

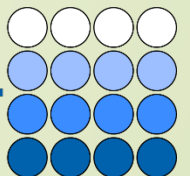


# Capital and Energy Efficient Emissions Control for Wood Drying Adsorption using Bead Activated Carbon in a Fluidized Bed Concentrator (FBC)

Kim Tutin, Hal Cowles, John Berger, Jim Starek  
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**Environmental C&C, Inc.**  
Solvent Recovery & VOC Abatement Systems



# Emissions Control Solutions & Terpenes

## - Activated Carbon in a Fluidized Bed Concentrator (FBC)

**Problem:** Current standard emissions control equipment, the Regenerative Thermal Oxidizer (RTO), incinerates the Volatile Organic Compounds (VOCs), is very expensive to operate & creates greenhouse gases.

- ▶ Expensive to operate
- ▶ Uses large amounts of energy (natural gas and electricity) to oxidize the VOCs.
- ▶ Creates greenhouse gas emissions

**Solution:** The alternative emission control equipment, the Fluidized Bed Concentrator (FBC), adsorbs valuable VOCs and is less expensive to operate.

- ▶ Proven technology in many commercial applications worldwide today!
- ▶ New Patent Pending technology for wood drying application
- ▶ Rather than oxidizing the VOCs, activated carbon efficiently adsorbs them
- ▶ After adsorbing the VOCs, they are desorbed, condensed, collected, & sold

### Benefits:

- ▶ Significantly reduced cost to control emissions
  - ▶ Emissions control equipment uses less energy and less maintenance than industry standard.
  - ▶ Emissions control equipment reduces greenhouse gases vs. industry standard RTO.
- ▶ Revenue generation via sales of valuable terpenes
  - ▶ Multiple potential sales outlets for recovered organics: Fragrances, Solvents, etc.



# Technology:

- Fluidized Bed Concentrator (FBC) with
- Bead Activated Carbon

## Technology Status of FBC:

- **Technology already commercialized and successfully used in many industries**
  - **Examples: Automotive, Electronics, etc.**
  - 62 Commercial Installations
    - 45 Systems Recover Organics (Solvents)
- Operational Reliability and **Safety**:
  - No dynamic (or mechanical) seals eliminates seal wear and replacement cost.
    - Fans are the only moving parts.
  - Rugged stainless-steel construction minimizes corrosion-related repairs.
- Patents Pending for Wood Drying application:
  - METHODS AND SYSTEMS FOR RECOVERING TERPENE COMPOSITIONS FROM WOOD DRYING EXHAUST
  - METHODS AND SYSTEMS FOR CONTROLLING EMISSIONS FROM WOOD DRYING PROCESSES

## Commercial FBC System



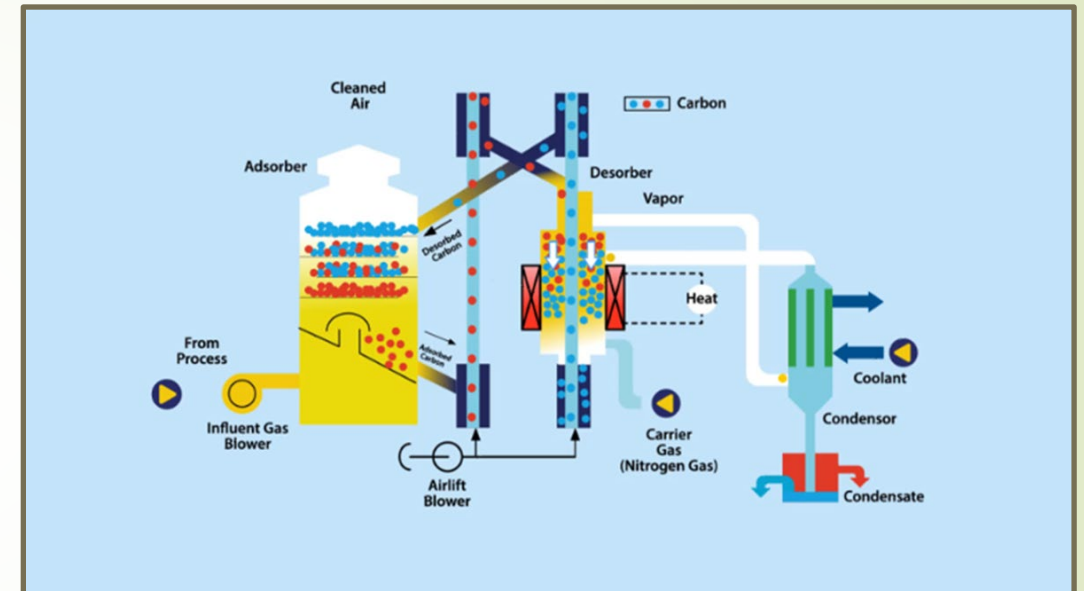
# Award for Environmental Excellence

## HONDA

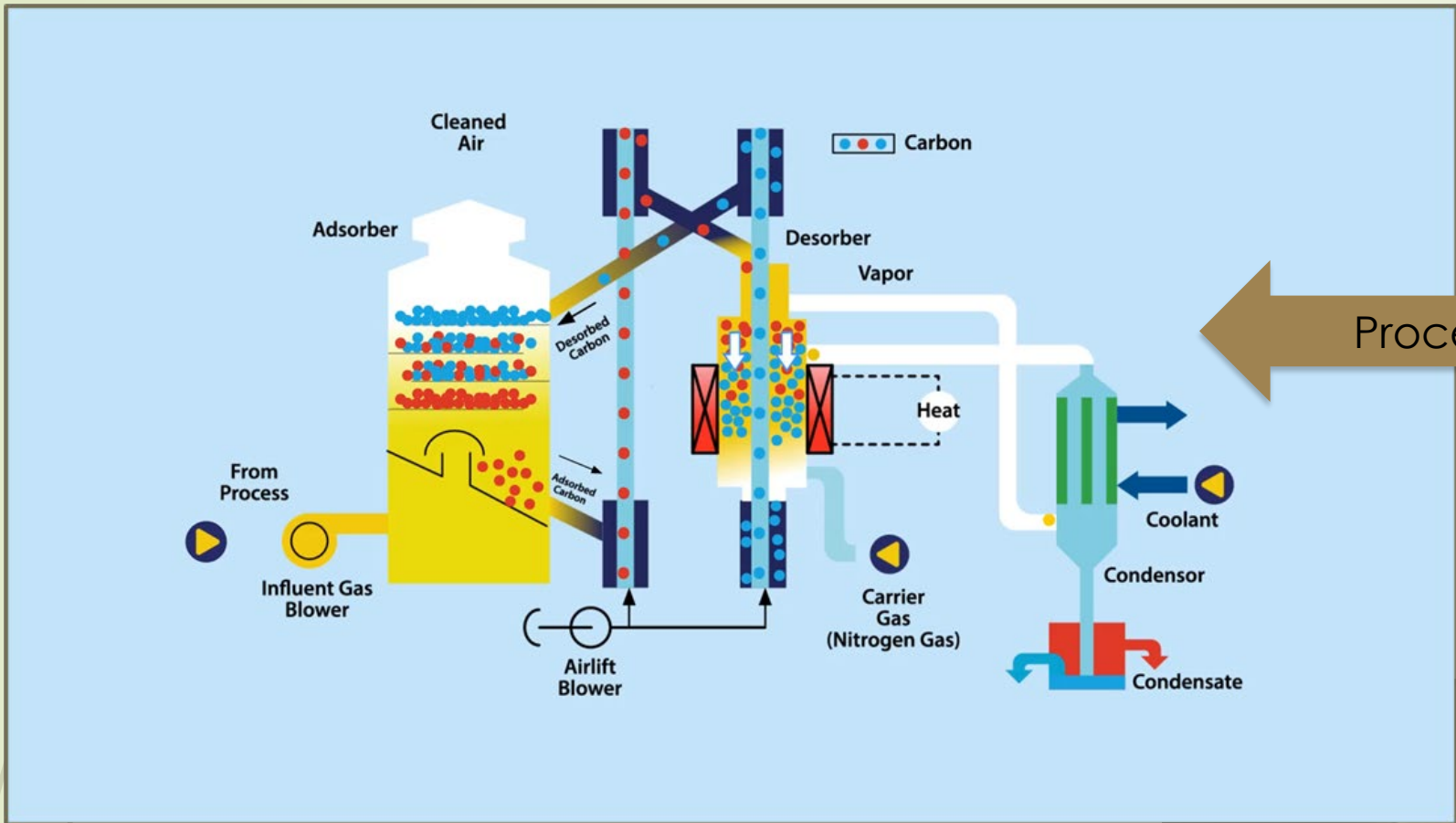
Honda Manufacturing of Alabama

Honda Motors of Alabama (HMA)  
honored as  
Air Conservationist of the Year

## Fluidized Bed Carbon (FBC) Adsorption system



- HMA has been awarded the Alabama Wildlife Federation 2014 Governor's Conservation Achievement Award as Air Conservationist of the Year.
- This award was presented to HMA in recognition of the company's efforts to significantly reduce emissions.
- In 2012, HMA expanded Line 2 production operations to increase overall annual vehicle output by more than 10%. One result of this expansion was a potential increase in Volatile Organic Compound (VOC) coating emissions from our paint shop operations.
- To offset these emissions, a new **fluidized-bed carbon adsorption (FBC) system** was installed to capture and destroy VOCs from certain painting processes.

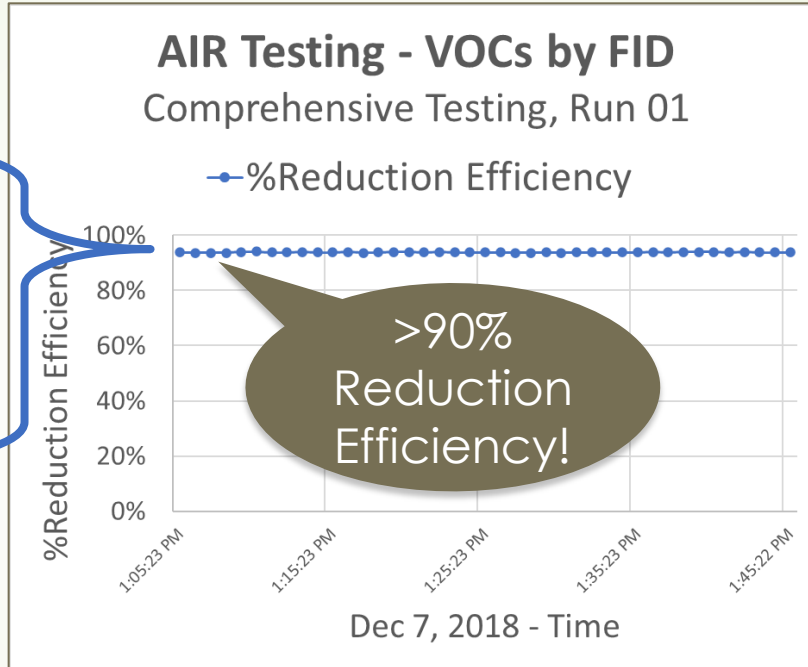
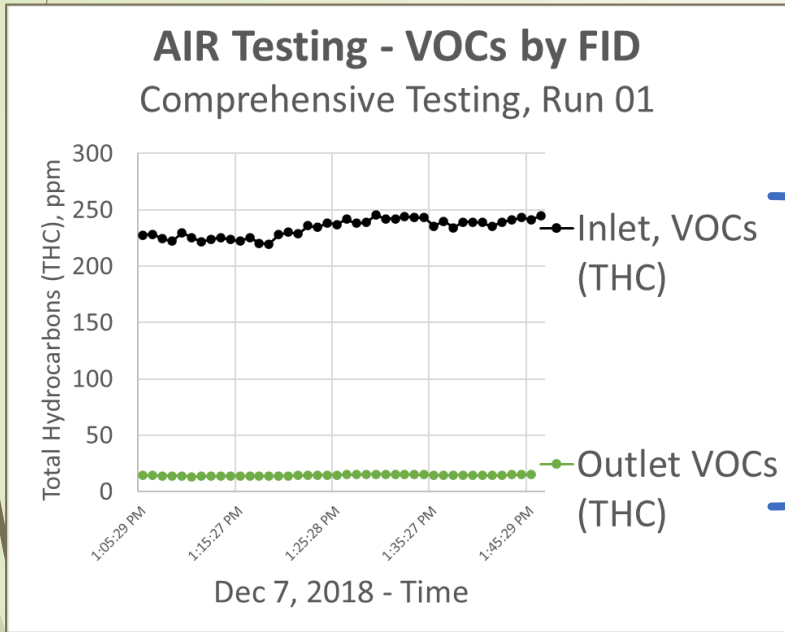


Process Overview

Activated Carbon Beads Fluidized in Trays Adsorbing Emissions



# Stack Testing Results: December 7, 2018 Pilot Emissions Test Results: $\geq 90\%$ VOC Reduction



## PCWP MACT Standard:

- FBC met the  $>90\%$  Reduction Efficiency requirement

## Air emissions control compliance was demonstrated by:

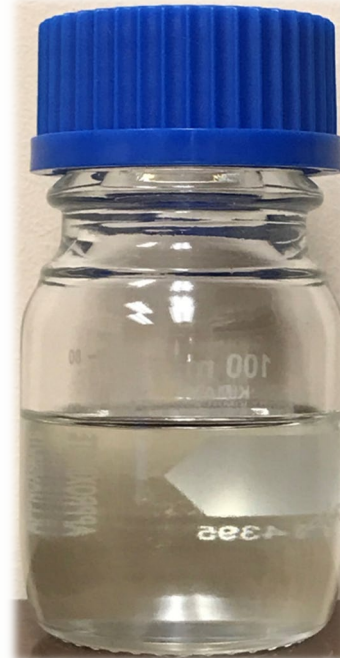
- Two independent certified air stack testing companies during
- Two separate testing events



<https://www.johnzinkhamworthy.com/testing-modeling/>

<https://airtest1.com/>

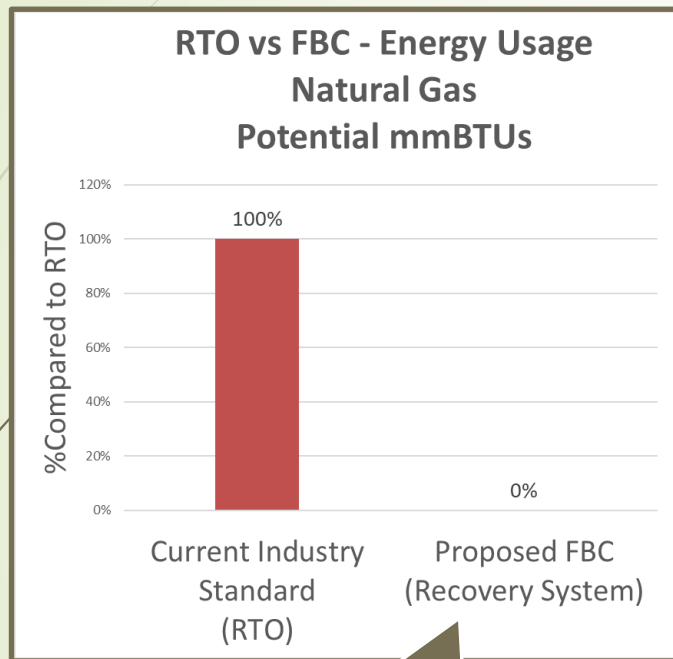
# Terpenes: New Product Development - Collected from Drying Wood (Pine Trees)



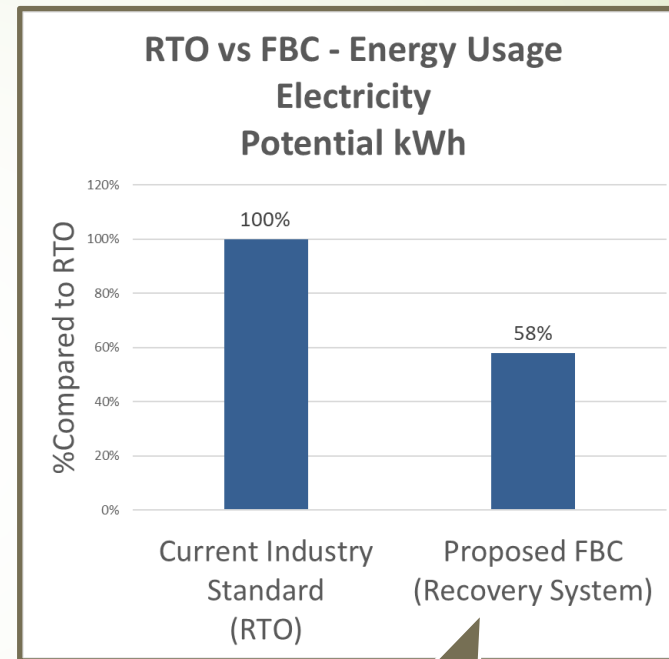
- Terpene hydrocarbons, primarily Alpha and Beta Pinenes.
- Responsibly-recovered, biobased materials.
- Potential uses:
  - Fragrances, solvents, adjuvants, cleaners, fuels, & polymers

# RTO vs FBC: ESTIMATES - Operational Comparisons

## - Reduced Energy Usage drives Savings



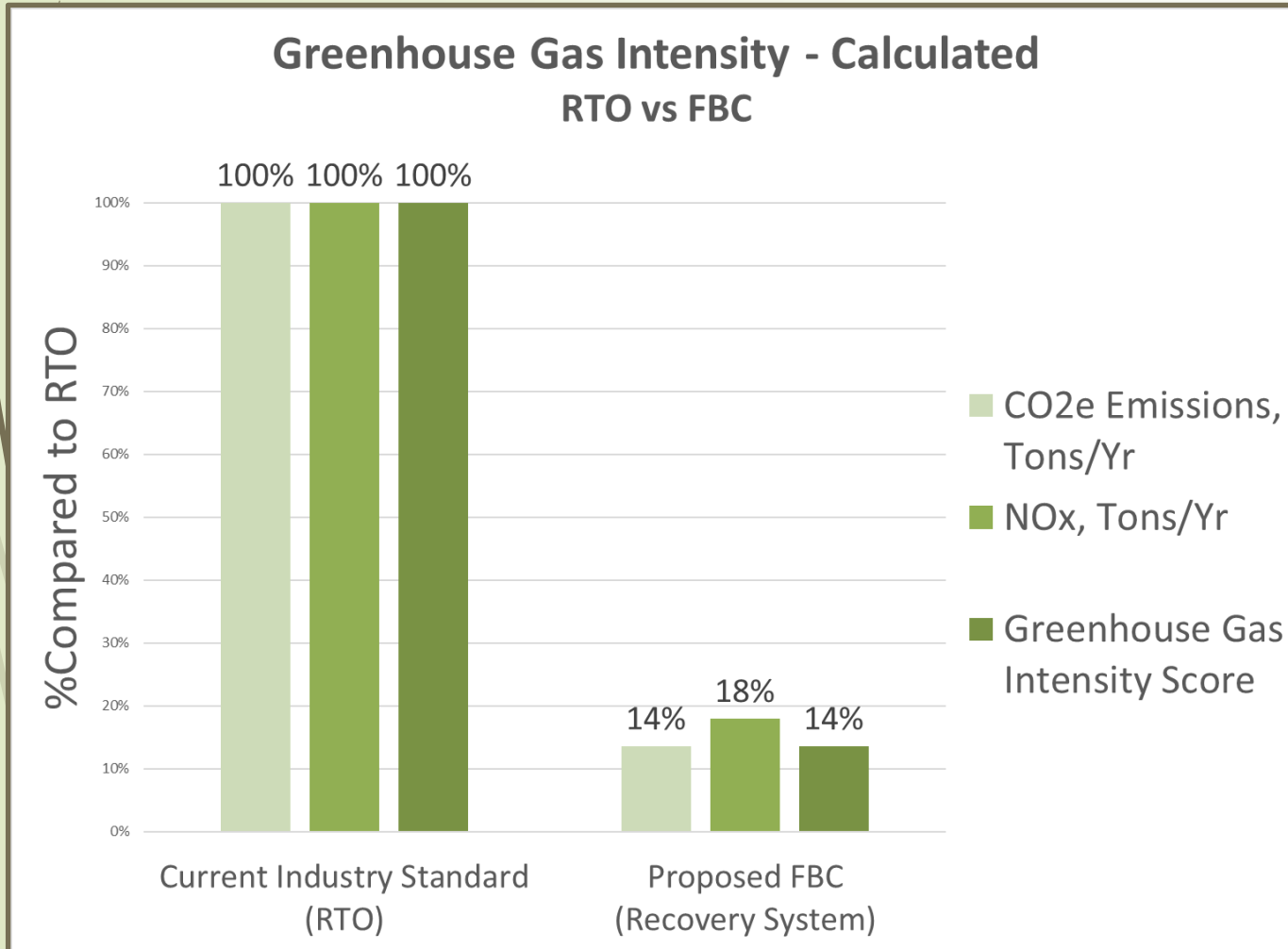
Estimated Reduced Natural Gas Usage



Estimated Reduced Electricity Used



# Green House Gas (GHG) Emissions Reduction - Carbon Intensity Score, Pilot 2018

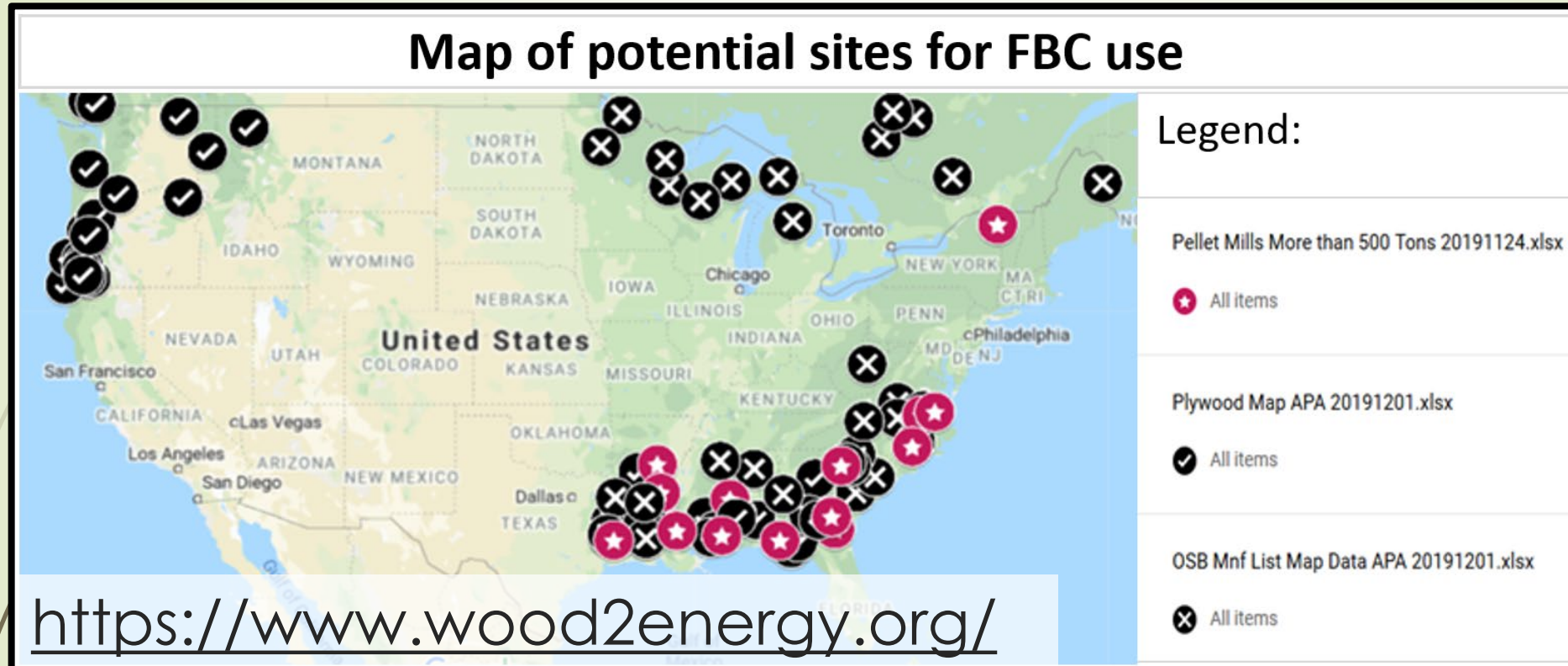


## GHG Intensity Calculations:

- Scope 1:
  - CO2 Emissions generated by
    - Incineration of VOCs
    - Combustion of natural gas and
- Scope 2:
  - CO2 Emissions generated by electricity production and usage
- Total Emissions are normalized to dryer production in Oven Dry Tons (ODT)

# Potential to Reduce Emissions at Multiple Sites

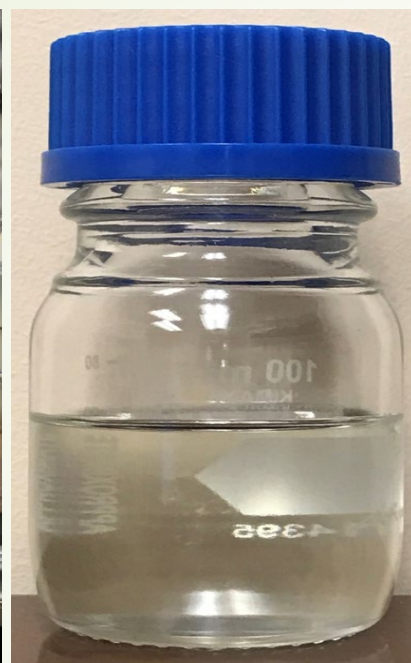
## - Wood Drying Sites in the United States



- Wood Composites: Wood Pellets, Oriented Strand Board (OSB), Plywood, etc.
- Multiple potential sites to:
  - Reduce Emissions
  - Capture Terpenes for Sale or Reuse rather than Oxidizing / Incinerating them as happens today.

# Technology Status – Pilot Final Results

## - Happy Days at commercial OSB mill!



- ✓ Achieved >90% Emissions Reduction!
- ✓ Collected Terpenes!
- ✓ Operational Reliability and Safety
- ✓ Next step full size commercial system



# Team:



- **Team Leader/Principle Investigator - Kim Tutin:** Founder & CEO Captis Aire LLC has >20 years experience in R&D and commercialization at Georgia-Pacific and > 5 years experience commercializing, developing, and operating the FBC for use in wood drying applications. University of MN. Bachelor's degree in Chemistry. MBA in Technology & Engineering Management.
- **Technical Lead - Hal Cowles:** Owner, Founder, & Engineer at Environmental C&C (EC&C) Inc. has been commercializing, researching, & developing the FBC technology in numerous applications for >20 years. EC&C, under Hal's leadership, has already completed 63 installations. Siena College, Loudonville, NY BS Pre-med Biology & Chemistry. Advanced Analytical Chemistry & Electrical Engineering
- **Business Lead - John Berger:** VP Sales, Marketing, and Engineer at EC&C has > 10 years experience in the Regenerative Thermal Oxidizer (RTO) industry and subsequently > 10 years experience in business and engineering support of FBC in numerous applications. Missouri Science & Technology. BS Mechanical Engineering Manufacturing and Energy Conservation. Purdue, Indiana. MS of Industrial Operations, Engineering & Business.
- **Operations Lead - Jim Starek:** Regional Manager, Project Manager, Controls Design Engineer & Senior Service Technician in Environmental Air Pollution Industry. > 20 years experience in controls, instrumentation, and electrical. University of Maryland. Air Force.

# Contact Information:

Kim Tutin

Founder and CEO

kim@captisaire.com

404-580-2795

1612 W. Cleveland Ave, Suite 001

East Point, GA 30344



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