Biomass Power Generation Resource and Infrastructure Requirements

Idaho Forest Restoration Partnership Conference,

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Presentation Overview

- Introduction
- Woody Biomass Utilization
- Conversion Technologies
- Infrastructure Requirements
- Fuel Requirements
- Project Development Considerations

What is Biomass?

- **Biomass** – any solid, nonhazardous, cellulosic material derived from: forest-related resources, solid wood wastes, agricultural wastes, and plants grown exclusively as a fuel.*

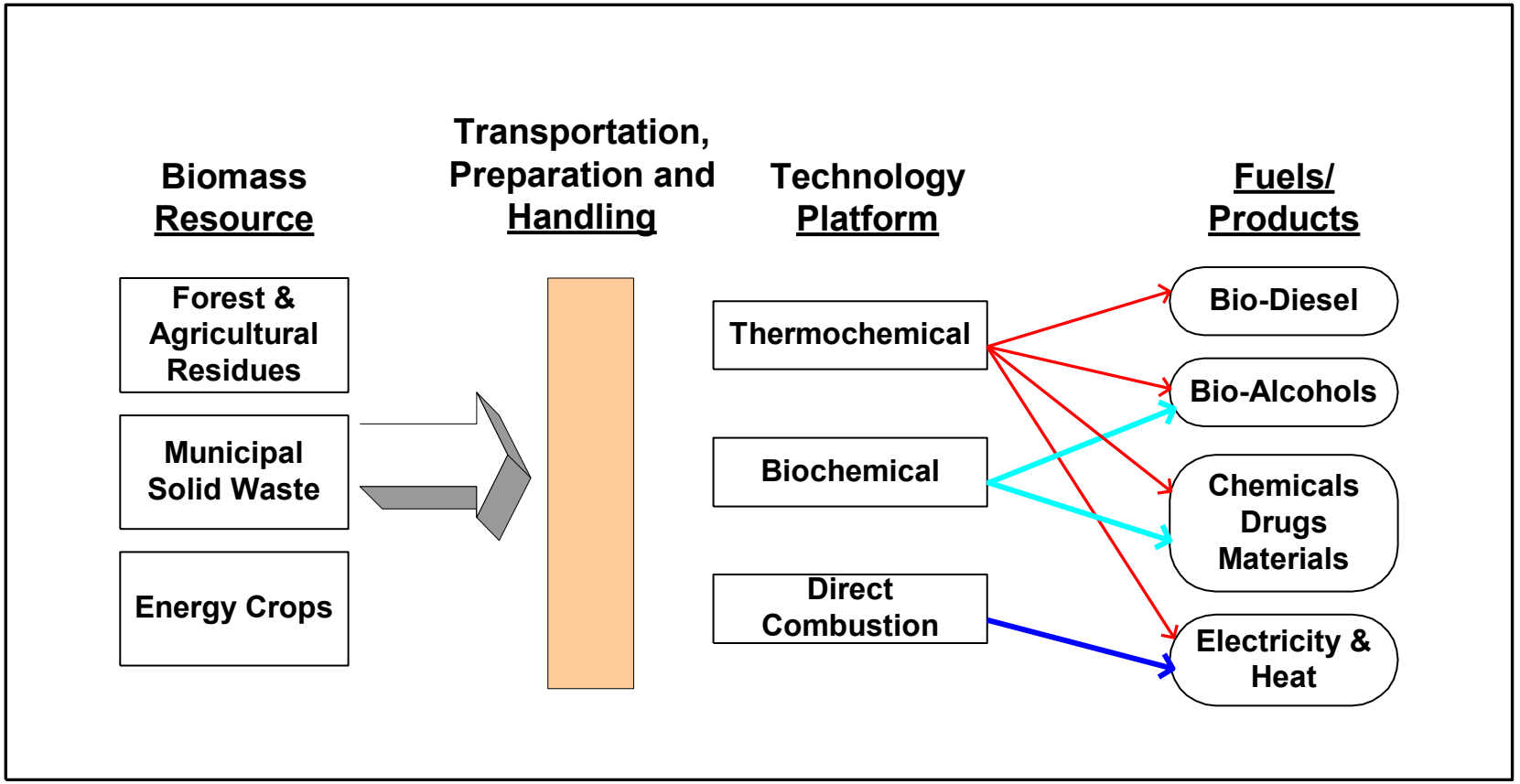
*based on the definition of biomass per the Federal Energy Act of 2005.

Woody Biomass Utilization

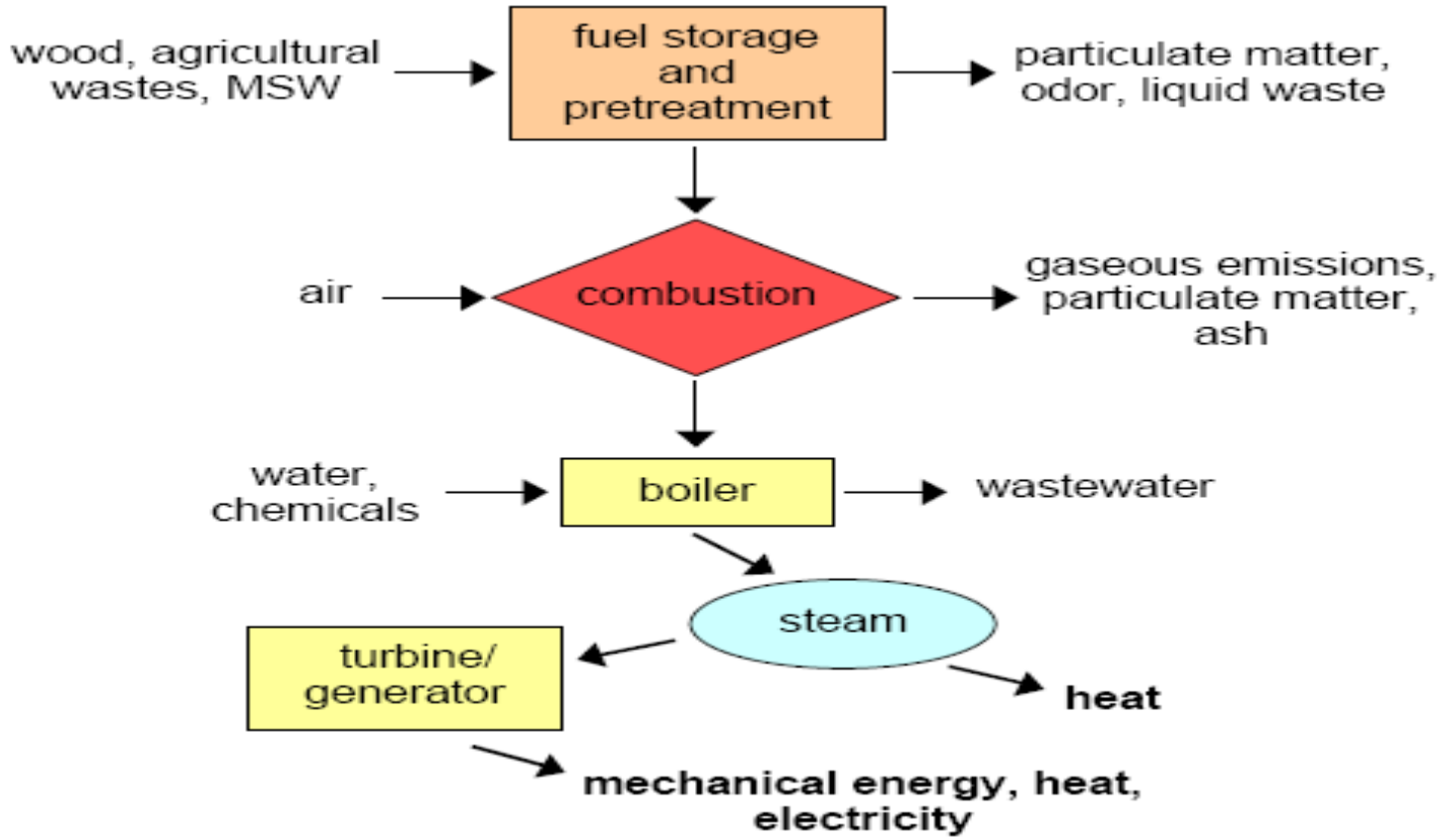
A variety of value-added end uses have evolved over time – Some are commercially proven and some are still in the RD & D Phases.

- Lumber products, composite panels, pulp
- Soil amendments
- Densified fuel pellets
- Animal Bedding
- Landscape cover
- Biofuels (ethanol, renewable diesel)
- Biomass power (generation or cogeneration)

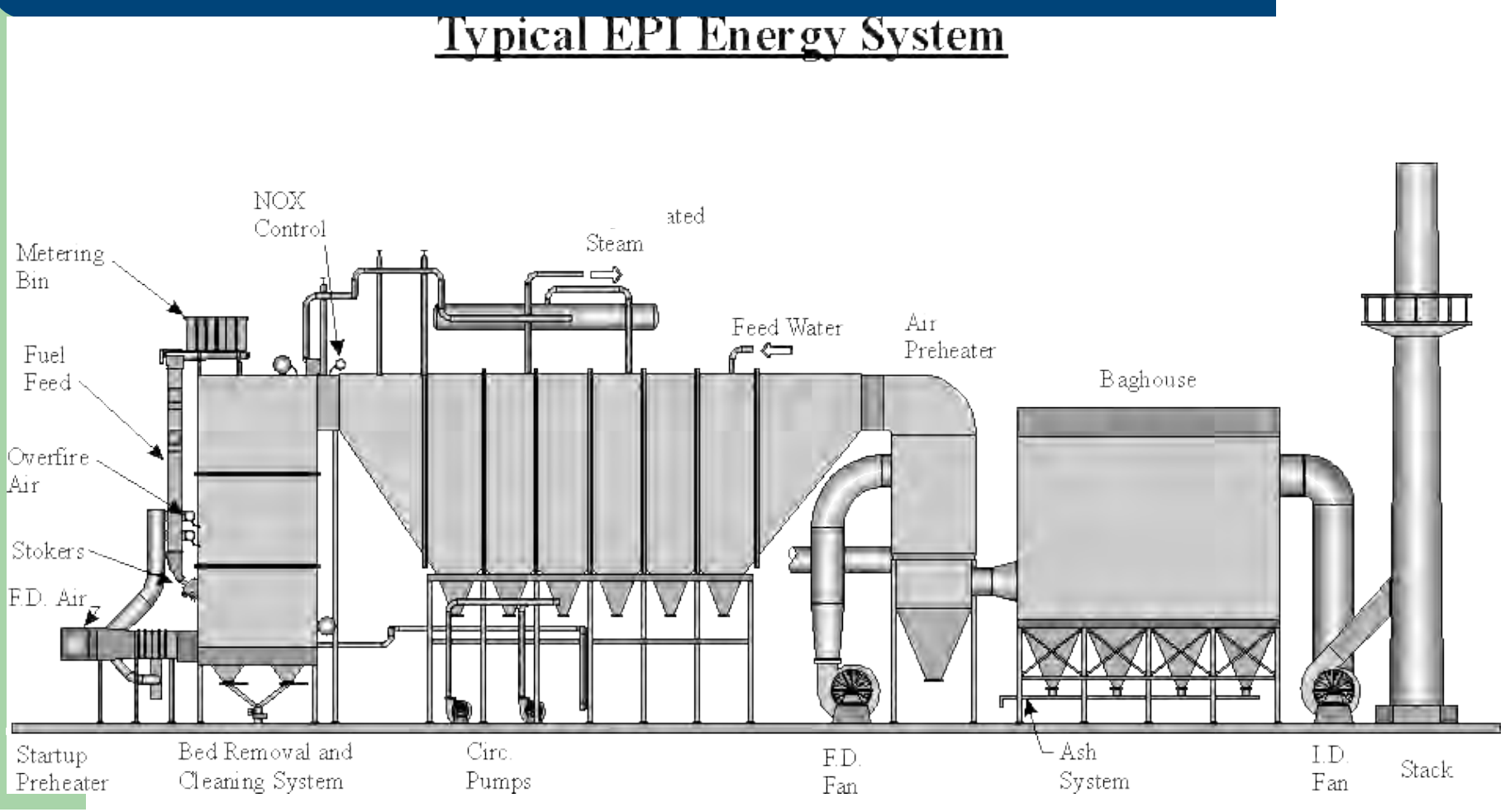
Conversion of Woody Biomass to Power and Fuels



Combustion Technology- Part 1



Combustion Technology- Part 2



Community Power Corp Gasifier - 12.5 KW, Philippines

Community Power Corp BioMax 50 kWh CHP at
Dixon Ridge Walnut Farm, Winters, CA

Phoenix Technologies Biomass 500 kWh
Gasification Unit at Merced, CA

DG Fairhaven Power 18 MW CHP at Fairhaven, CA

Burney Forest Power 31 MW CHP at Burney, CA

Wheelabrator Shasta Energy Company 50 MW Generation facility at Anderson, CA

Biomass Energy – Some Rules of Thumb

- 1 MW (1,000 kW) is enough power for 800 to 1,000 homes.
- Biomass fuel is purchased on a Bone Dry Ton basis.
- Typical amount of biomass recovered during fuels treatment is 10-14BDT/acre.
- Typical “burn rate” is 1 BDT/MW hr.
- 10MW plant consumes 10 BDT/hr.
- Assuming that 12 BDT/ac is recovered, a 10 MW plant would procure biomass from fuels treatment on approximately 7,000 acres/year.

Biopower in North America
Current Industrial Technology

- Nearly 10,000 MW of generation capacity.
- Almost all systems are combustion / steam turbine.
- Most are grate stokers.
- 5-110 MW (avg. 20 MW).
- Heat rate 11,000-20,000 BTU/kWh.
- Installed cost $1,700-$4,000 per kW.

Biopower Facility Example

- 20 MW plant produces enough power for about 18,000 to 20,000 homes
- New plant construction cost = $60 to $80 million
- Consumes about 160,000 BDT/yr (1BDT/MW/hour burn rate)
- Biomass transported up to 50 miles (maybe farther)
- Delivered biomass fuel valued at $20 - 55 per BDT
- Average electrical energy production cost

  ~ $0.09 - $0.13/kWh

Advantages of Biomass When Compared to Wind and Solar Energy

- Provides baseload renewable energy (24/7) on a cost effective basis.
- Has numerous societal benefits:
  - Supports hazardous fuels reduction and healthy forests
  - Provides employment (4.9 jobs/MW)
  - Greenhouse gas reduction displacing fossil fuels
  - Reduces waste material destined for landfills
  - Net improvement in air quality

Improving Air Quality

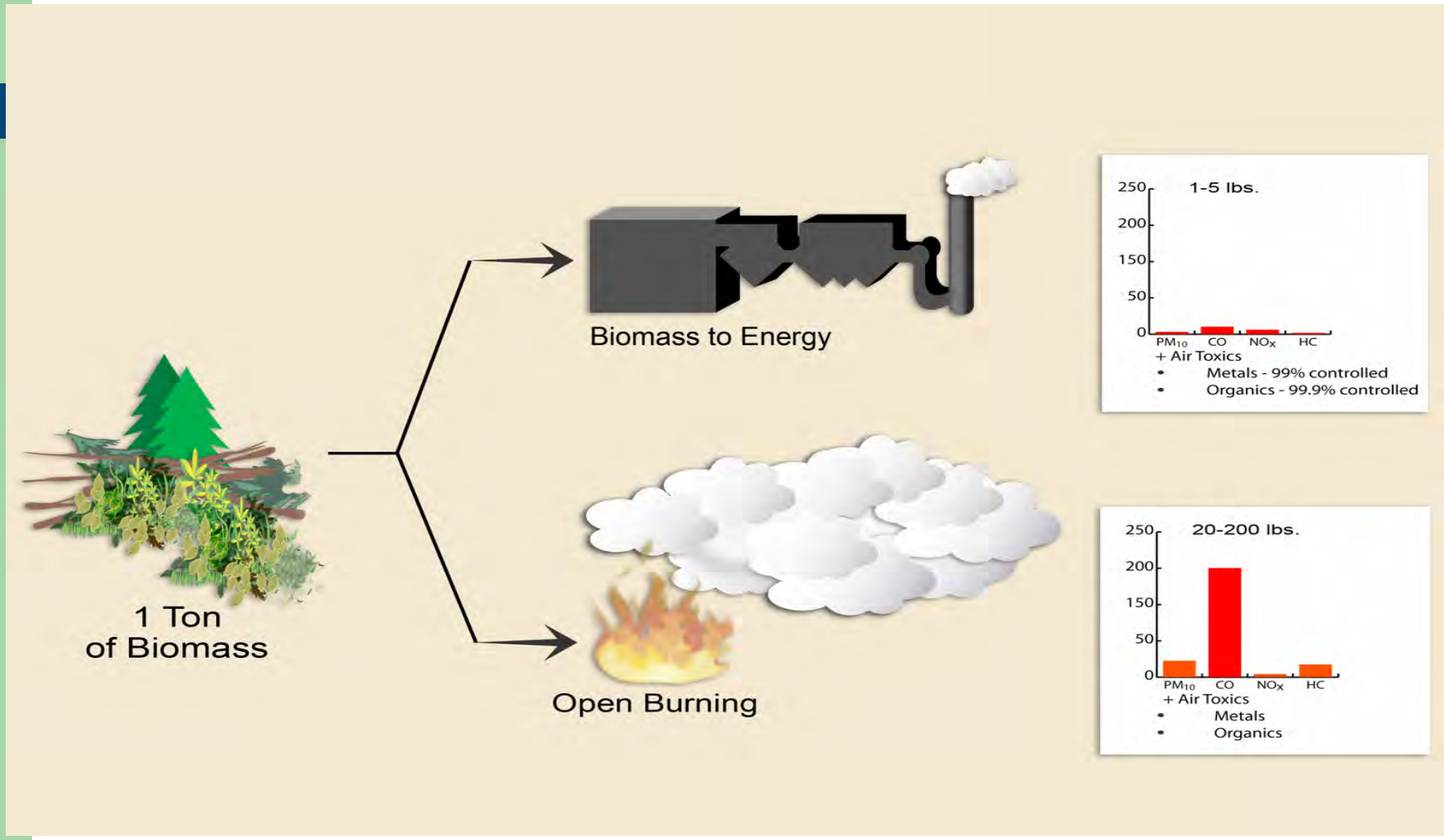


Diagram courtesy of Placer County Air Pollution Control District

Infrastructure Requirements

- Transportation System
  - Road System
  - Rail (helpful but not required)
- Industrial Site – 2 to 40 acres
- Water
- Collocated (Utilization of Waste Heat)

Key Fuel Characteristics

- Heating Value (Btu/dry pound)
- Moisture Content (% moisture)
- Sizing (typically 3” minus)
- Ash Content (% non-combustibles)
- Chemical Make-Up (sulfur, potassium, lignin)

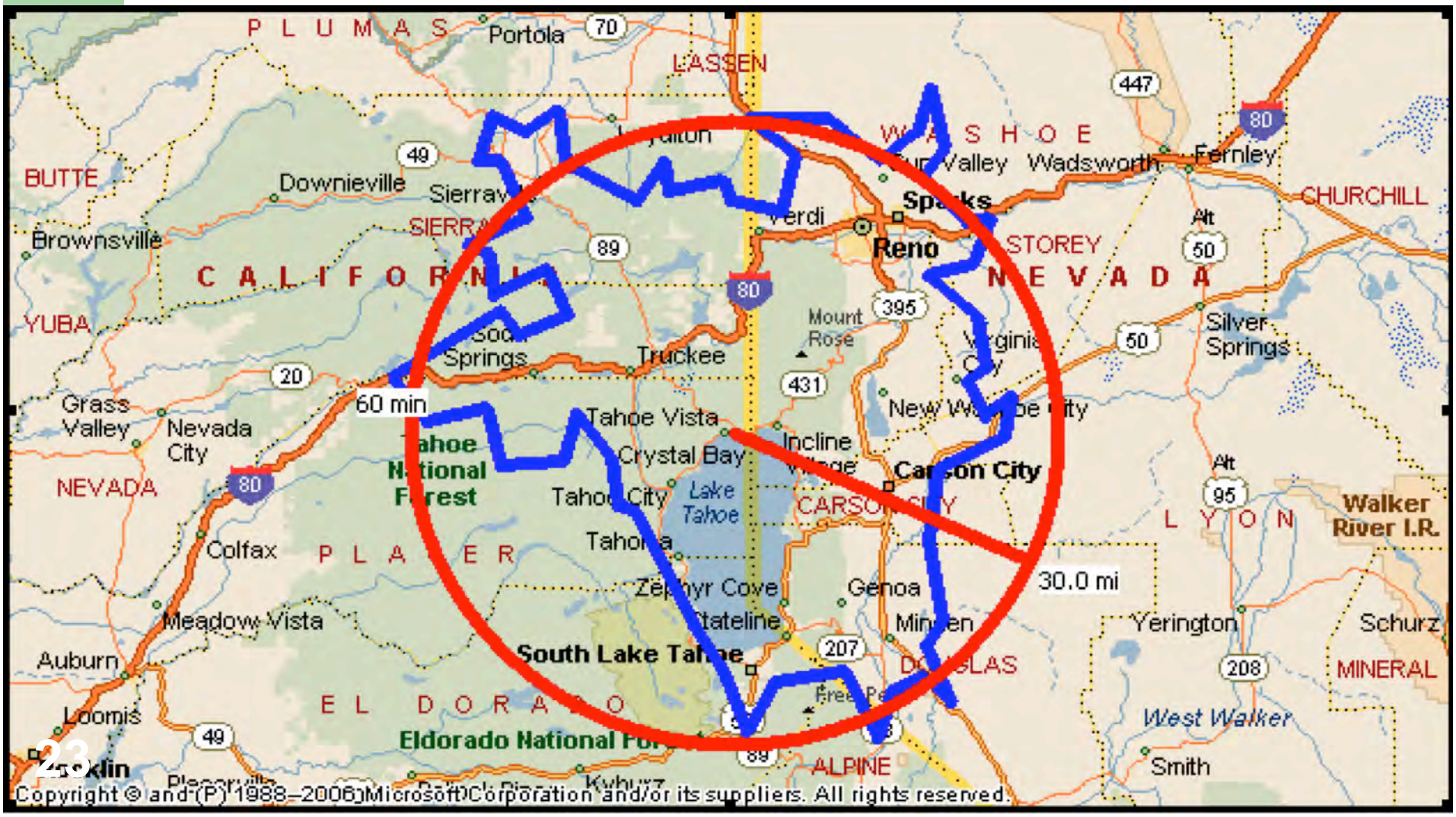
Confirm Types of Fuel/Feedstock That Meet Project Specifications

- **Forest**
  - Forest operations (fuels reduction, timber harvest residuals)
  - Forest manufacturing byproducts (sawdust, bark, shavings)
- **Agricultural**
  - Byproducts (orchard removals, prunings, shells)
  - Dedicated crops (poplar, willow, eucalyptus, switchgrass)
- **Urban**
  - Tree trimmings, general wood waste
  - Clean construction & demolition wood

Target Study Area

- Define feedstock availability – Target Study Area based on economic haul distances required to source fuel/feedstock.
- Typical radial distances from the targeted site are 30, 50, 75, or 100 miles.

Kings Beach, CA Project
Target Study Area



Assessment Filters

Three filters used to confirm availability of fuel/feedstock resource:

- **Potential** – Gross estimate.
- **Technical** – More refined based on physical recovery and resource policy factors.
- **Economic** – Very refined using current competition/demand, potential competition, community support and actual costs to harvest, collect, process and transport.

Current & Potential Competition

- Assess current uses/competition for fuel/ feedstock.
- Examples include:
  - Other bioenergy projects.
  - Furnish for composite panel manufacturing.
  - Raw material for soil amendment/landscape cover.
  - Feedstock for densified fuel pellet facility.

Key State and Federal Policies

- List existing policies that impact fuel/ feedstock availability and pricing. Some may only be available for defined periods or are currently being considered:
  - Federal - Biomass Crop Assistance Program
  - State - HB 2210 Tax Credit

Fuel/Feedstock Supply Assessment – Key Factors

- Meets project specifications.
- Sustainable long term supply located within close proximity (30 to 125 mile radius).
- Economically available (accounting for current/ potential competition, state/federal policies).
- Available in quantities and from diverse financially viable sources that support project financing:
  - Minimum 10 year supply, 50% - 70% under contract.
  - At least 2.5 – 3 times facility usage (fuel supply coverage ratio).

Bioenergy Project Development - Deal Killer Issues to Consider

- Fuel/Feedstock Supply
- Community Support
- Project Economics
- Appropriate Technology
- Siting/Infrastructure & Permitting

Importance of Stewardship Contracts

- Long term sustainable fuel supply is #1 risk factor for private capital investors.
- Range of Stew Contracts:
  - IRTC
  - IRSC
    - IDIQ

Community Participation in Attracting Bioenergy Projects

- Renewable Portfolio Standard
- State Legislative Initiative
- Idaho PUC
- Collocation
  - Community Buildings
  - Commercial Facilities

Federal Tax Credits/Grants

- Production Tax Credit
- Investment Tax Credit
- Treasury Dept 1603 Grant
- New Market Tax Credit
- Woody BUG

Three Major Components For a Viable Bioenergy Project

- Fuel Supply
- Off-Take Market
- Financing

Other Biomass Utilization Options

- Small Scale CHP
- Thermal Only
- Densified Fuel Pellets
- Animal Bedding
- Landscape Cover
- Firewood

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