Oakland UNIVERSITY

Clean Energy Research Center

within the School of Engineering and Computer Science

& the OU INC

Jim Leidel
Director of Clean Energy Systems

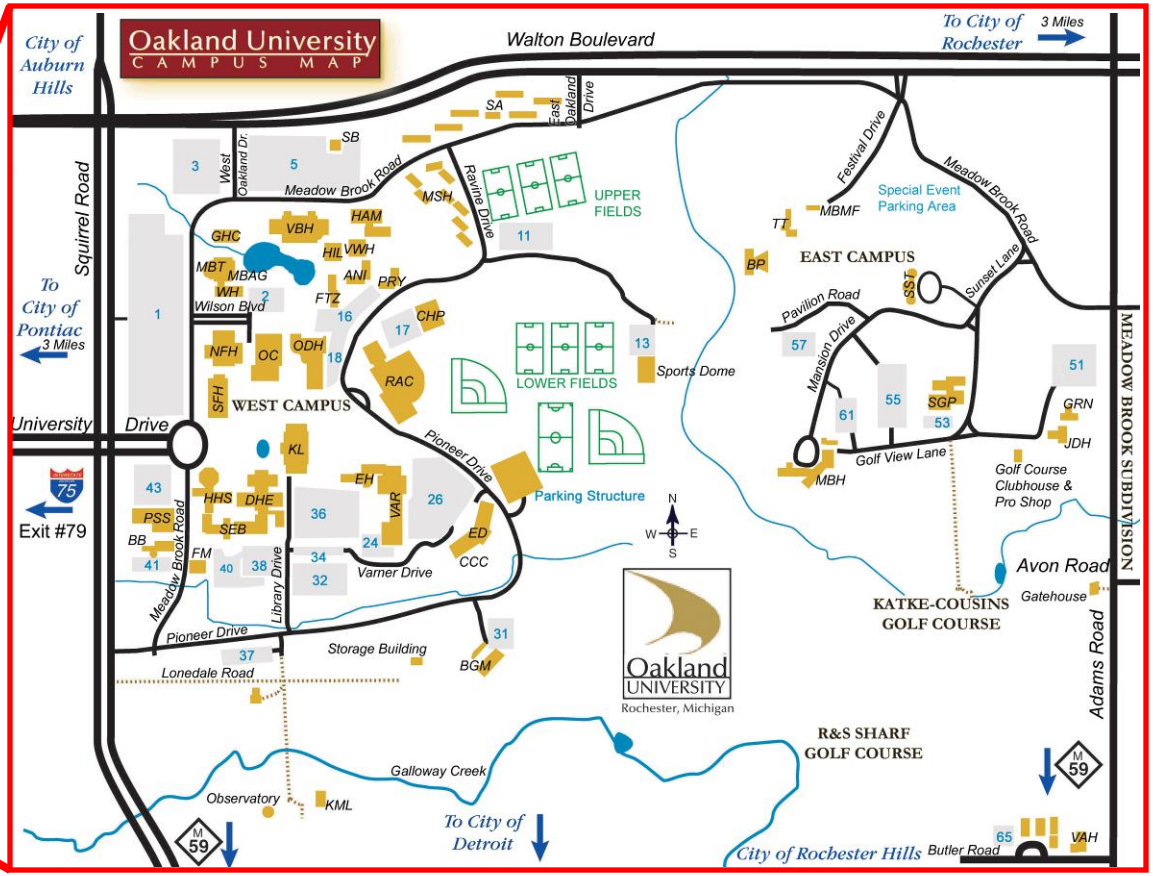
OU INC / CERC

within the School of Engineering and Computer Science

- Brief introduction to Oakland University
- OU INC
- and the Clean Energy Research Center
- Biomass Resources
- Energy Needs
- Biomass Use & Technology Options

Golden Grizzlies

Located in Southeast Michigan, just north of Detroit in suburban Oakland County



Oakland University
West Campus

Public University

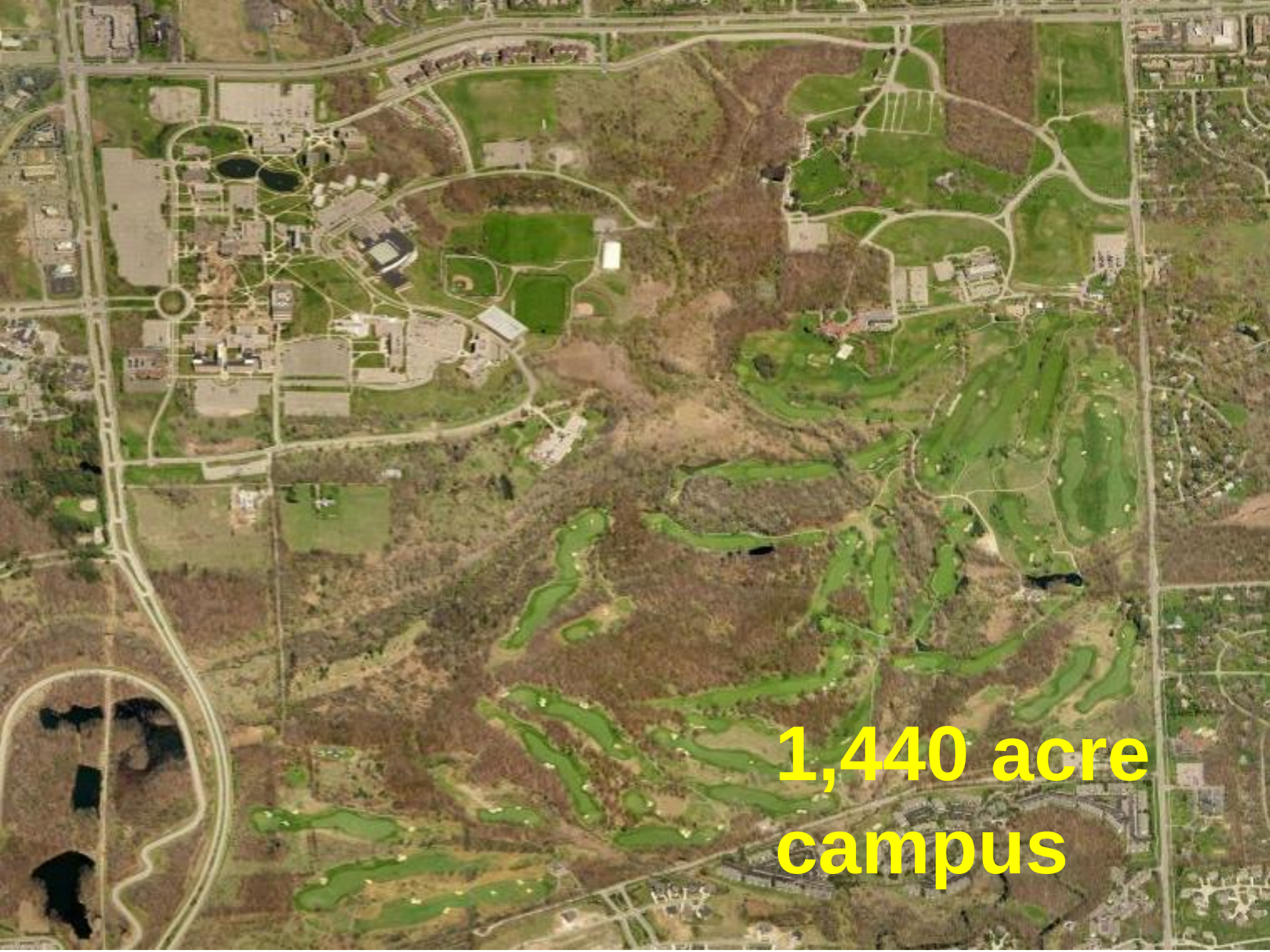
19,000 students

2.5M square feet

132 baccalaureate degree programs

126 graduate degree and certificate programs

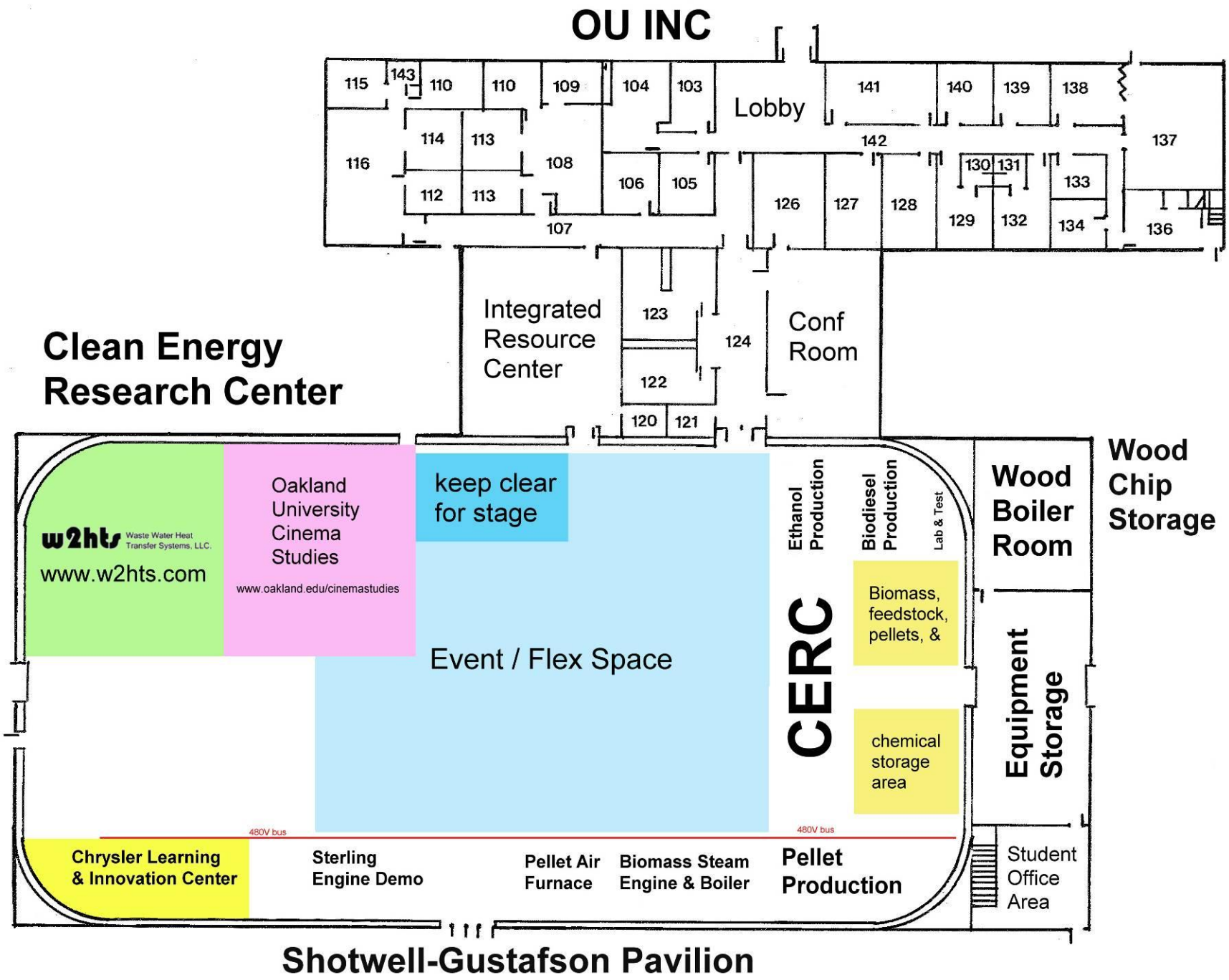
For FY2010 $35M total research expenditures and $18M federal awards


1,440 acre
campus

OU East Campus

Meadowbrook Estate – Meadowbrook Hall, John Dodge House, Shotwell Pavilion (old riding hall), OU INC and the Clean Energy Research Center.

OU's business incubator (OU INC) provides entrepreneurial resources and strategic business solutions while providing a safe environment for innovation.


OU INC
115
143
110
110
109
104
103
Lobby
141
140
139
138
137
114
113
142
116
108
106
105
130
131
133
112
113
126
127
128
129
132
134
136
107
Integrated Resource Center
123
124
Conf Room
122
120
121
Clean Energy Research Center
w2hts
Waste Water Heat Transfer Systems, LLC.
www.w2hts.com
Oakland University Cinema Studies
www.oakland.edu/cinemastudies
keep clear for stage
Event / Flex Space
Ethanol Production
Biodiesel Production
Lab & Test
CERC
Biomass, feedstock, pellets, &
chemical storage area
Wood Boiler Room
Wood Chip Storage
Equipment Storage
480V bus
480V bus
Chrysler Learning & Innovation Center
Sterling Engine Demo
Pellet Air Furnace
Biomass Steam Engine & Boiler
Pellet Production
Student Office Area
Shotwell-Gustafson Pavilion

Biomass Resources

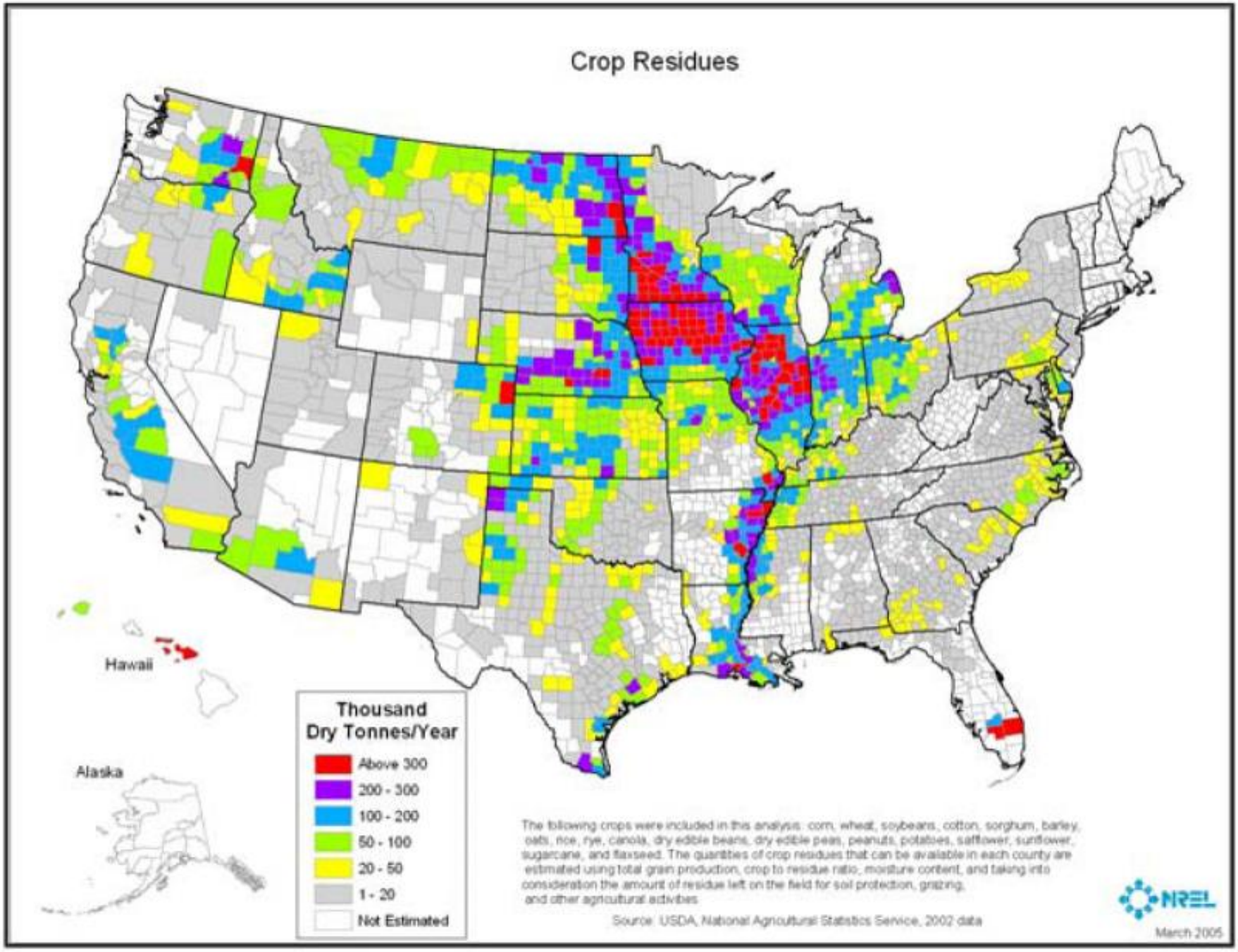
Prospecting
for
Biomass ?

A Geographic Perspective on the Current Biomass Resource Availability in the United States

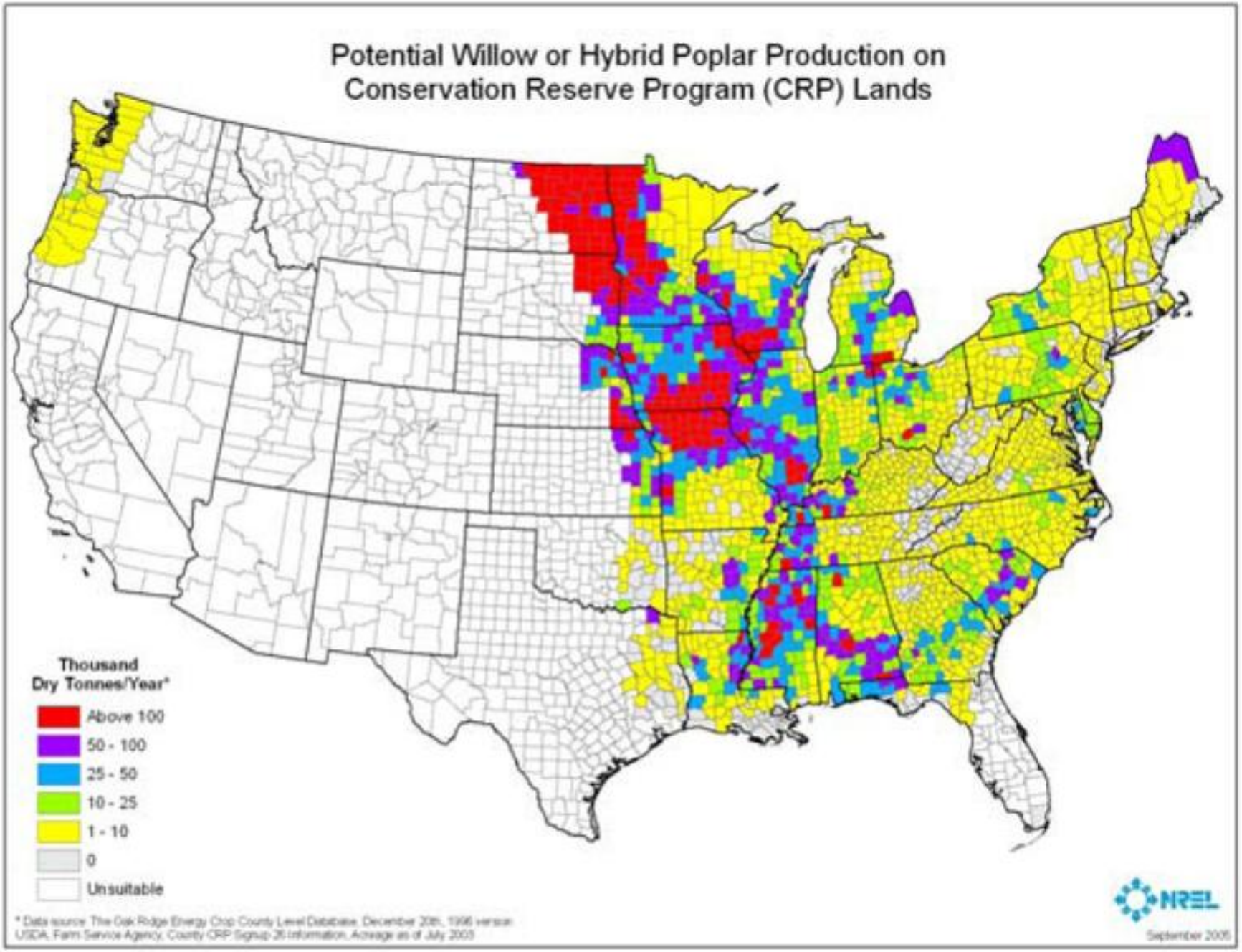
A. Milbrandt

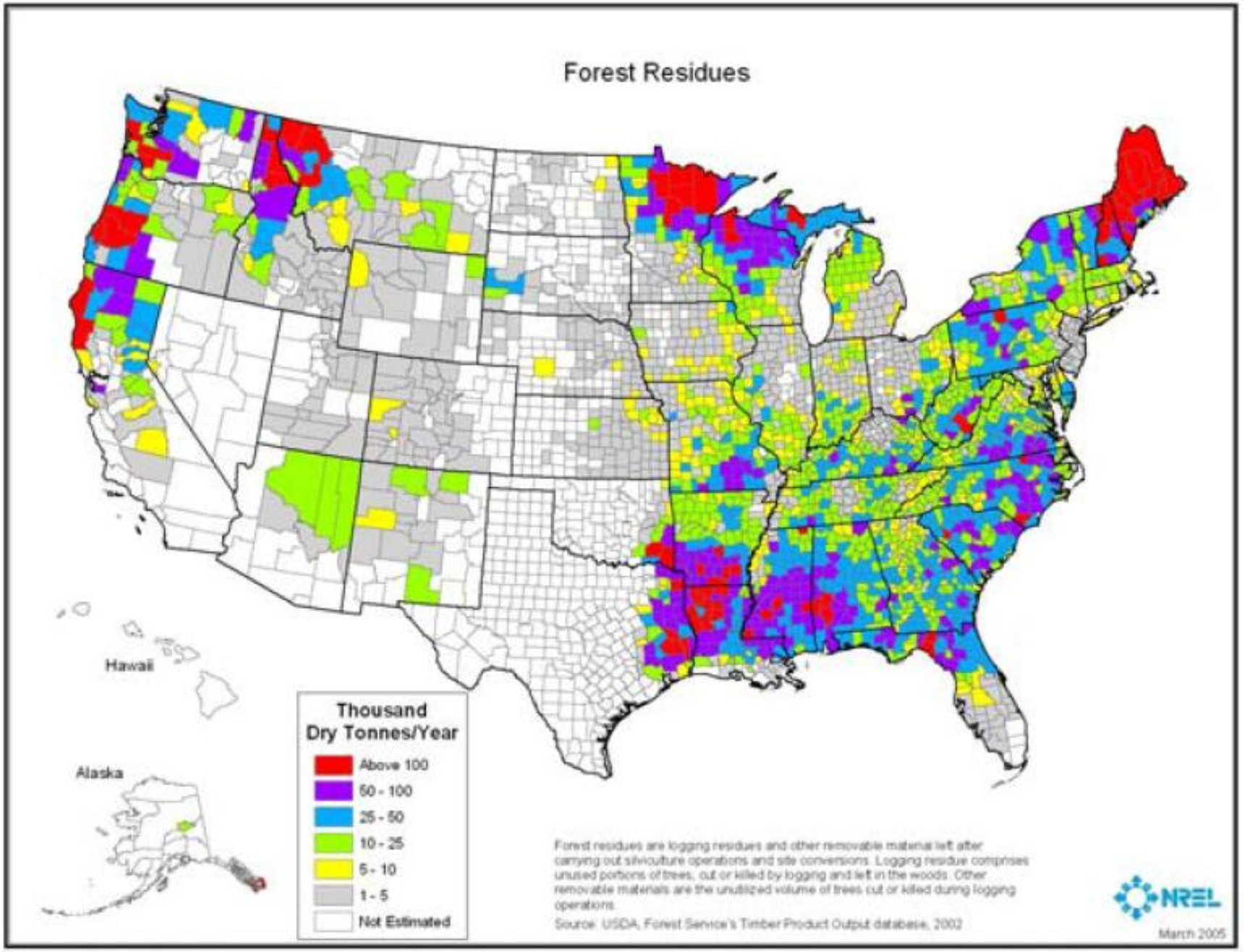
2005

NREL National Renewable Energy Laboratory

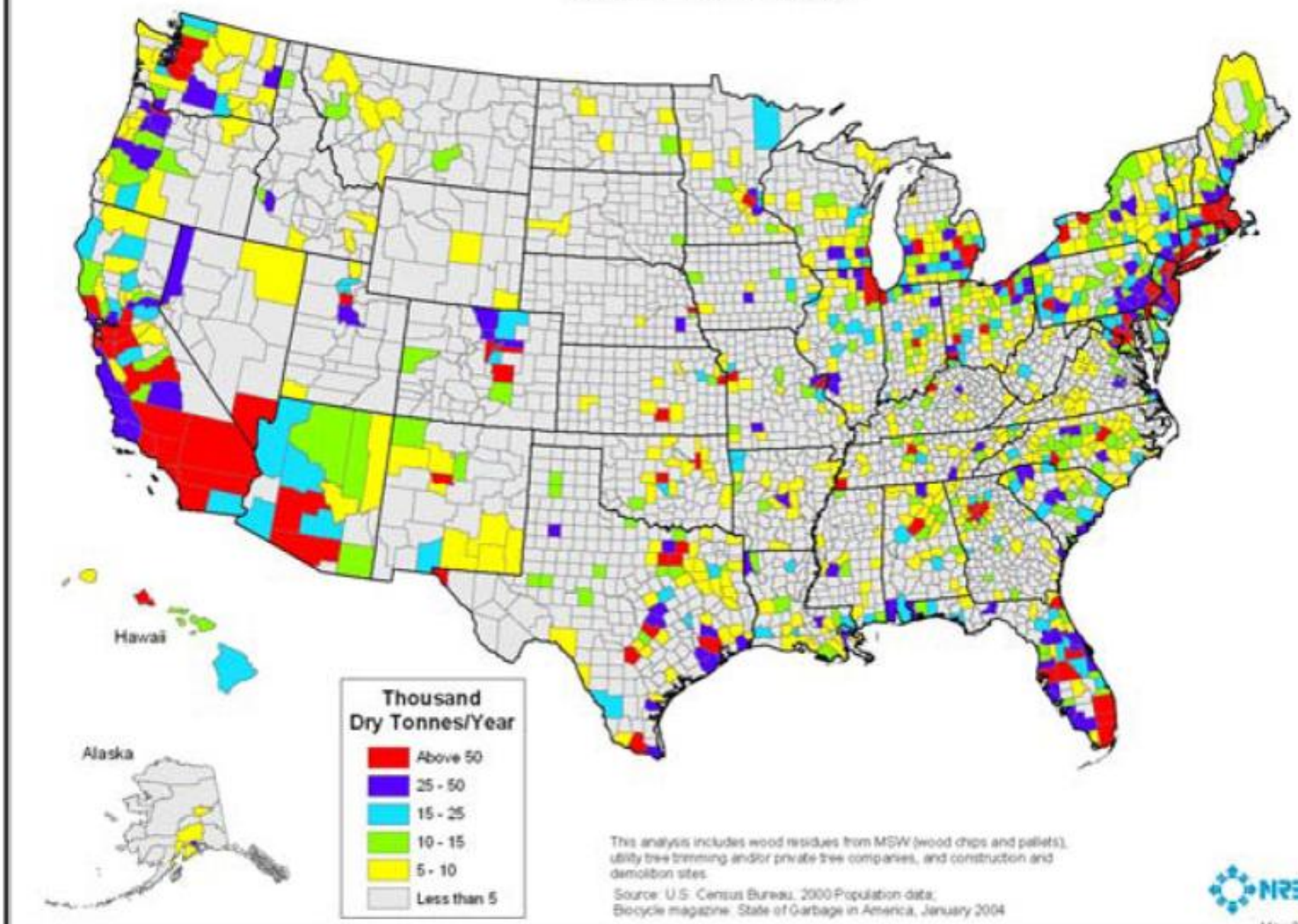

Crop Residues
Hawaii
Alaska
Thousand Dry Tonnes/Year
Above 300
200 - 300
100 - 200
50 - 100
20 - 50
1 - 20
Not Estimated
The following crops were included in this analysis: corn, wheat, soybeans, cotton, sorghum, barley, oats, rice, rye, canola, dry edible beans, dry edible peas, peanuts, potatoes, safflower, sunflower, sugarcane, and flaxseed. The quantities of crop residues that can be available in each county are estimated using total grain production, crop to residue ratio, moisture content, and taking into consideration the amount of residue left on the field for soil protection, grazing, and other agricultural activities.
Source: USDA, National Agricultural Statistics Service, 2002 data
NREL
March 2005

Potential Willow or Hybrid Poplar Production on Conservation Reserve Program (CRP) Lands




Forest Residues
Hawaii
Alaska
Thousand
Dry Tonnes/Year
Above 100
50 - 100
25 - 50
10 - 25
5 - 10
1 - 5
Not Estimated
Forest residues are logging residues and other removable material left after carrying out silviculture operations and site conversions. Logging residue comprises unused portions of trees, cut or killed by logging and left in the woods. Other removable materials are the unutilized volume of trees cut or killed during logging operations.
Source: USDA, Forest Service's Timber Product Output database, 2002
NREL
March 2005

Urban Wood Residues



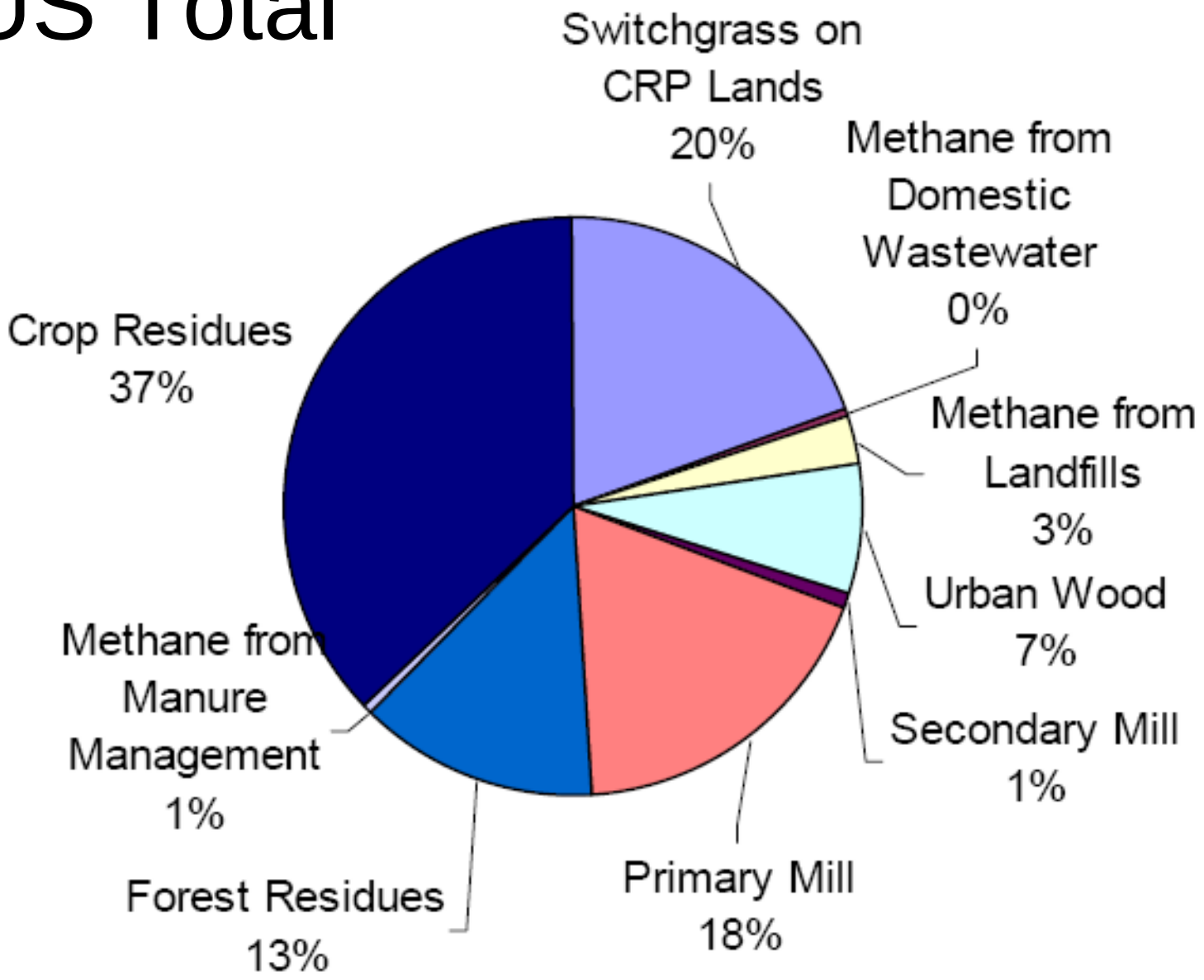
This analysis includes wood residues from MSW (wood chips and pallets), utility tree trimming and/or private tree companies, and construction and demolition sites.

Source: U.S. Census Bureau, 2000 Population data;
Biocycle magazine: State of Garbage in America, January 2004

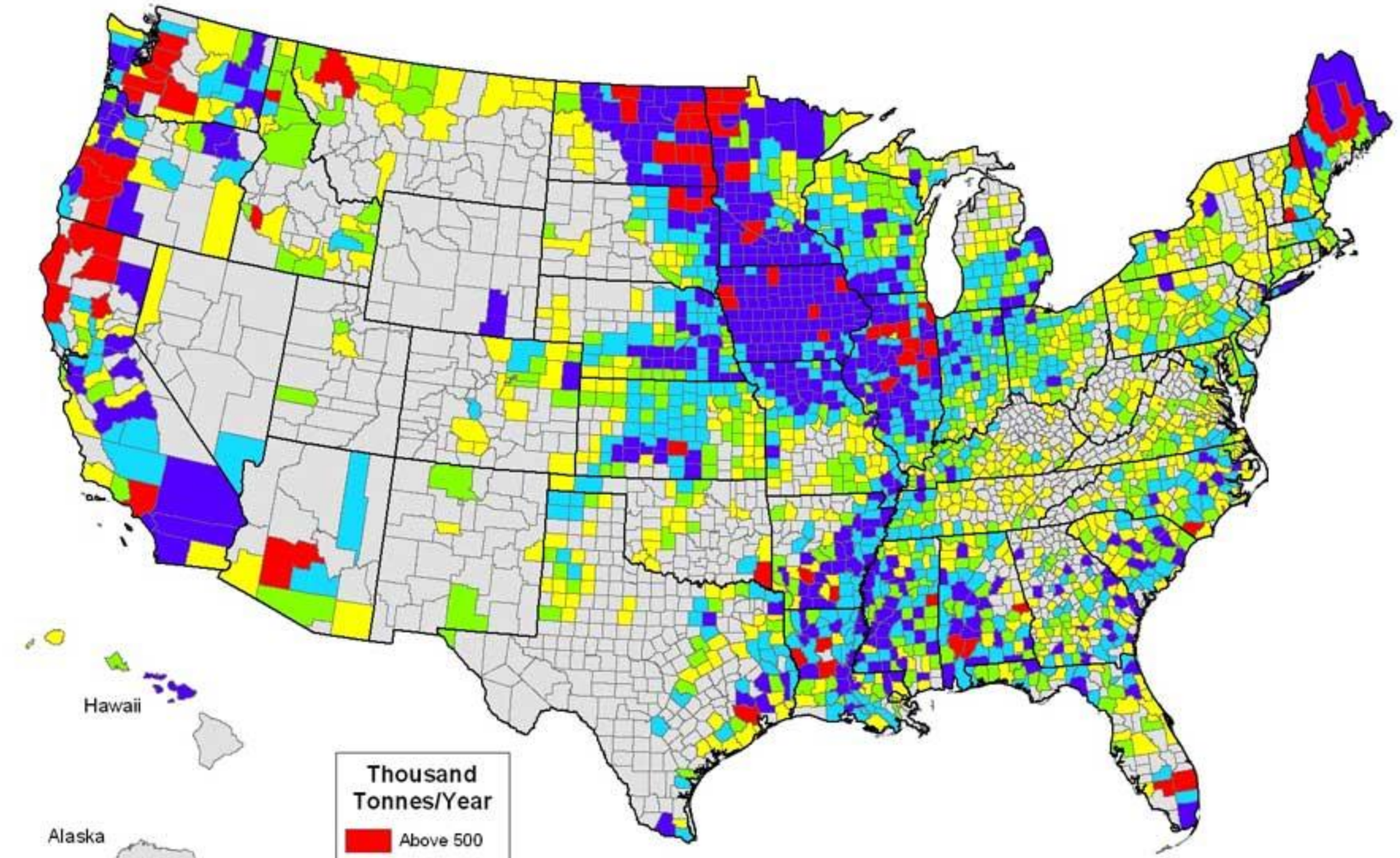
NREL

May 2005

US Total


Switchgrass on CRP Lands 20%
Methane from Domestic Wastewater 0%
Methane from Landfills 3%
Urban Wood 7%
Secondary Mill 1%
Primary Mill 18%
Forest Residues 13%
Methane from Manure Management 1%
Crop Residues 37%

Biomass Resources Available in the United States



This study estimates the technical biomass resources currently available in the United States by county. It includes the following feedstock categories:

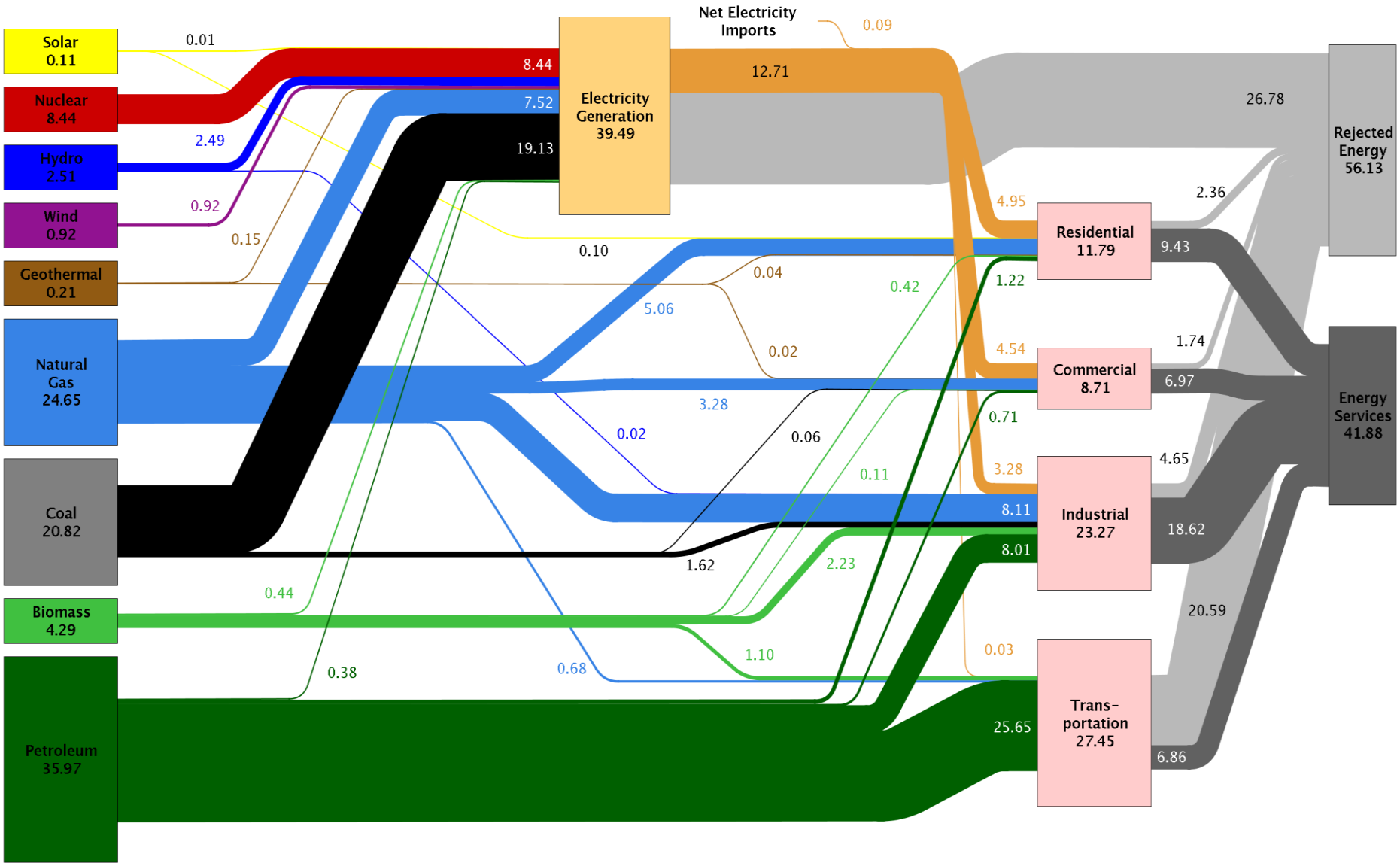
- Agricultural residues (crops and animal manure);
- Wood residues (forest, primary mill, secondary mill, and urban wood);
- Municipal discards (methane emissions from landfills and domestic wastewater treatment);
- Dedicated energy crops (on Conservation Reserve Program and Abandoned Mine Lands).

NREL

September 2005

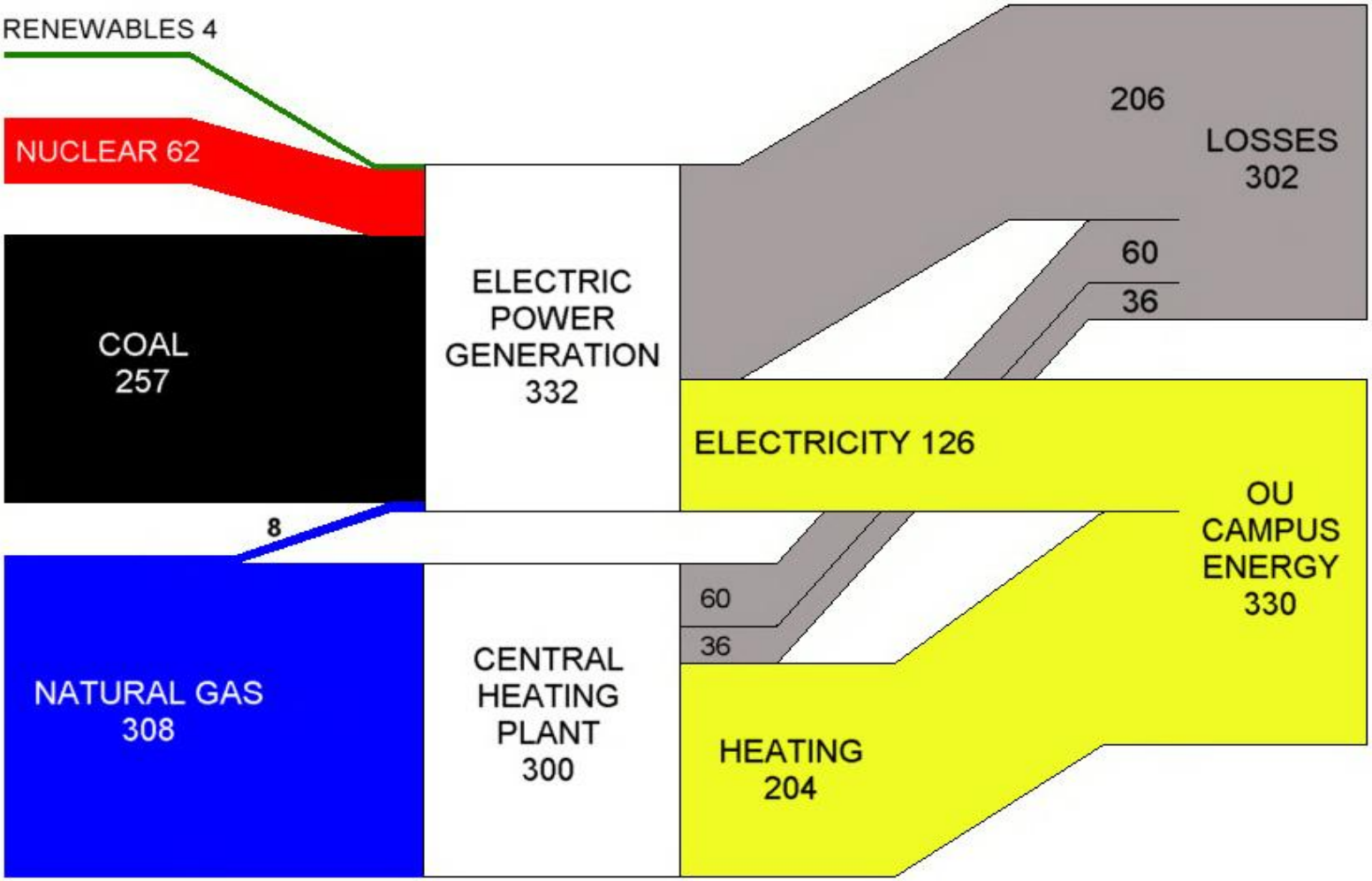
Estimated U.S. Energy Use in 2010: ~98.0 Quads

Lawrence Livermore National Laboratory



OAKLAND UNIVERSITY ENERGY FLOW, 632 billion BTU in FISCAL YEAR 2011 (units = billion BTU / year)

(Fiscal Year is July 2010 - June 2011)

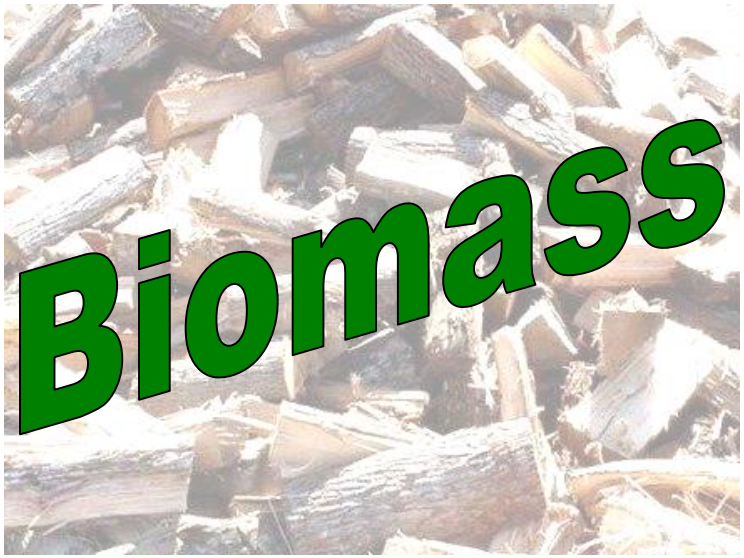


Assumptions:
Electric Power fuel mix is from Detroit Edison assuming 40% power plant efficiency and 5% distribution losses. Oakland University heating calculations are based on 80% boiler efficiency and 15% distribution losses.

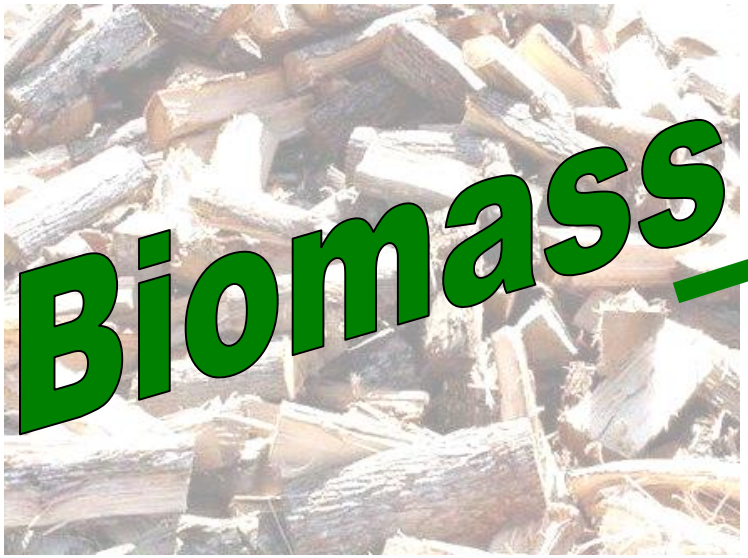
Biomass Project/Supply Issues

- Sourcing & procurement process
- Quality and consistency
- Transportation
- Pre-Treatment
- Competing uses of supply
- Competing energy sources
- Economic project or business model

Biomass Use Options

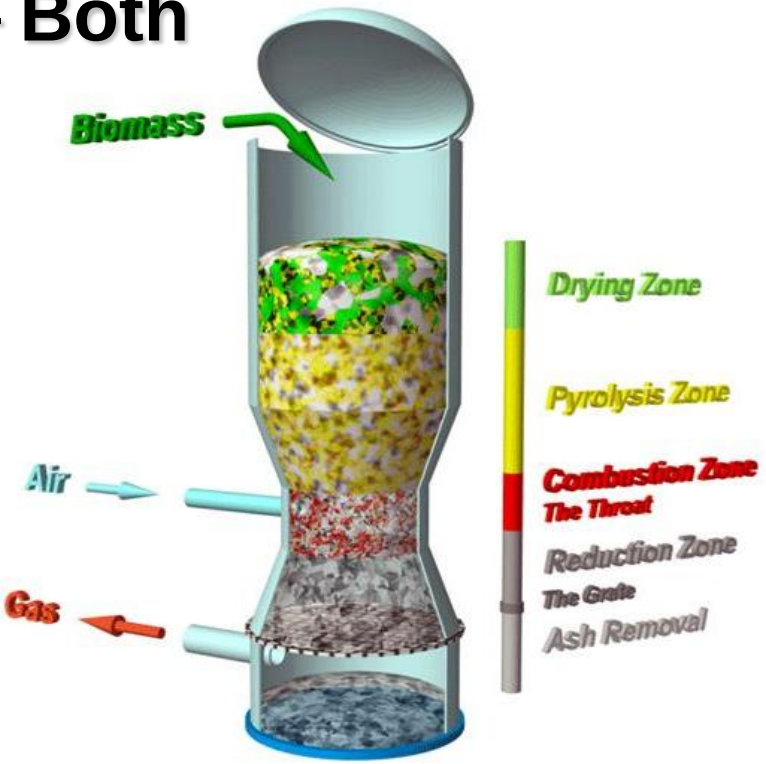


Biomass Use Options



Convert to Energy

- Electric
- Thermal
- Both



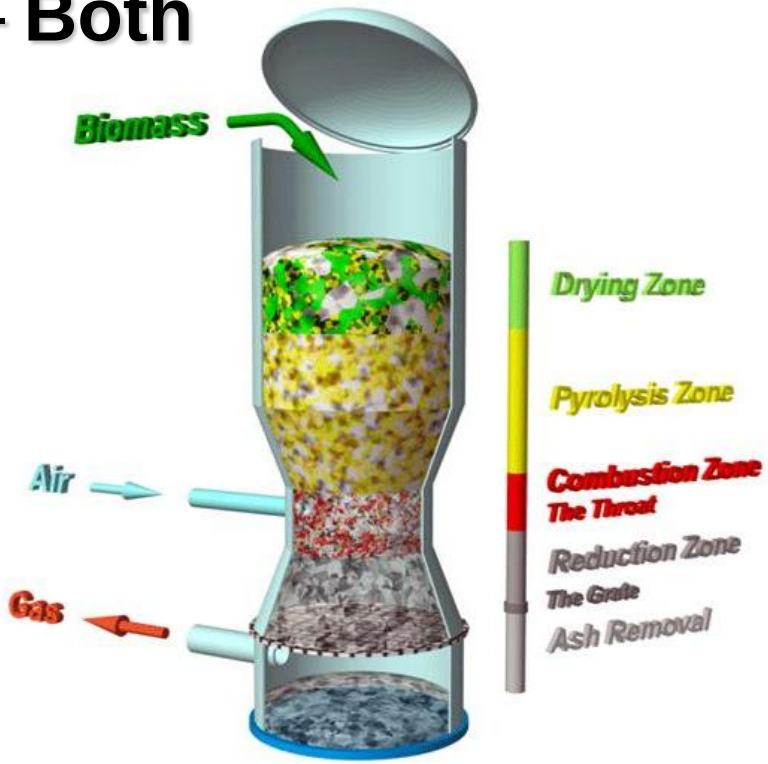
Biomass Use Options

Convert to Energy

- Electric
- Thermal
- Both

Bio-Products

- Lumber
- Fiberboard
- Plastics
- Paper
- Landscape mulch



Biomass Use Options

Convert to Energy

- Electric
- Thermal
- Both

Bio-Products

- Lumber
- Fiberboard
- Plastics
- Paper
- Landscape mulch

Higher value feedstock to Some other process or use

- Ethanol, biodiesel
- Wood pellets, biochar
- Biogas
- Chemicals for industry

“Drop-In” Biofuels

“Drop-in” biofuels, in the transportation sector, refers to fuels compatible with the $9 trillion energy refinery and gas-station infrastructure that we currently have, and seamlessly compatible with existing fuels and engines (gasoline, jet fuel, and diesel fuel)

“Drop-In” Biofuels

“Drop-in” biofuels, in the transportation sector, refers to fuels compatible with the $9 trillion energy refinery and gas-station infrastructure that we currently have, and seamlessly compatible with existing fuels and engines (gasoline, jet fuel, and diesel fuel)

“Drop-In” Biofuels

“Drop-in” biofuels, in the transportation sector, refers to fuels compatible with the $9 trillion energy refinery and gas-station infrastructure that we currently have, and seamlessly compatible with existing fuels and engines (gasoline, jet fuel, and diesel fuel)

Transportation

- **Biobutanol → gasoline**
- **Biodiesel → diesel**

“Drop-In” Biofuels

“Drop-in” biofuels, in the transportation sector, refers to fuels compatible with the $9 trillion energy refinery and gas-station infrastructure that we currently have, and seamlessly compatible with existing fuels and engines (gasoline, jet fuel, and diesel fuel)

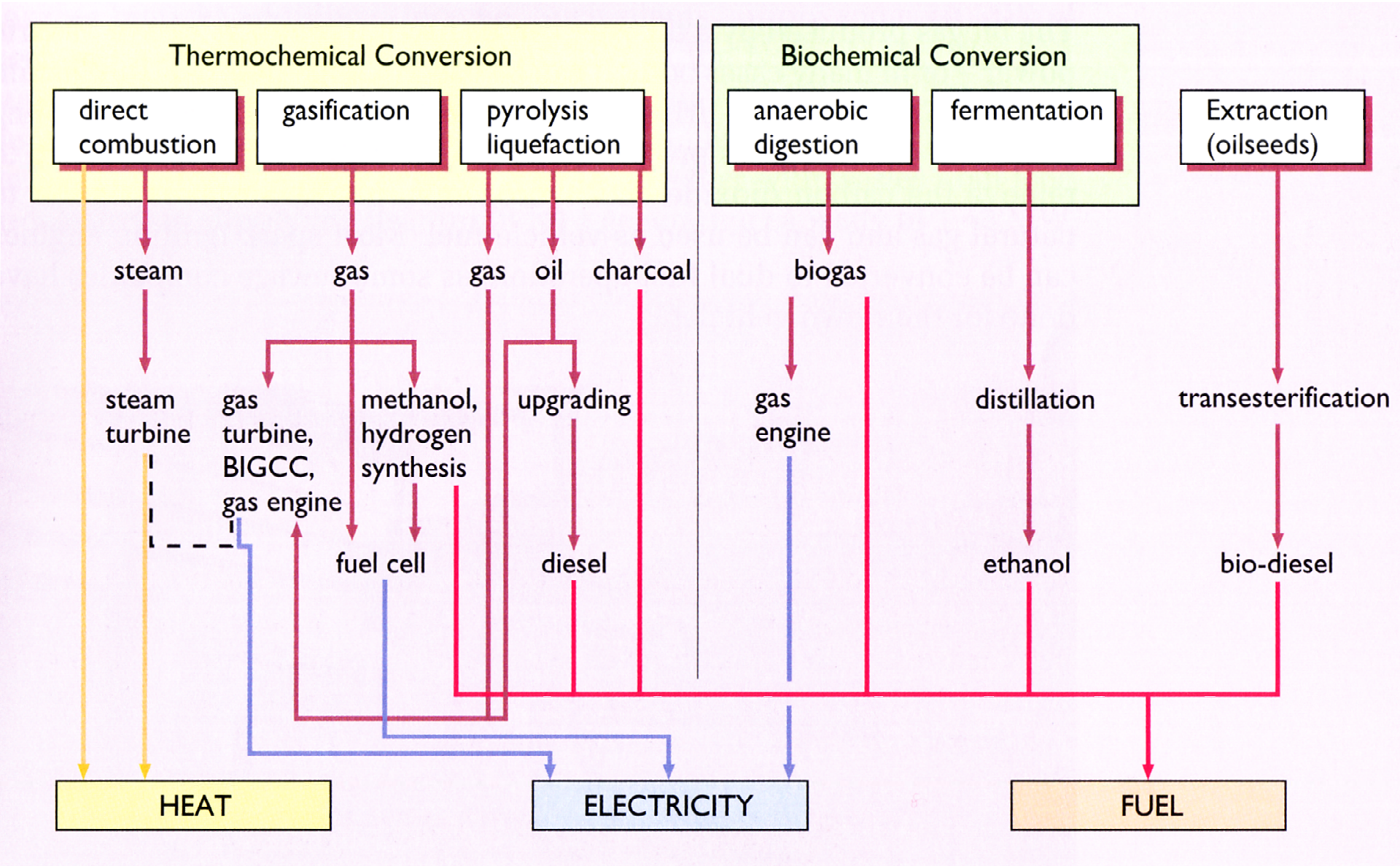
Transportation

- **Biobutanol → gasoline**
- **Biodiesel → diesel**

Buildings and Utility Bio-Energy Systems

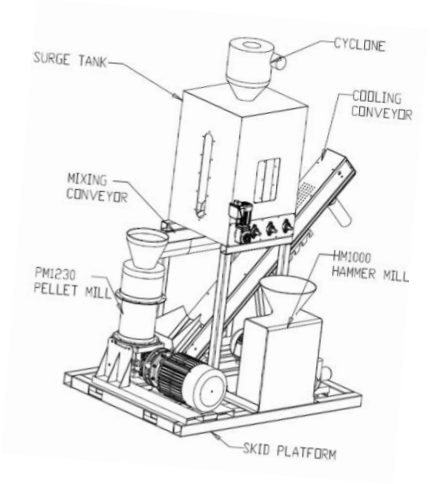
- **Digestion or gasification → pipeline gas**
- **Biochar → coal plants & boilers**
- **Torrefied biomass → dust burners for boilers**

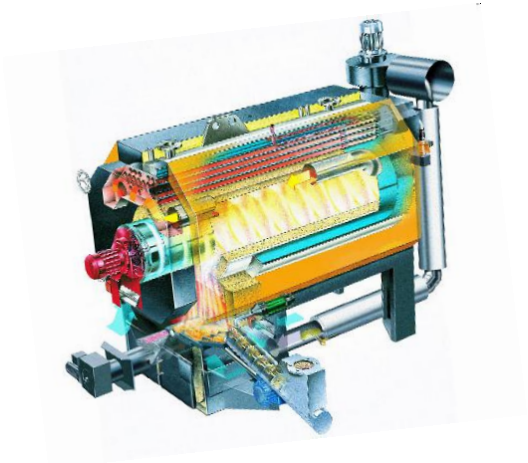
Biomass Conversion Technologies



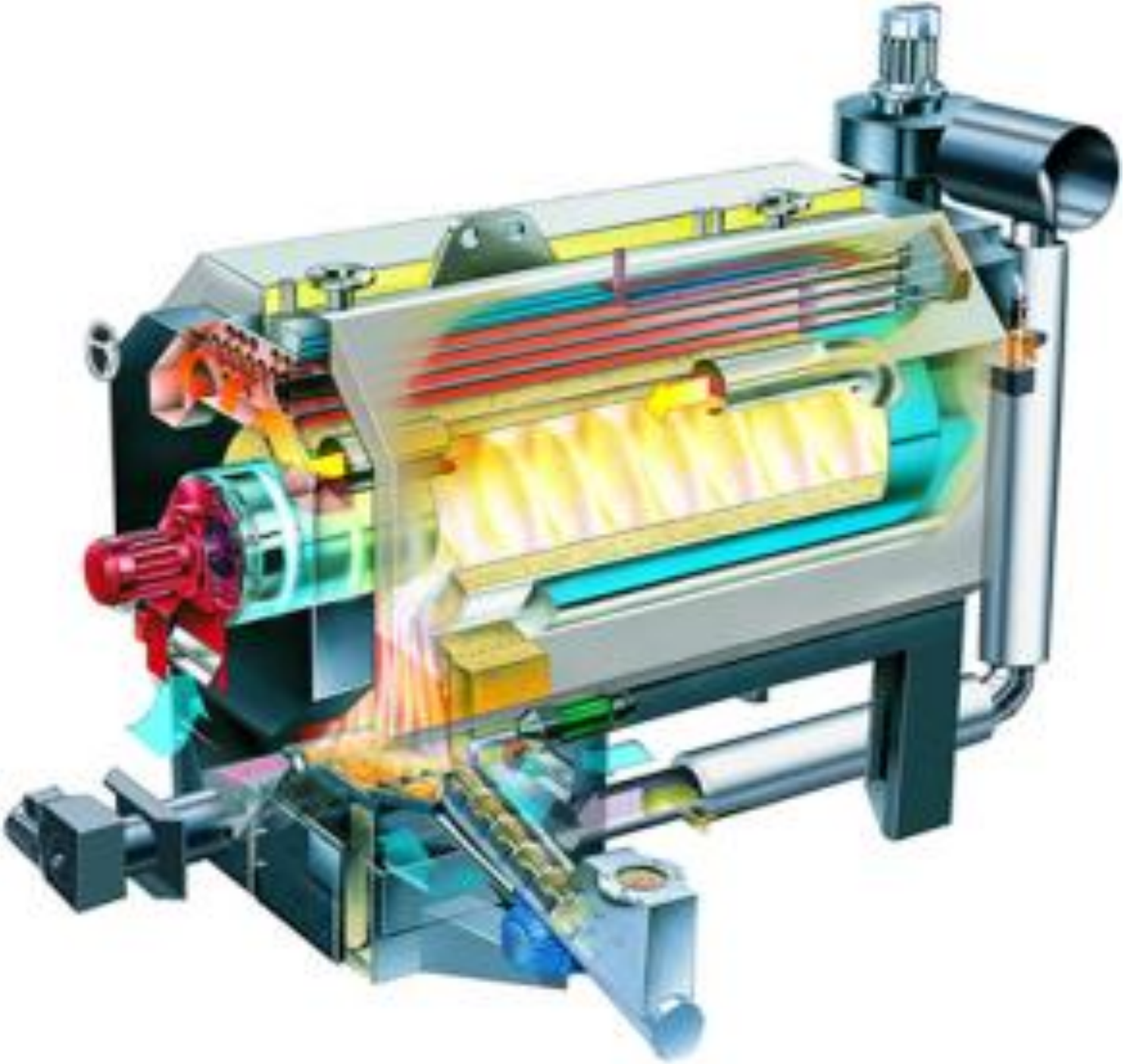
Oakland CERC Projects

- Biodiesel production demo
- Ethanol production demo
- Biomass pelletization and combustion demonstration and testing
- High tech wood chip boiler system



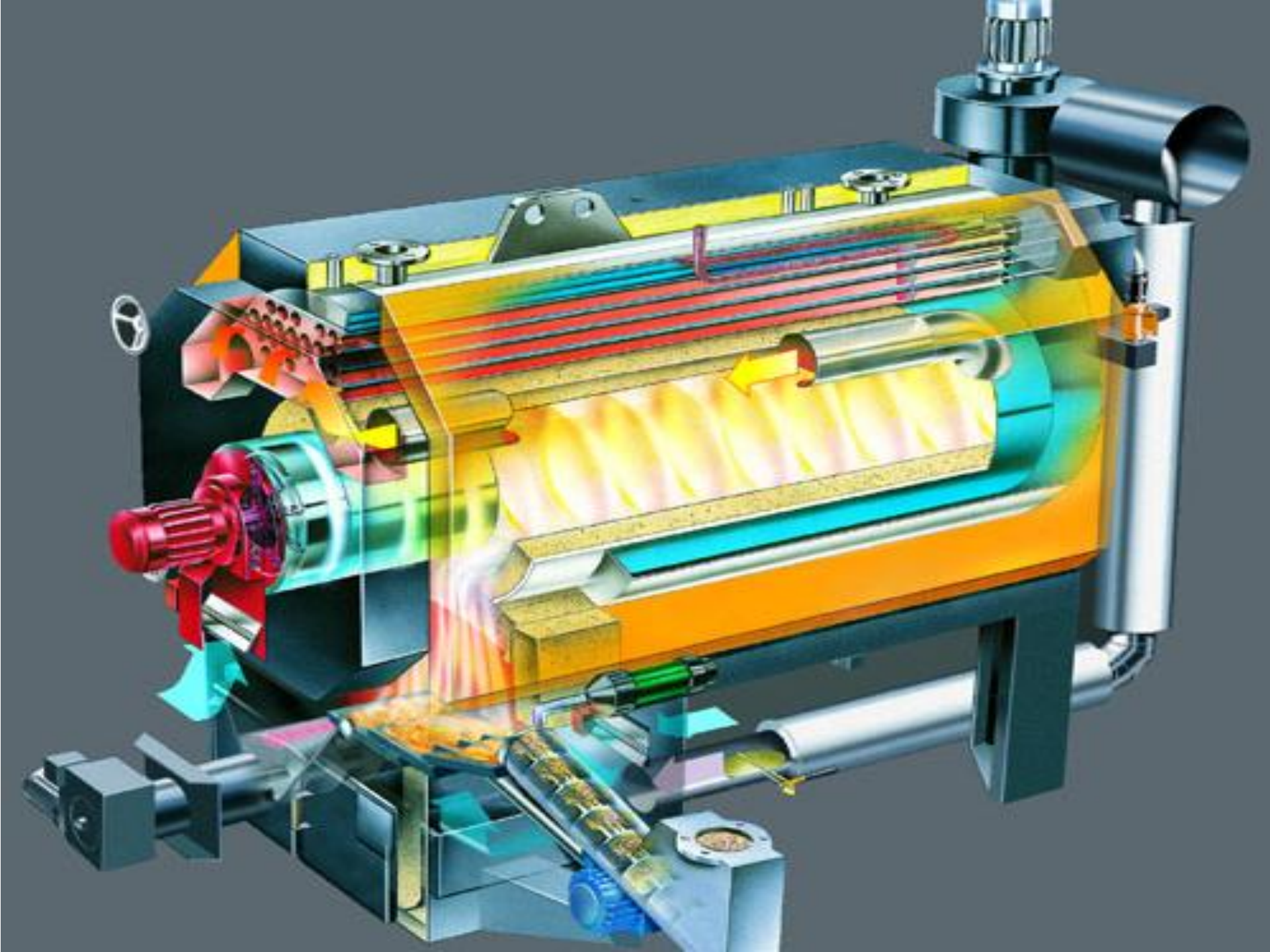



KOB
VIESMANN Group



On-Campus Wood Resource

Densification Testing and Demonstration



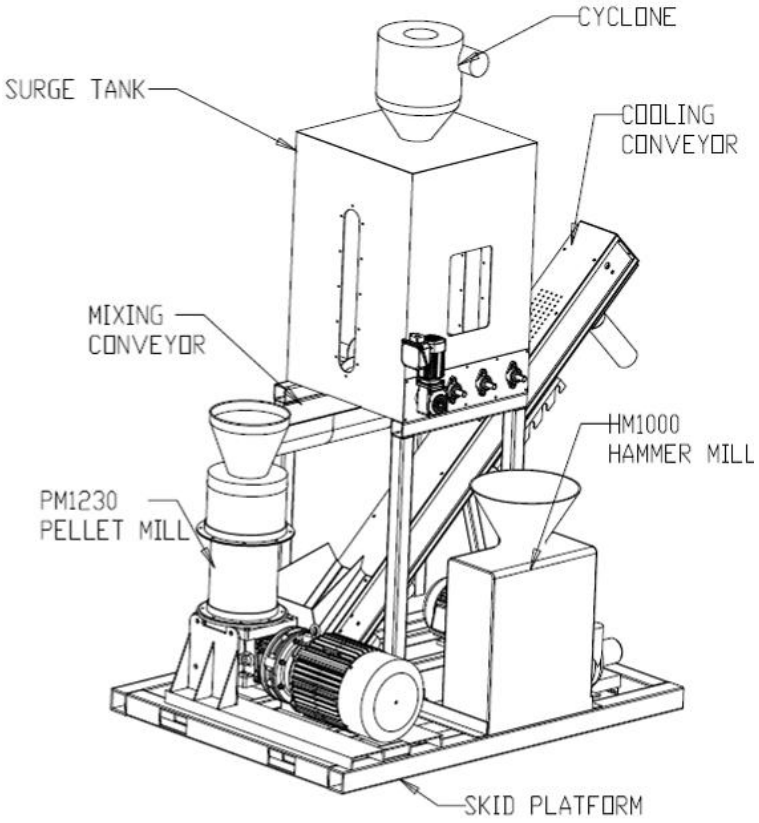
Oakland University

School of Engineering and Computer Science

Other Equipment

BUSKIRK ENGINEERING

30 HP
Pellet Mill



Future Applied R&D Projects

- Biomass pellet research
- Dual fuel biodiesel Combined Heat and Power (CHP) unit
- Torreffied biomass fired gas turbine CHP prototype
- However, our core mission will remain energy efficiency in commercial / industrial buildings

Past BioEnergy Conferences

- May 2008 – Wind/Biomass Project Development Workshop

- April 2011 – BioEnergy Conference

(agendas and PowerPoint's are available online at www.oakland.edu/cerc)

OU INC Clean Energy Research Center

Thank you

Jim Leidel
Director of Clean Energy Systems
leidel@oakland.edu

www.oakland.edu/cerc

and

www.oakland.edu/energy

Oakland UNIVERSITY