Potential Positive and Negative Environmental Impacts of the Increased Utilization of Woody Biomass for Energy Production

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Site and landscape level environmental sustainability – what is known - what are the knowledge gaps

- Nutrient cycling consequences
- Wildlife and biodiversity consequences
- Wildlife Habitat Relationship (WHR) assessment
- Changes in probability of losses to fires, insects, and diseases.
- Water quality and soil productivity consequences
- Ongoing stakeholder survey on sustainability issues
- Annotated literature review with 600+ journal articles
- Review of guidelines and BMPS in US states
- Briefer review of practices of Kyoto Protocol signatories (Europe, Canada)

Preliminary Stakeholder Survey Results

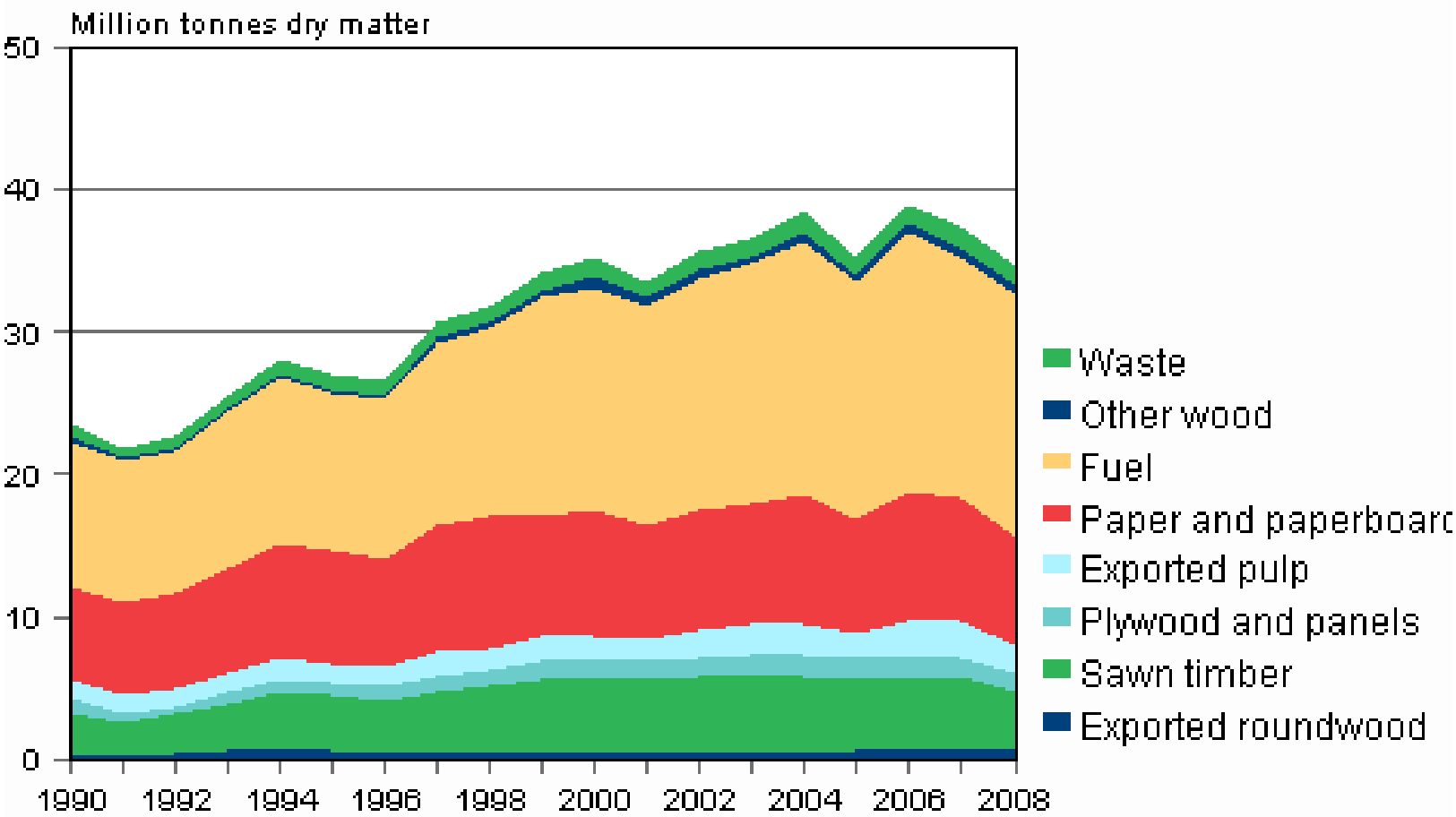
Ranking of Sustainability Themes (Max = 5)

Theme	Regulators (n=12)	Most important sub-theme
Atmospheric	**4.0**	Avoided CO2 from all energy plants
Social	3.8	Local livelihoods
Site-Environmental	3.7	Wildlife and Biodiversity
Economic	3.4	Cost to consumers

	Foresters (n=14)	Most important sub-theme
Social	**3.9**	Local wildfire reductions
Site-Environmental	3.6	Long term productivity
Economic	3.5	High cost of permits
Atmospheric	3.4	Avoided wildfire emissions

Finland – ½ of sustainable forest biomass output is now fuel.

5x increase in non-industrial energy since 2000



http://www.stat.fi/til/mettp/2007/mettp_2007_2009-12-17_tie_001_en.html

Key Economic Points

- Renewable energy use = Σ (CA + imports + non-achievement)
- Forest biomass rarely pays its own way out of the woods
- Nearly always a by-product of another operation
- OR, WA, and BC produce lots of wood products and green energy
- Higher prices and demand could spur increased production from managed forests as well as marginal lands

Wildlife and Biodiversity

- Biodiversity
  - Measures: structural and biological
  - Structural Complexity
  - Spatial heterogeneity
- Wildlife
  - Essential habitat elements
  - Impacts vary by species, intensity of removal, landscape context

California Wildlife Habitat Relationship (CWHR) System

- Impacts are determined by changes in vegetation structure
- Modeled 12 biomass harvests in Sierran mixed conifer, blue oak woodlands, and mixed chaparral
- Impacts
  - Resulted from changes in canopy closure, QMD, and loss of understory shrub and tree layers
  - Could not be tied to the harvest of CWD/FWD, logs, stumps and snags because these elements were not “essential” habitat for our evaluation species
  - Analysis limited by spatial/temporal scales

Nutrient Cycling

- California forest soils have high but variable nutrient levels that are not well correlated with forest type or site index
- Non-forest soils where biomass could also be produced typically have lower nutrient levels that may be at risk of ‘nutrient mining’

Water Quality and Soil Productivity

- Existing water quality BMPs have been shown to be effective where evaluated
- Stump harvesting disrupts soil profiles
- Need for long term research on impacts of slash removal during intermediate treatments in forests, woodlands, and shrublands

Disturbance Risk

- Removal of forest fuels generally reduces fire hazard
  - The duration of these benefits is variable
- Thinning treatments improve tree vigor and increase resistance to insects and disease
- Slash removal reduces available breeding substrates for forest pests
- The net C effects of forest biomass harvests are poorly understood: above and below ground C
- Using biomass to offset fossil fuel use may result in no net C emissions

Existing Biomass Harvesting Guidelines

- Five states have voluntary biomass harvest BMPs
  - Maine, Minnesota, Missouri, Pennsylvania, and Wisconsin
    - In comparison to CA, these states have very different climates, forest cover types and forest industries
- SFM certification programs (FSC and SFI)
- Canada and Europe
- Dead and downed wood retention is KEY