Spring 2022 Yale Forest Forum (YFF) Webinar Series

The Future of Forest Products in a Changing Climate: Bioenergy from Forests
YFF Webinar on BioEnergy from Forests (BEF)

1. Introductions
2. Webinar Basics
3. Guest Speakers
4. BEF Overview
   • Life cycle overview, process map
   • Types of conversion technologies
   • BEF and energy consumption
   • Issues of contention for BEF
Introductions

• Welcome
• Host Organizations:
  • Yale Carbon Containment Lab
  • Yale Center for Industrial Ecology
  • The Forests Dialogue
• Series Objective: to provide a broad and engaged global audience with the latest information from key experts on the opportunities and challenges of BEF
• Series Facilitators
Series Facilitators

**Mark Ashton**
Professor of Silviculture and Forest Ecology, and the Director of the Yale Forests, The Forest School at the Yale School of the Environment

**Anastasia O’Rourke**
Managing Director at the Carbon Containment Lab, Yale School of the Environment

**Reid Lifset**
Research Scholar, Resident Fellow in Industrial Ecology, and Editor-in-Chief of the Journal of Industrial Ecology, Yale School of the Environment

**Gary Dunning**
Executive Director of the The Forests Dialogue (TFD), The Forest School at the Yale School of the Environment
Webinar Basics

- 2nd YFF Series on Forest Products in a Changing Climate
- Will meet every Tuesday from January 25 to April 19
  - From 11:30 – 12:15 US ET
- Format: After brief introduction, guest speakers present for 25-30 minutes leaving about 10 minutes for Q&A with the audience
- Webinars are open to all via registration
- All Webinars will be recorded and made accessible
- More information can be found on YFF Website including:
  - Speaker bio, talk title and abstract, associated readings
  - Plus, after the presentation, slides and talk recording
- All talks will be summarized and compiled in the next edition of the *YFF Review* publication focused on “BioEnergy from Forests”
Webinar Themes and Speakers

Week 2 Theme: Biomass and Land Use
**Alice Favero**
School of Public Policy, Georgia Tech

Week 3 Theme: The Industrial Ecology of BEF
**Annie Levasseur**
École de technologie supérieure, ÉTS

Week 4 Theme: Conservation and ‘right sizing’ BEF
**Steve Hamburg**
Environmental Defense Fund

Week 5 Theme: Key Environmental Challenges of BEF
**William Moomaw**
The Fletcher School - Tufts

Week 6 Theme: BEF Opportunities for the Forest Products Industry
**Kim Cesafsky DuBose**
Enviva Inc.

Week 7 Theme: Energy Industry’s Interest in BEF
**Richard Peberdy**
Drax Biomass Inc.

Week 8 Theme: The Future of BEF

Week 9 Theme: Investment in BEF
**Daniel Sanchez**
University of California-Berkeley

Week 10 Theme: Wildfire and BEF
**Matt Donegan**
Oregon Wildfire Response Council

Week 11 Theme: Community Concerns with BEF
**Treva Gear**
Concerned Citizens of Cook County

Week 12 Theme: US and Global Policy Matters Related to BEF
**Ann Bartuska**
Resources for the Future
Wood Bioenergy System Overview

Forests

Lumber/Paper Production

Fuel Production

Conversion

Carbon Capture & Storage

Exhaust gas

Electricity
Heat
Fuel
Chemicals

Energy Use

Heating
Transport
Industry
Grid
Wood Bioenergy System Overview: CO₂

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Avoided emissions through replacing fossil fuels

Energy Use
- Grid
- Industry
- Transport
- Heating

Wood Bioenergy System Overview: CO₂

Forests → Roundwood/Forest residues → Fuel Production

Lumber/Paper Production

Conversion

Electricity Heat Fuel Chemicals

Exhaust gas → CO₂ → Carbon Capture & Storage

Avoided emissions through replacing fossil fuels

Energy Use
- Grid
- Industry
- Transport
- Heating
Wood Bioenergy System: Environmental impacts

1. Forest
   - Water quality
   - Habitat loss/biodiversity
   - Soil impacts
   - Landscape change
   + Fire risk reduction
   + Forest restoration

2. Transport
   - Air emissions

3. Lumber & Paper Production
   - Water quality
   - Air emissions

4. Fuel Production
   - Air emissions

5. Conversion
   - Air emissions
   - Noise
   - Hazardous & nonhazardous wastes

6. Energy Use
   - Air emissions

7. Carbon Capture & Storage
   - Energy Use

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Wood Bioenergy System: Social & Economic Impacts

1. **Forest**
   - Visual aesthetics
   - Cultural, historical & archeological sites
   - Recreation/land use change
   - Income to landowners
   - Jobs
   - Tax revenues
   - Prevention of forest conversion

2. **Transport**
   - Health impacts
   - Environmental justice
   - Traffic
   - Safety
   - Jobs

3. **Lumber & Paper Production**
   - Health impacts
   - Environmental justice
   - Safety
   - Income to facility owners
   - Jobs
   - Tax revenues

4. **Fuel Production**
   - Health impacts
   - Environmental justice
   - Safety
   - Income to facility owners
   - Jobs
   - Tax revenues

5. **Conversion**
   - Health impacts
   - Environmental justice
   - Safety

6. **Energy Use**
   - Health impacts
   - Energy security
   - Reduced energy price volatility

7. **Carbon Capture & Storage**
   - Health impacts
   - Environmental justice
   - Safety

**Image credits:**
Wood Bioenergy System: Diving deeper

1. Sources
   - Bioenergy from Forests

2. Roundwood/Forest residues
   - Lumber/Paper Production

3. Production residues
   - Fuel Production

4. Wood fuel
   - Conversion

5. Exhaust gas
   - Carbon Capture & Storage

Energy Use
- Grid
- Heating
- Industry
- Transport

Energy Carriers
- Electricity
- Heat
- Fuel
- Chemicals

Conversion
- Combustion
- Gasification
- Pyrolysis

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Biomass Energy Sources

Source: IEA 2016, 2022

Municipal solid waste
Refuse derived fuel
Solid recovered fuel
Scrap tires
Wood wastes
Sewage sludge
Grass and hedge cuttings

Harvesting residues
Primary processing residues
- bark, sawdust, offcuts, wood pellets
Secondary processing residues
- Sawdust
- Offcuts

Wood & poplar crops
- Switch grass
- Reed carry grass
- Miscanthus
- Algae

Harvesting residues
- Straw
- Cornstalk
Animal wastes
- Poultry litter
- Tallow
- Meat & bone meal

Processing residues
- Rice husks
- Sugarcane bagasse
- Olive, palm oil, sunflower husks
- Fruit residues
- Cereal residues

Landfill gas
Composters

Types of biomass
wood
garbage
crops
landfill gas
agricultural residues
Bioenergy Conversion Pathways

Main conversion routes for biomass to secondary energy carriers.

Different systems combine different technologies and generate a range of energy and non-energy products.

Adapted from: Global Energy Assessment: Chapter 11: Renewables 2012, and UNDP, 2000
Bioenergy’s share of global total energy consumption

Source: REN21, 2021: https://www.ren21.net/gsr-2021/chapters/chapter_03/chapter_03/
Energy consumption by source in the U.S.

U.S. coal and renewable energy consumption by source (1950-2019)
quadrillion British thermal units

12% of energy consumed in the US was renewable in 2020

Source: EIA 2020
2.7% of total energy consumed in US in 2020

Source: EIA 2020
61% of bioenergy from wood and waste is consumed by industrial sector

Source: EIA 2020


Bioenergy as a “negative emissions” technology?

Source: Yan, J in Nature Climate Change 2018
https://www.nature.com/articles/s41558-018-0215-9/figures/1

a, Global CO₂ emission pathways from the scenario literature. b, Examples of technologies. Reproduced from ref.¹. INDC; Intended Nationally Determined Contributions.
BioEnergy from Forests – Issues of contention

“Currently the most fiercely debated forest issue in North America and Europe”

- Pellets shipped to Europe
- Forest certification
- Access to Federal Lands
- Climate mitigation and clean energy
- Carbon accounting
- Market for biomass
- Siting of facilities
- Environmental justice
Questions?

Thank you!

Contact us:

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**Adam Colette**
Dogwood Alliance