, by sector



Source: BloombergNEF

8 out of 13 major sector can use CNW to help reach their strict net zero carbon goals by 2050

Product Roadmap



IP Strategy

2-tier layered IP strategy

A single set of core layer patents further protected by multiple derivative product layer patents

Increase protection for the core, while allowing strategic flexibility for products

Core layer:

CNW Nanocrystal synthesis & process technologies have been filed as patent in the US

- Patent Application Serial No. 63/395,915 filed on August 8, 2022 entitled METHODS FOR PROCESSING CHITIN

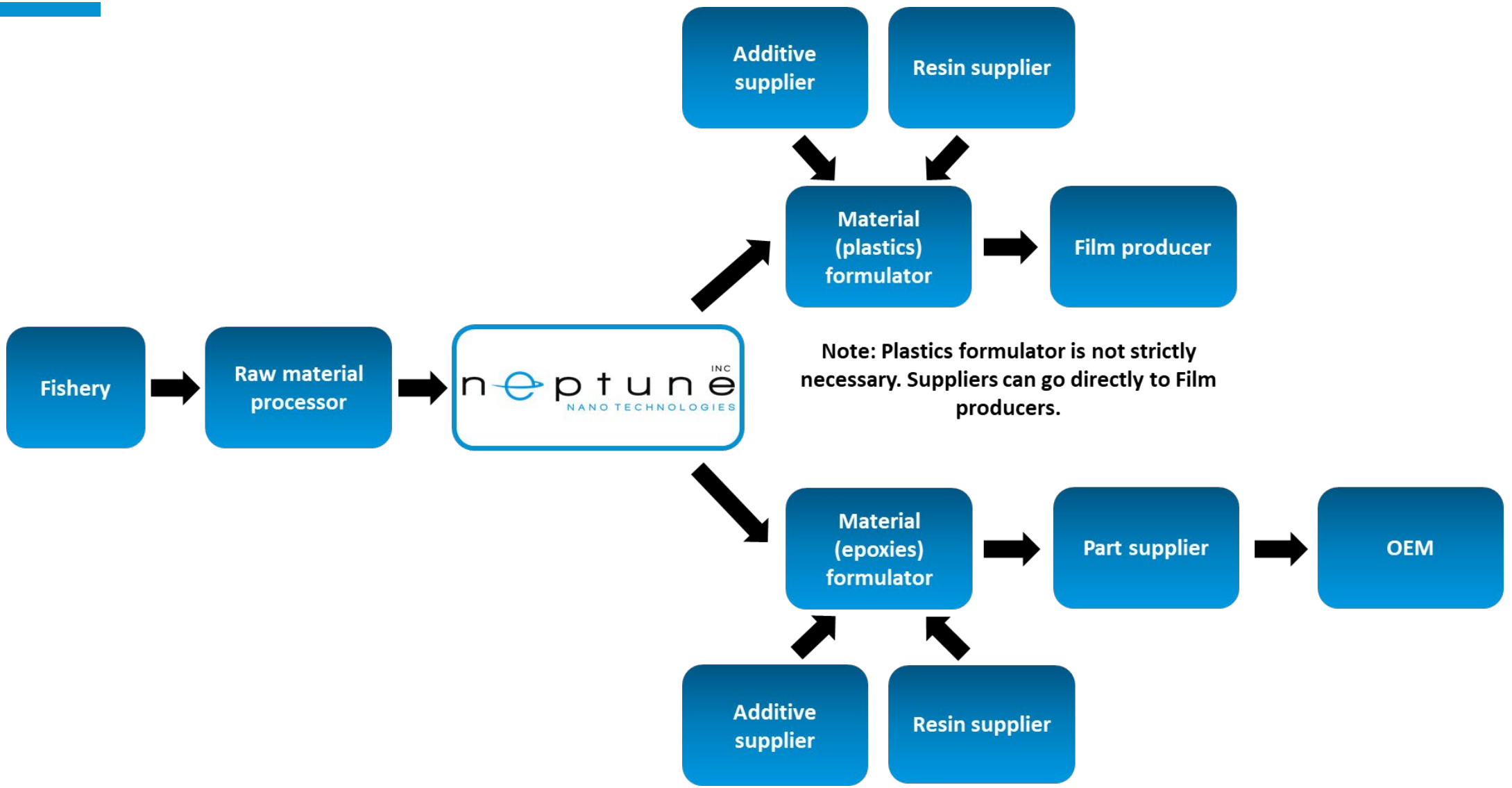
Product layer:

Product and material composition patents are in the pipeline:

- CNW Nanocrystal nanocomposite masterbatch for film applications
- CNW Nanocrystal nanocomposite concentrates for epoxy applications

Appendices

Supply Chain Map



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