

# Composites and Sustainability: What is the State of the Art

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PATTON ENGINEERING AND CONSULTING

A Subsidiary of Red Rooster Ltd.

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# Sustainability – What Is It and what Isn't it?



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**Sustainability is NOT:**

**Just the ability to recycle  
some components at end  
of useful life**

**OR**

**Continuing the use of  
petroleum in any raw  
material or process for  
composites**

**Sustainability IS:**

**Use of plant-based or  
recycled raw materials and  
precursors**

**AND**

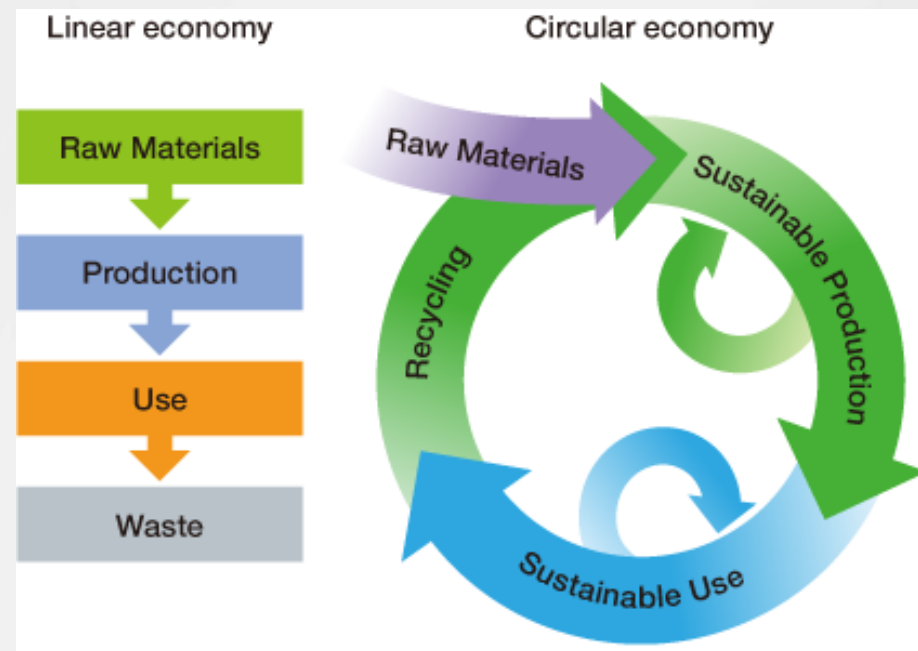
**Use of renewable energy  
sources for all composites  
processing**

# Linear Versus Circular Economy



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- Current State of the Art is Linear
  - 1) Petroleum Precursors
  - 2) Fibers & Resins
  - 3) Composite Part(s)
  - 4) Use until worn out
  - 5) Grind Up and Landfill
- This has to Change to Achieve Sustainability



# Our Biggest Problem



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- **Wind Turbine Blades at end of life**
- **Most are cut up and put in a landfill**
- **Potential for 50 Million Tons of Blades by 2050**



# Some of the Other Problem(s)



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- Aging Aircraft
  - Boeing 787 and Airbus A350
  - More than 2000 will need to be recycled / reused in next 20 years
- Automotive Sector
  - Percentage of Composites in new cars only going up
  - In 20-30 years these newer cars will end up in junk yards
- Sporting Goods
  - Tennis rackets, golf clubs, helmets, paddleboards, canoes,...



# Where Are We Today?



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- Beginning to reclaim some carbon fiber
  - Usually chopped up into smaller bits and resin pyrolyzed
- Also starting to reclaim some parts of wind turbine blades
- Thermoplastics usually cut up and reprocessed



# The Future



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- New Resins
  - Plant-based precursors (biomass sugars)
  - Reformulated to be easily dissolved by special catalysts
- Carbon fibers from plant fiber
  - Flax, corn stalks, wood cellulose waste
- New Precursors for Carbon Fiber
  - Plant-based acrylonitrile
  - Lignin waste from paper processing
  - Nanocellulose fibrils



# Project ELIOT (Europe)



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TECHNOLOGY READINESS LEVEL	CURRENT STATE OF EOL METHOD FOR CONVENTIONAL COMPOSITES	ELIOT EOL METHODS FOR BIOCOMPOSITES
9	INCINERATION      LANDFILL	<b>SOLUTIONS READY FOR PROTOTYPE DEVELOPMENT</b>
8	PYROLYSIS (CF)      MECHANICAL RECYCLING (GF)	
7	PYROLYSIS (GF)      MECHANICAL RECYCLING (CF)	
6		
5		BEST METHOD BIOCOMPOSITE A      BEST METHOD BIOCOMPOSITE B
4	FLUIDISED BED PYROLYSIS      SOLVOLYSIS	METHOD RANKED 1 <sup>ST</sup> METHOD RANKED 2 <sup>ND</sup> METHOD RANKED 3 <sup>RD</sup>
3	MICROWAVE-ASSITED PYROLYSIS	3 SELECTED EOL METHODS
2		12 EOL METHODS EVALUATED
1		ANY EOL METHOD FOR BIOCOMPOSITES

PROJECT PROGRESS
AFTER PROJECT

M. 30  
M. 24  
M. 18  
M. 12  
M. 0

**ELIOT**

**“End of Life for Biomaterials”**

**Roughly Translated (from Spanish) ELIOT is focused on end of life for Biocomposites**



# Conclusions



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- We have a lot of work to do
- Engineers are going to be the key to solving the sustainability challenge
- The good news – the composites industry is engaged and working on these challenges now
- Europe is a little ahead of us but we are catching up
- If you are in the industry – get involved. Together we can make this happen.



**European Composites  
Industry Association**

# Thanks for Listening



PATTON ENGINEERING  
& CONSULTING

[www.nedpatton.com](http://www.nedpatton.com)

[ned@nedpatton.com](mailto:ned@nedpatton.com)

