Technical feasibility
Resource availability and cost
Resource competition
Technology evolution
Summary
Sustainability
GHG emissions
Forest practices

Bioenergy in California

A perspective on feasibility and impacts

California Energy Commission
DOCKETED
13-IEP-1M
TN 71261
JUN 12 2013

P. Tittmann[1]

[1]Center for Forestry
University of California, Berkeley

California Energy Commission Staff Integrated Energy Policy Report (IEPR) Workshop

1 Technical feasibility
- Resource availability and cost
- Resource competition
- Technology evolution
- Summary

2 Sustainability
- GHG emissions
- Forest practices

Return on Investment drives markets

Biomass Renewable Obligation Certificate in the UK at \$99 MWh^{-1}

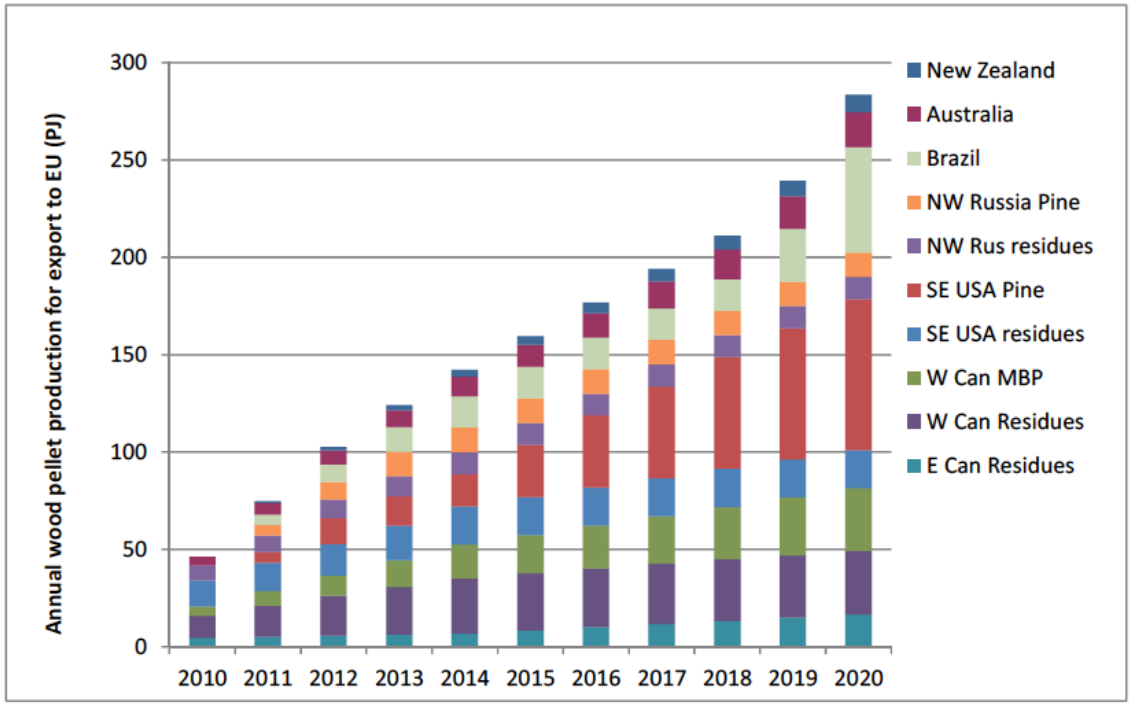


Fig. 1.9 - Anticipated growth in available solid biomass supply from the various sourcing regions. residues = woody industry residues (e.g. sawdust), MPB = Mountain pine beetle affected wood

Figure: Projected imports of wood pellets to europe at \$180 ton^{-1}

Biomass availability

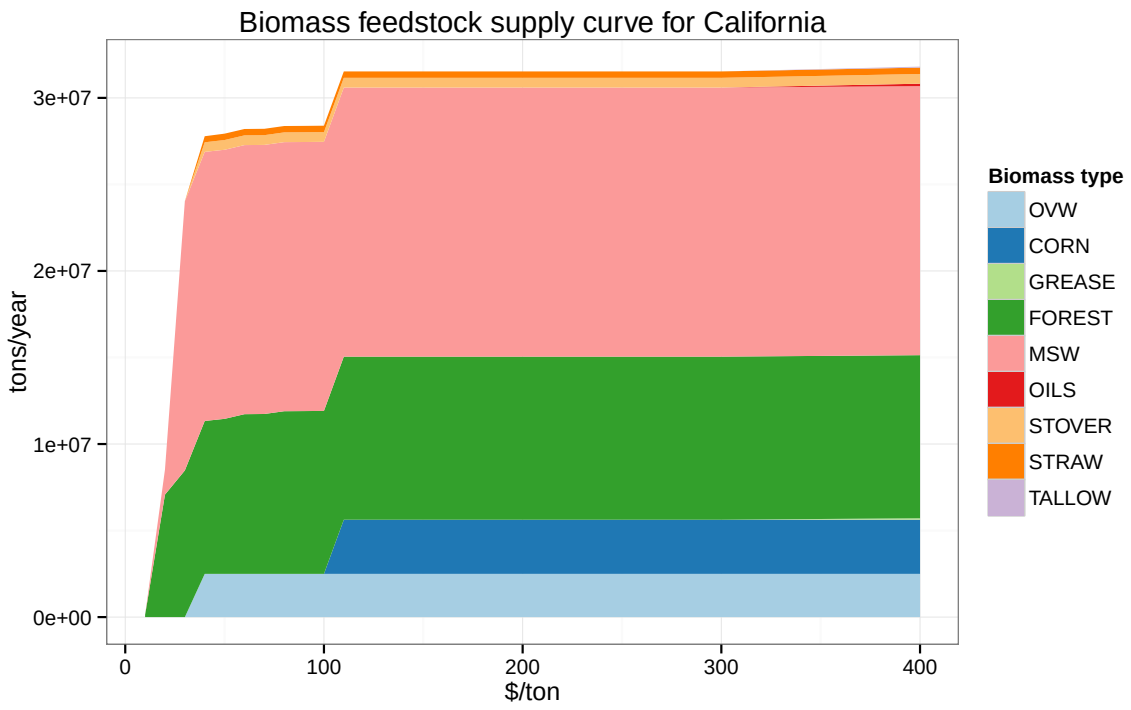


Figure: California biomass supply curve. Source: CBC

Does not include:

- Manures
- Biosolids
- Wastewater
- Landfilled waste

At full utilization solid fuels could generate $\approx$ 4000 MWe

Forest biomass resources in California

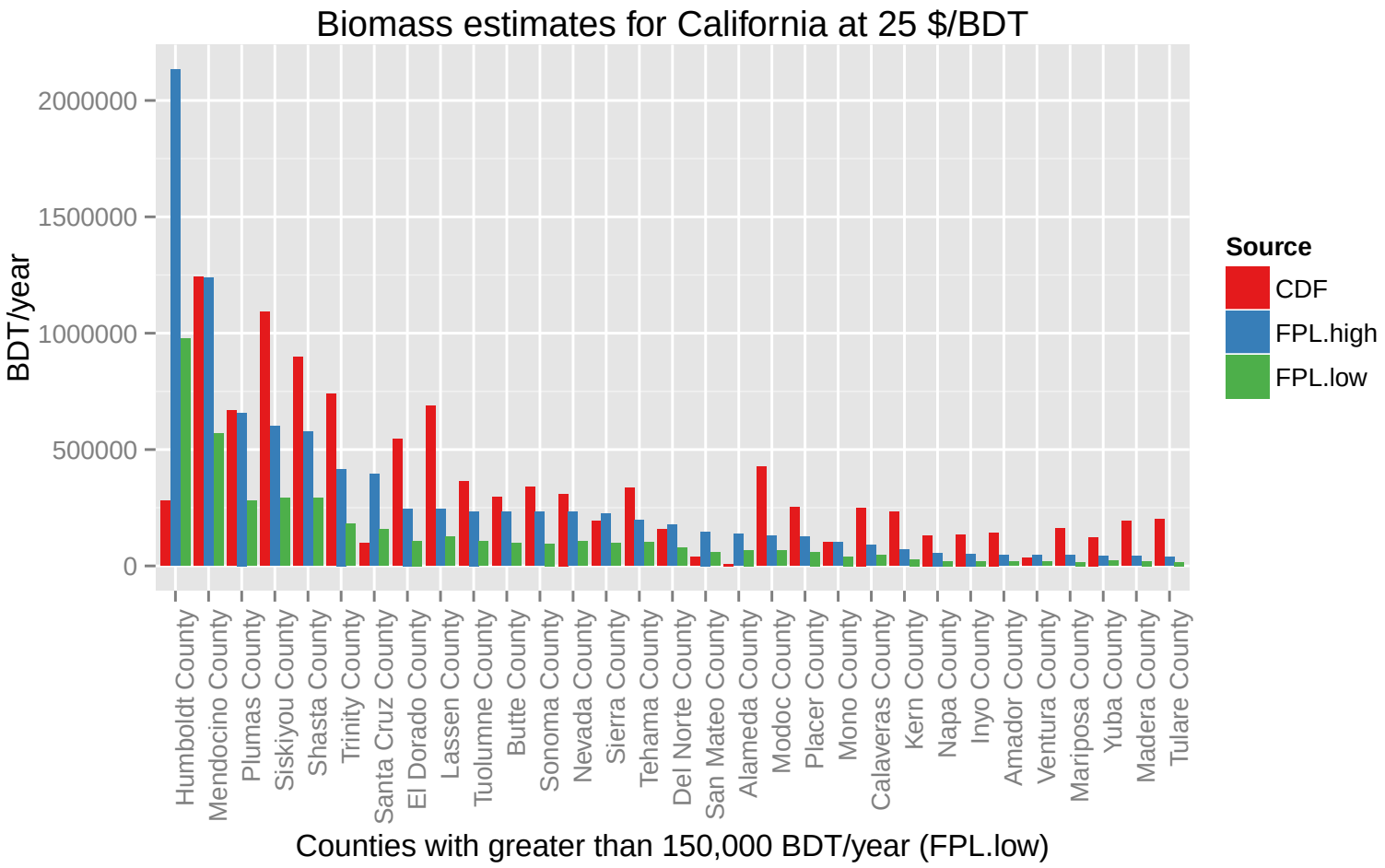


Figure: California Biomass Collaborative, does not include transportation costs

Procurement costs

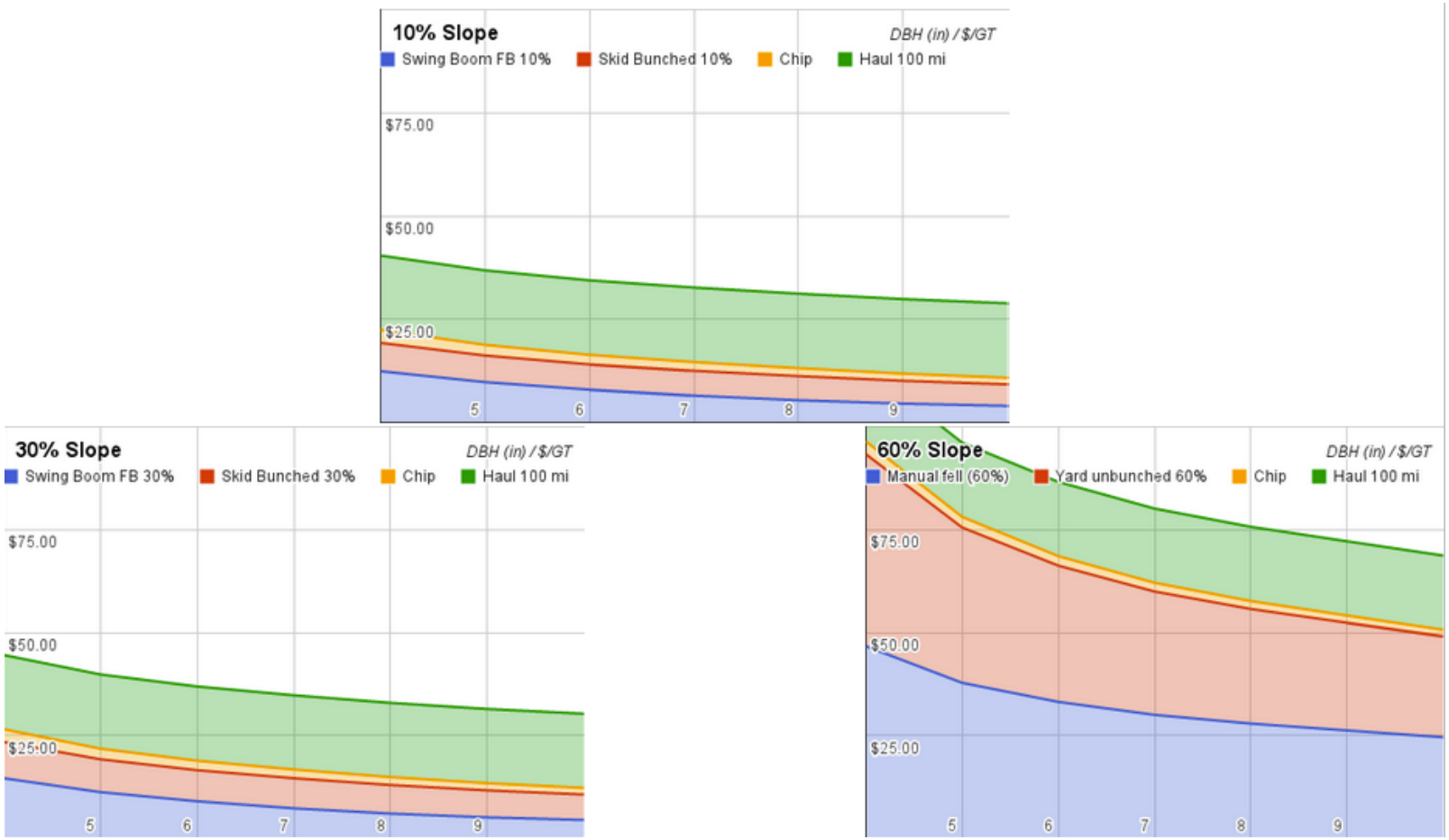


Figure: Feedstock procurement from forests.

RPS bioenergy pricing undervalues biomass electricity

Uncompensated (Ancillary) Benefits of Biomass Energy Production
(from 1999 NREL Report)

US Biomass Fuel Mix

	thousand bdt/yr
Mill Residues	6,400
Forest Residues	1,800
Agricultural Residues	2,300
Urban Wood Residues	1,400
Total	11,900

Value of the Benefits

	¢ /kWh
Criteria Pollutants	4.3
Greenhouse Gases	5.9
Avoided Landfill	1.1
Timber Stand Improvement	0.1
Total Benefits, US Biomass fuel mix	11.4

Figure: Estimated value of biomass electricity

Does not include:

- Wildfire suppression costs
- Impacts to utility infrastructure
- Water impacts
- Market price of electricity.

Competition between fuels and electricity

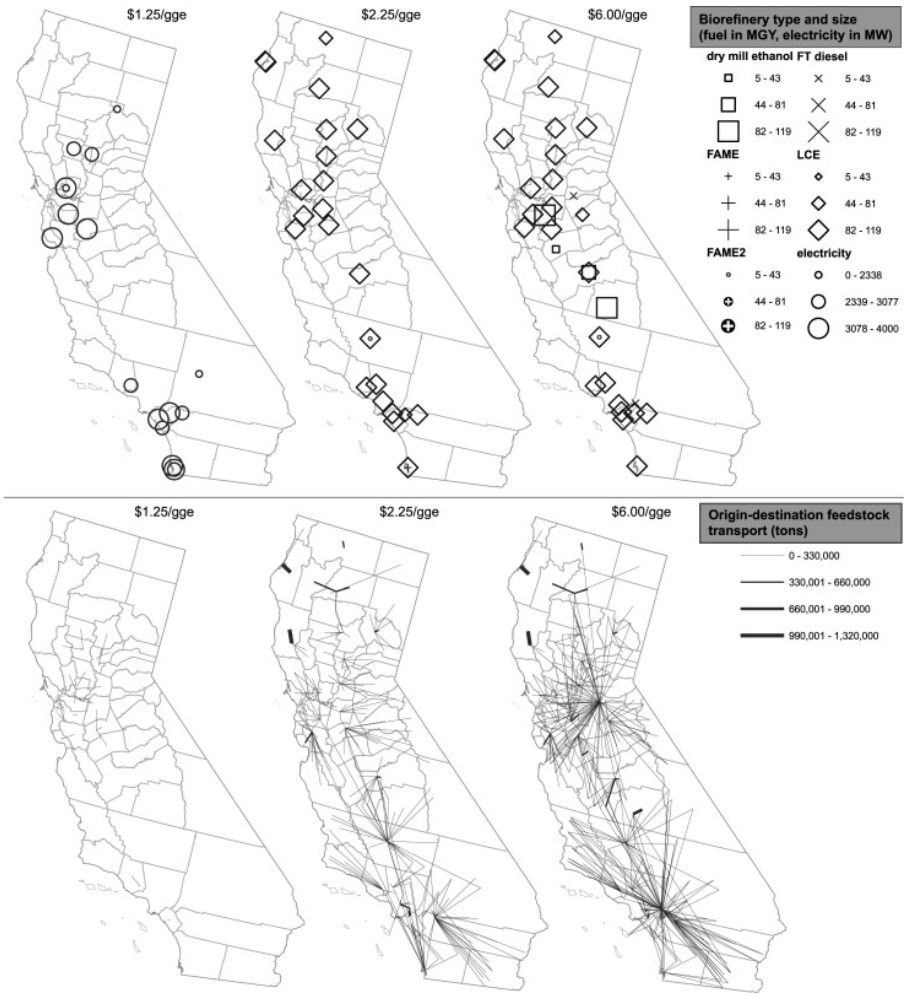
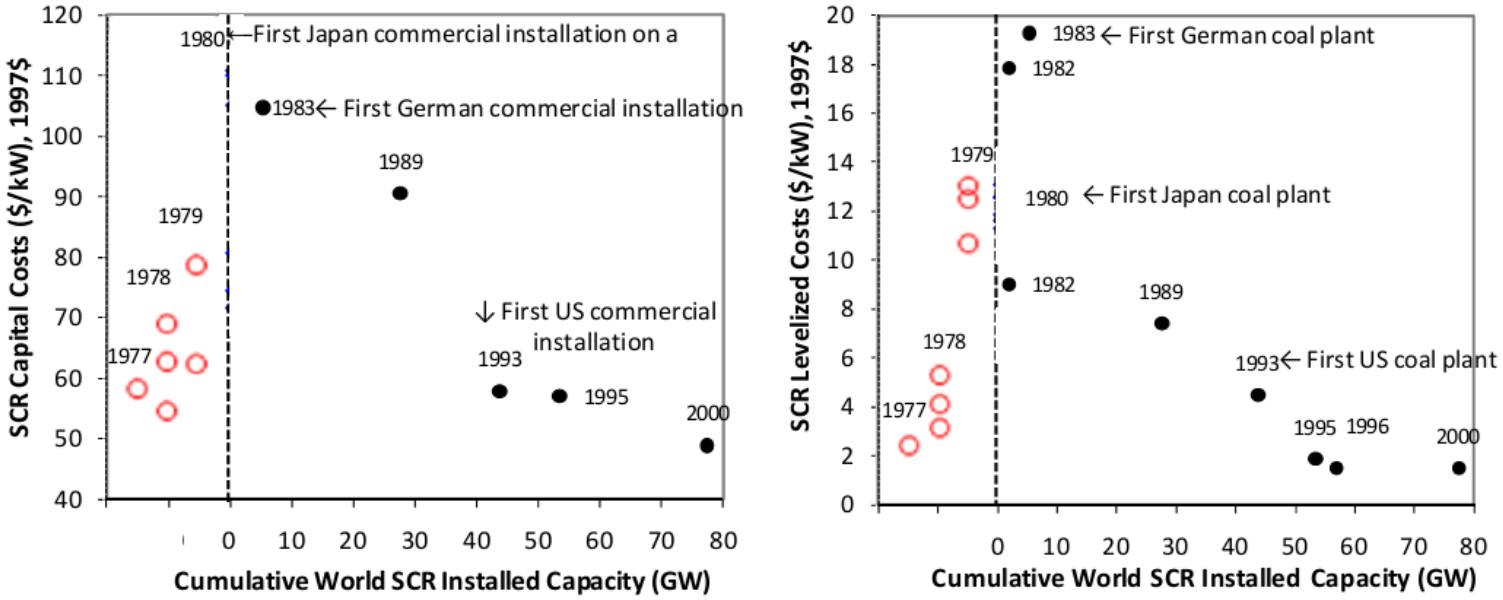


Figure: Feedstock utilization under a range of fuel prices.

Sustained market effects on production costs.



From Yeh, S. and E. Rubin. (2010) Uncertainties in Technology Experience Curves for Energy-Economics Models.

- Sustained competitive markets result in innovation and increases in production efficiency.

Feasibility summary

- Feasibility of bioenergy policy objectives limited by markets ($ J^{-1}).
- Resource potential is a constraint but:
  - difficult to quantify
  - unlikely to be a limiting factor on balance with procurement cost.
- A sustained market will exert downward pressure on production costs.
  - Initial costs will be high compared with legacy technologies.
- Monetizing ancillary benefits can offset early stage technology costs but cannot be achieved w/o political will.

The difficulty with sustainability

I dont like the word very much. The reason is that no one, as far as I know, is in favor of un-sustainability, and so therefore sustainability tends to mean almost anything you want it to mean, and I think we should be rather **more specific** *than that. The other problem is that sustainability sometimes sounds a bit* **too passive and static**, *and I think throughout history we have transformed our relationship to nature sometimes in good ways sometimes in bad ways. And I think the question for us is* **how we are going to transform our relationship to nature in the future**.

- David Harvey on the term "Sustainability"

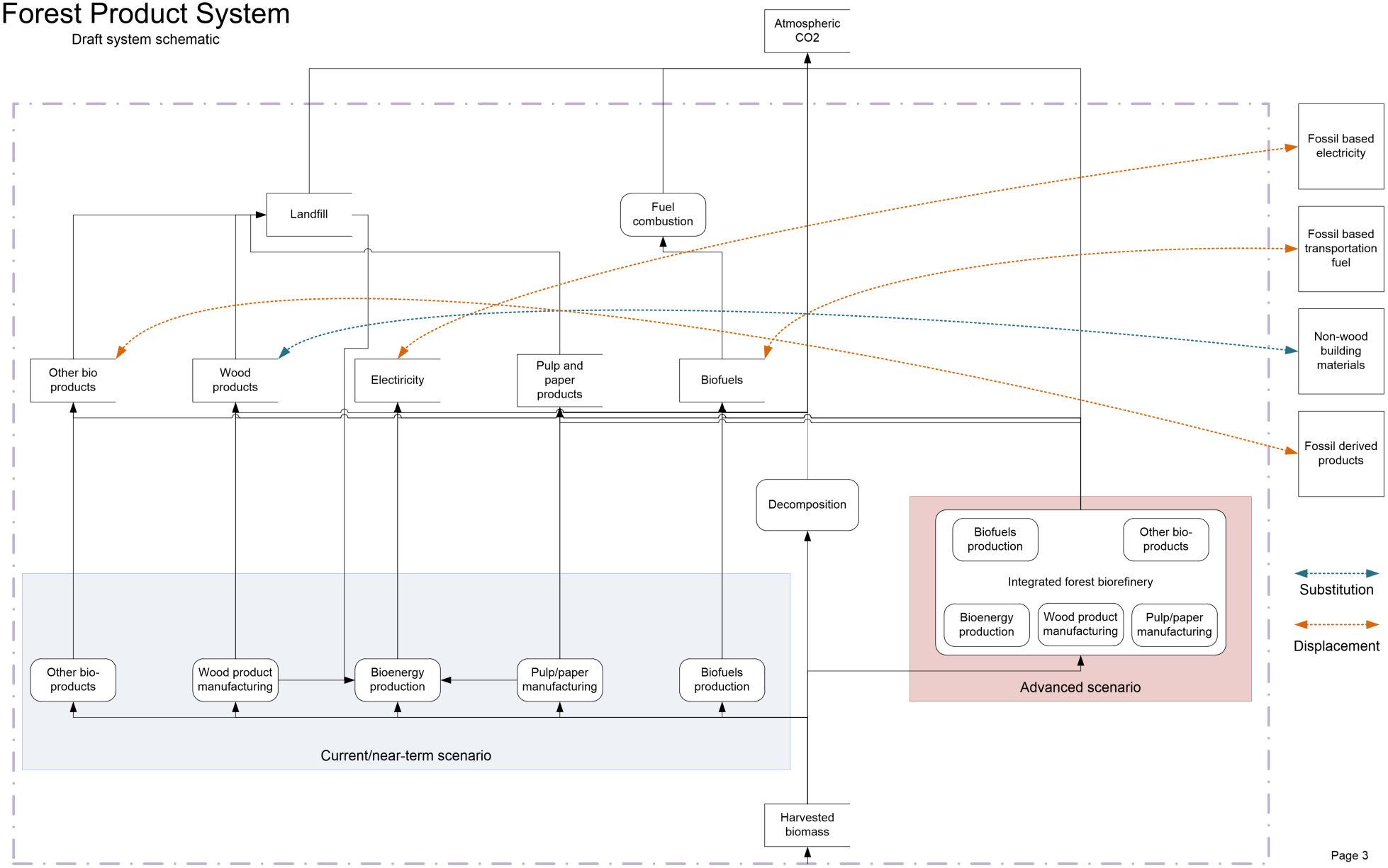
What we talk about when we talk about sustainability of bioenergy

With apologies to Raymond Carver

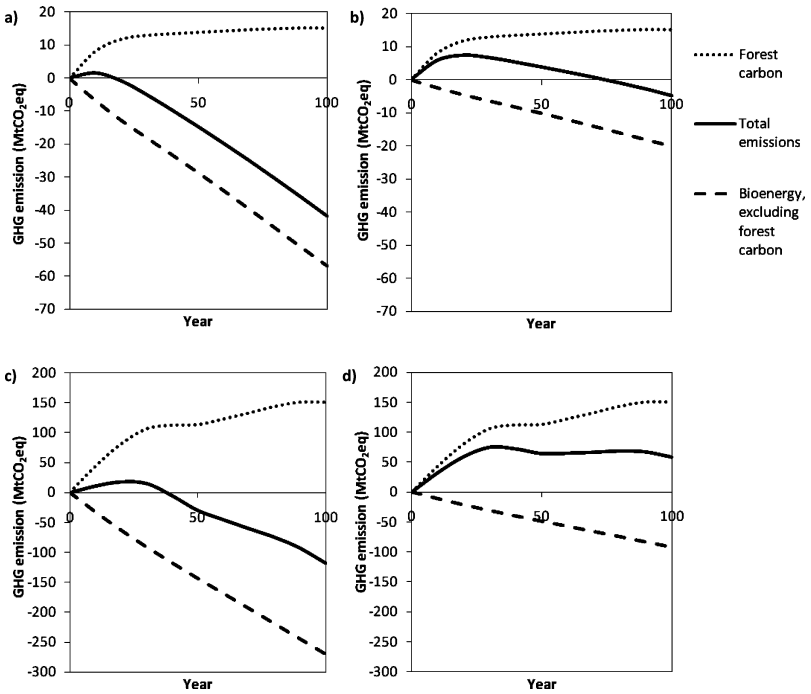
- Forest productivity
- **Forest resistance/resilience**
- Habitat
- **GHG emissions**
- Water quality/quantity
- Ecosystem services (broadly)
- Jobs
- Environmental equity
- ...

Forest Product System

Draft system schematic



Impacts of wood biomass utilization for energy



Cumulative GHG emissions from continuous biomass harvest for bioenergy production: (a) pellets produced from residues, displacing coal (20% cofiring), (b) ethanol produced from residues, displacing gasoline (E85 fuel), (c) pellets produced from standing trees, displacing coal (20% cofiring), and (d) ethanol produced from standing trees, displacing gasoline (E85 fuel). Positive values indicate an increase in GHG emissions to the atmosphere.

- Important time-scale difference between GHG from biomass and GHG from fossil resources.

Forest bioenergy impact on forest practices

- Unlikely that markets for biomass will incentivise additional adverse impacts from forestry operations.
- Restricting restricting the use of residuals in energy production:
  - likely won't impact industrial timber operations (driven by timber value)
  - misses low-hanging fruit for low-carbon energy source
  - misses an opportunity to enable restorative forest management on public and private lands that generate no or little timber value.

University of California Woody Biomass Utilization Program

John Shelly UC Berkeley and UC Cooperative Extension
jshelly@berkeley.edu

Peter Tittmann UC Berkeley Center for Frestry
pwt@berkeley.edu Program Funded in part through a

Cooperative Agreement with the USDA Forest Service