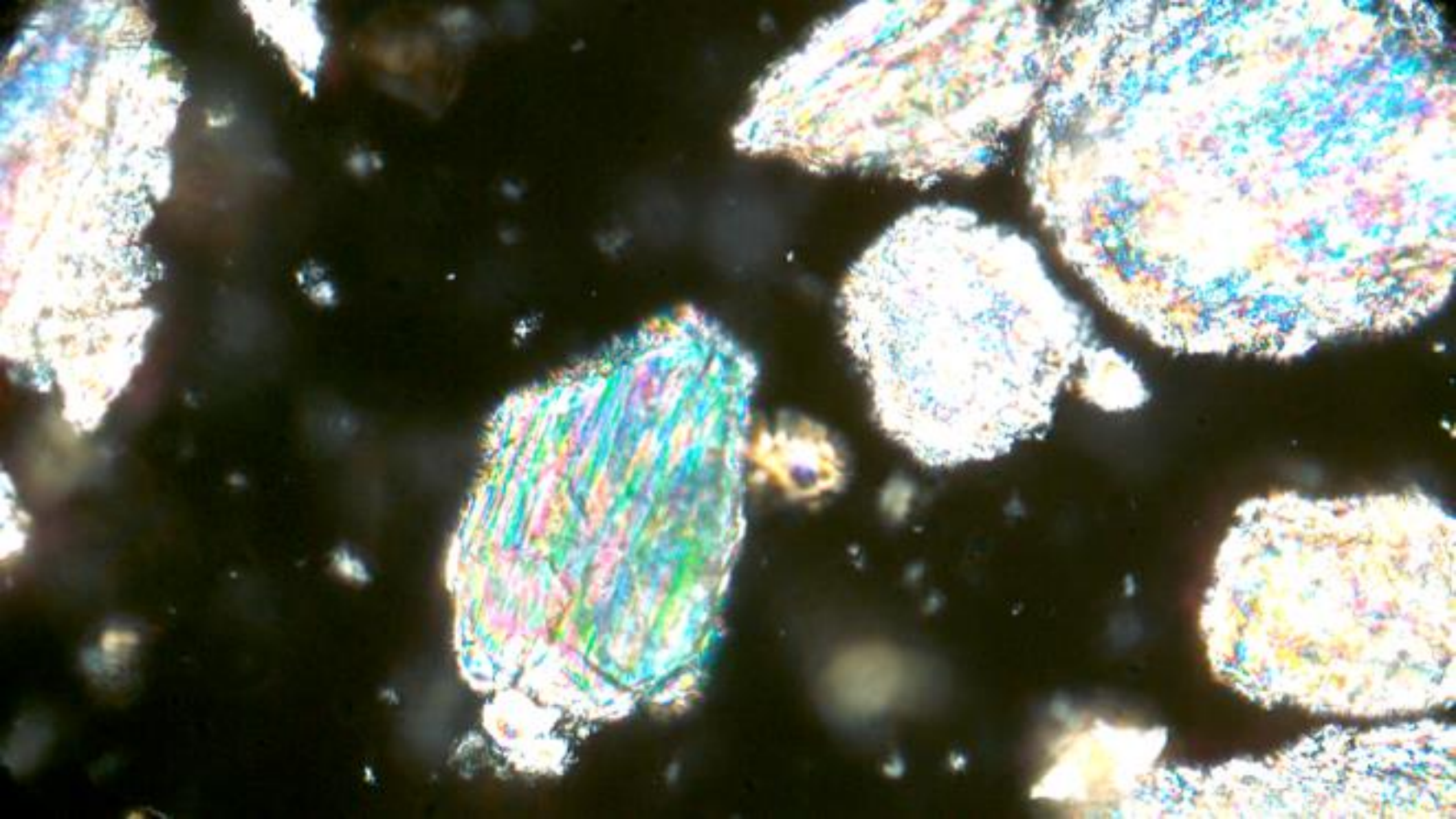
Cellulosic Nanomaterials in Yreka

Cellulosic Nanomaterials

- Head of a pin is one million nanometers wide, cellulosic nanocrystals are 6 nanometers wide
- As strong as steel, only 1/5th the weight
- Typically made from pulp, but can be made from wood chips
- Packaging, automotive components, paper and paperboard, cement, polymer composites, medical applications, defense applications, electronics, aircraft components and more



Project Overview

- Develop preliminary engineering for processes to produce cellulose nanomaterials from wood chip residuals from forest thinning
- Target production of high value products with unique applications
- Processes considered emerging technologies
- Target production rate of 50 dry metric tons per day (semi-commercial scale)

Class 5 Studies (2018)

- Purpose: Review potential processes to develop high level estimates and select processes for further investigation
- Team of Harris Group, Forest Service Forest Products Laboratory, and U.S. Endowment with a process developer for each potential process (total of 5)
- Pilot studies of each process conducted using wood chips from Yreka, CA to demonstrate feasibility
- Each process reviewed for technical and economic feasibility, two selected for further investigation

2020 Activities In Progress

- Develop Class 4 estimate for production of cellulose nanofibrils using process developed by University of Maine and Valmet
- Revise Class 5 estimate for production of cellulose nanocrystals using process developed by Blue Goose Biorefineries

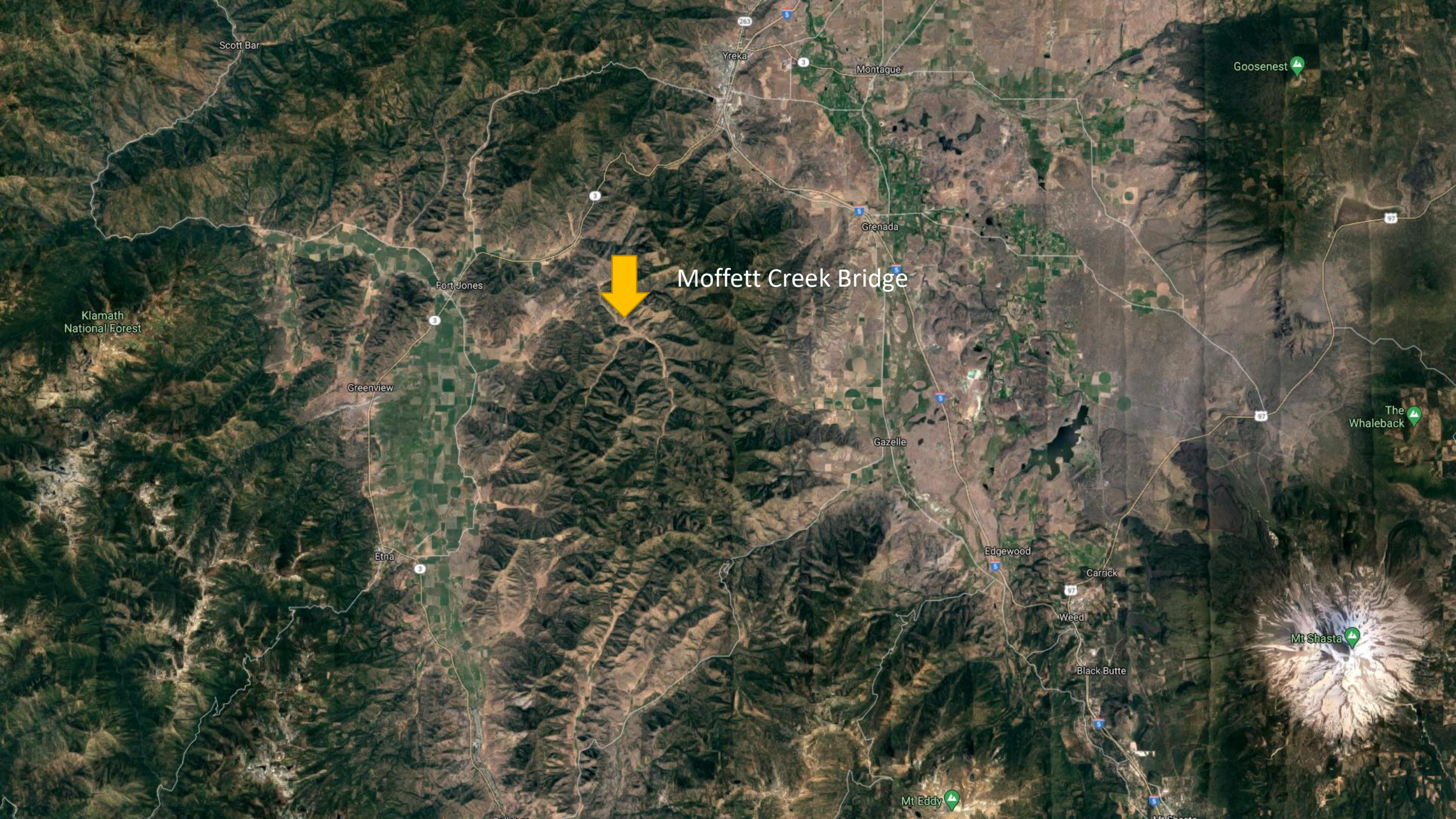
UMaine CNF Product

End Use Testing

- Structural Insulated Panels
- Food Coatings
- Polylactic Acid Reinforcement
- Other Polymers
- Concrete

Concrete and CNC

- CNC increases hydration of cement element of concrete mix
- Increased hydration increases strength by approximately 20%
- Can capture the additional strength gain, or reduce cement in the mix by 20%
- Cement accounts for most of the GHG emissions from concrete which as an industry emits 8% of worldwide additions


Moffett Creek Bridge
Scott Bar
Yreka
Montague
Goosenest
Grenada
Fort Jones
Klamath
National Forest
Greenview
Gazelle
The
Whaleback
Etna
Edgewood
Carrick
Weed
Mt Shasta
Black Butte
Mt Eddy


Scarface Rd
Scarface Rd
Scarface Rd
Moffett Creek Rd
Moffett Creek Rd
Scarface Rd
Scarface Rd
Google

Volumes, Concrete, Acres

- 5 Tons of concrete needs about 9 pounds of CNC
- CNC yield from raw wood 12 percent
- 13 bone dry tons of wood per acre
- 3120 pounds of CNC per acre treated
- 1733 tons of concrete per acre
- 21,000 cubic yards of concrete per mile of interstate
- 41,000 tons of concrete per mile of interstate (density assumed is 145 lb/ft^3)
- 23.65 acres treated per mile

CNC Concrete Strategy

- Addressing transportation infrastructure CO2 emissions using CNC as an additive for concrete
- Transportation departments are receptive as reducing emissions is a challenge
- Need to demonstrate performance
  - Yreka bridge
  - Curb, gutter and pavement tests
- If we can show performance and CO2 reduction, there is a pathway for California to adopt the technology