Opportunity to Rebuild Infrastructure with Biomass?

Jay O'Laughlin, Ph.D.
Director, Policy Analysis Group
College of Natural Resources
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University of Idaho

Opportunity to Rebuild Infrastructure with Biomass?

What is "Infrastructure"?

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What is "Biomass"?

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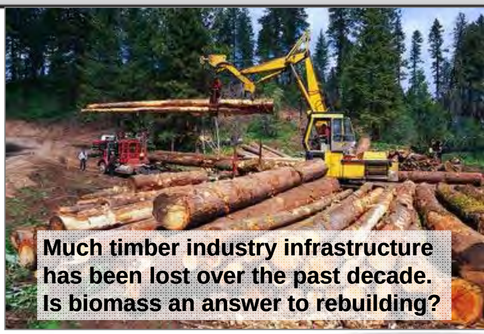
Infrastructure . . .



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Woody biomass categories & definitions

- Woody biomass
  - Merchantable timber (harvests or "removals")
  - Mill residues
  - Forest biomass
    - Harvest residues (logging slash)
    - Forest thinnings (non-merchantable)
  - Landfill
  - Short-rotation woody crops (SRWC)

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Forestry Task Force — IDAHO Strategic Energy Alliance

- Mark Benson, Potlatch Corp.
- Andy Brunelle, U.S. Forest Service
- John Crockett, Office of Energy Resources
- Richard Furman, Idaho Dept. of Lands
- Ron Gray, Avista Corp.
- Morris Huffman, Woody Biomass Utilization Partnership
- Jim Lacey, PacifiCorp Energy
- Jay O'Laughlin, University of Idaho (Chair)
- Jim Riley, Intermountain Forest Association
- Bob Swandby, Idaho Dept. of Commerce
- Mike Tennery, Idaho Fuels for Schools Program Coordinator

IDAHO Strategic Energy Alliance

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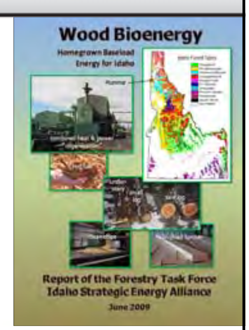
Executive Summary

- Current Situation
- Potential
- Barriers and Challenges to Development
- Options for Development



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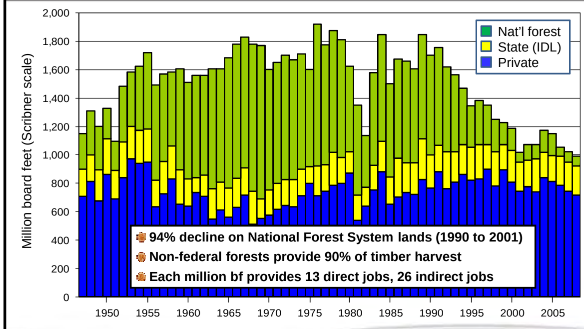
Idaho timber harvest by ownership, 1947-2008



Data: BBER, Univ. of Montana (Brandt et al. 2009)

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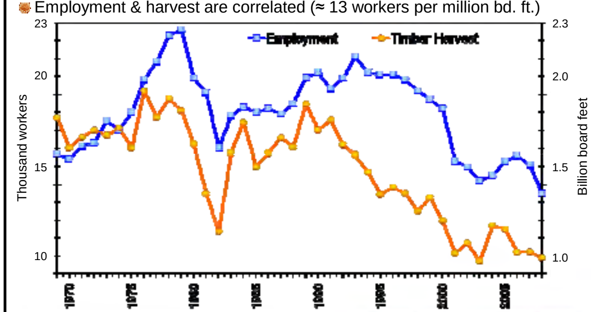
Employment & timber harvest, 1969-2008

- Employment & harvest are correlated (≈ 13 workers per million bd. ft.)



Data: Bureau of Business & Economics Research, Univ. of Montana

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Forest business sector employment

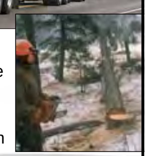
Idahoans rely on jobs in the woods, on the roads, and in the mills

4.6% of total labor income comes directly from jobs in the forest business sector (2000 data)

Each of the 13,500 forest sector jobs (2008 data) supports two more jobs in other sectors

Only two other states* rely more on the forest business sector

*Maine & Oregon



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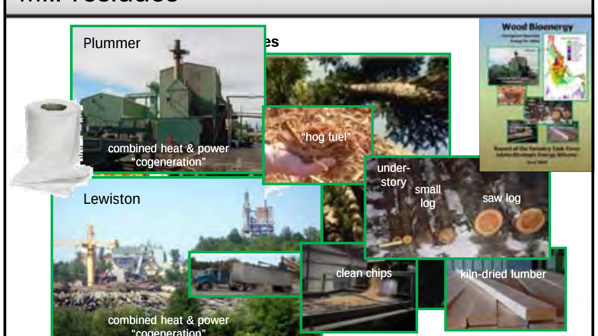
Mill residues



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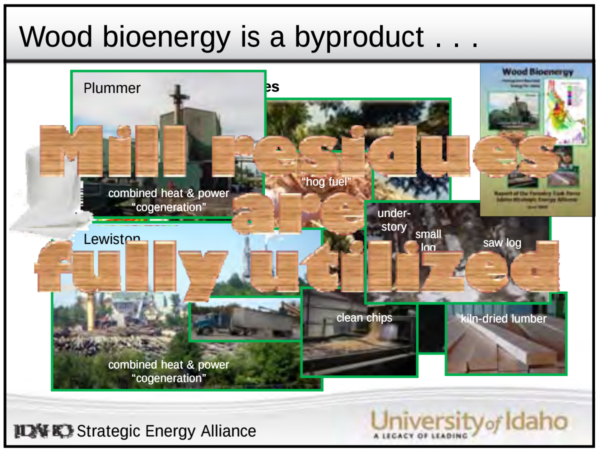
Wood bioenergy is a byproduct . . .
Plummer
Mill residues are fully utilized
combined heat & power
"cogeneration"
"hog fuel"
under-story
small log
saw log
Lewiston
clean chips
kiln-dried lumber
combined heat & power
"cogeneration"
Wood Bioenergy
Strategic Energy Alliance
University of Idaho
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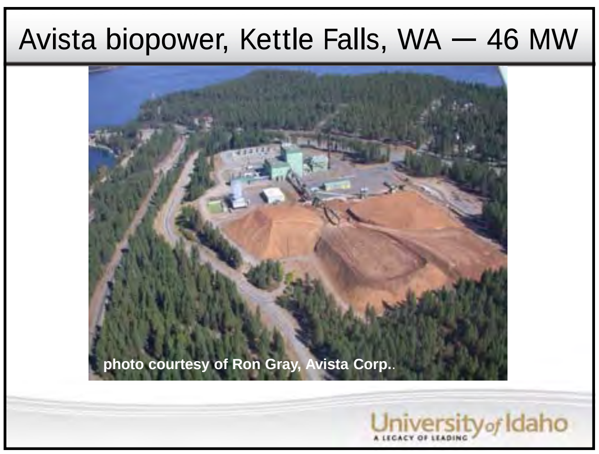
BIOPOWER


Avista biopower, Kettle Falls, WA — 46 MW
photo courtesy of Ron Gray, Avista Corp..
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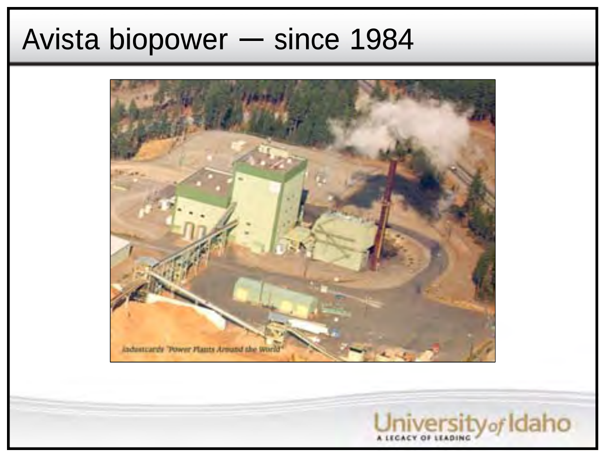
Avista biopower — since 1984
University of Idaho
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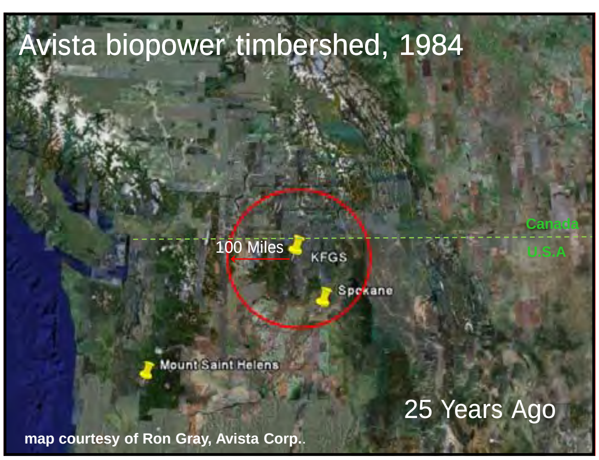
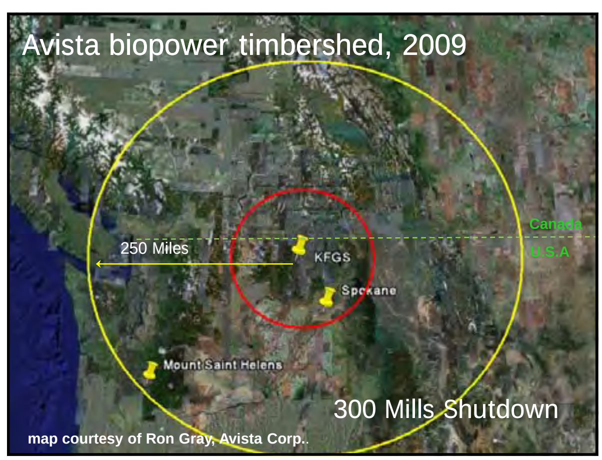

Avista biopower timbershed, 1984
Canada
U.S.A.
100 Miles
KFGS
Spokane
Mount Saint Helens
25 Years Ago
map courtesy of Ron Gray, Avista Corp..


Avista biopower timbershed, 2009
Canada
U.S.A.
250 Miles
KFGS
Spokane
Mount Saint Helens
300 Mills Shutdown
map courtesy of Ron Gray, Avista Corp..

"Wood energy in America" (*Science* , March 2009)

To rekindle wood energy, one initiative that can have wide-ranging, positive effects is to expand district-energy systems (in which heat is supplied from a central source to several sites) tied to advanced wood combustion technology (AWC).

District-energy AWC is used throughout Europe. It can be observed in downtown St. Paul, Minnesota; in hospitals and public buildings in Akron, Ohio; and on campuses such as Colgate University and the universities of Idaho and South Carolina. District energy is attractive for high-density communities and eco-friendly urban and suburban housing.

Richter et al. "Wood energy in America"
Science 323: 1432-1433 (13 March 2009)

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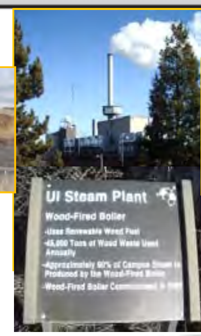
Schools and Fuels



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Fuels for Schools

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Biomass for heat & power

Fuels for Schools biomass requirements
- **U of I steam plant – 22,000 ODT/year**
- **Council schools – 300 ODT/year**
- **Kellogg schools – 600 ODT/year**

Electric power biomass requirements
- **8,400 ODT/year for 1 MWe (WGA 2006)**

Quincy Cogen - Fuel Pile

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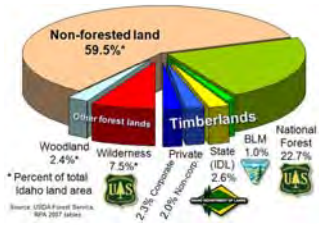
Summary — current situation

- **Idaho's forests cover 40.5% of the state; most of these lands are classified as timberlands.**



Data: *Forest Resources of the U.S., 2007* (U.S. Forest Service)

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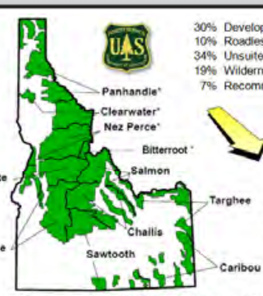
Idaho national forests

30% Developed (roaded) timberlands
10% Roadless timberlands
34% Unsuited for timber production
19% Wilderness
7% Recommended for Wilderness



70% of Idaho's National Forest lands are not available for timber harvest

* Northern Region (R1) national forests report to Missoula, Montana.
Intermountain Region (R4) national forests report to Ogden, Utah.

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Summary — current situation

- Idaho's forests cover 40.5% of the state; most of these lands are classified as timberlands.
- Idaho's timberlands have 36.7 billion cubic feet of growing stock volume (wood volume in trees > 5" diameter).
- In 2007 Idaho's forests grew one billion cubic feet of new wood.

Data: *Forest Resources of the U.S., 2007* (U.S. Forest Service)

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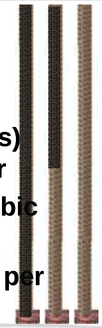
Forest inventory change – Idaho 2007

- **≈ one billion cubic feet <u>per year</u>**
- **equivalent to four football fields stacked one mile high with wood**
- **<u>Removals</u> (mostly timber harvests) are 246 million cubic feet per year**
- **<u>Wood increment</u> is 748 million cubic feet per year**
- **<u>Mortality</u> is 383 million cubic feet per year**



Data: *Forest Resources of the U.S., 2007* (U.S. Forest Service)

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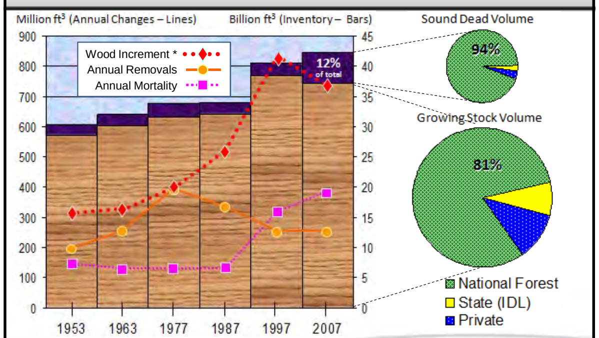
Forest inventory change, 1953-2007



* Wood Increment is Annual Growth minus Annual Removals

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Executive Summary

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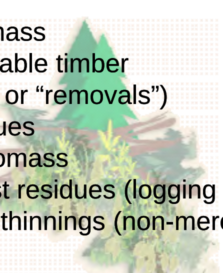
Woody biomass categories & definitions



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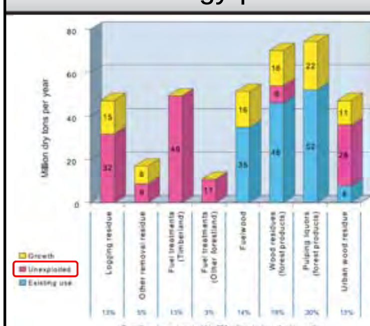
Wood bioenergy potential feedstocks



Rank-ordered

- Fuel treatments (timberland)
- Logging residues
- Urban wood residues
- Mill residues
- Fuel treatments (rangeland)

http://www1.eere.energy.gov/biomass/pdfs/final_billionton_vision_report2.pdf

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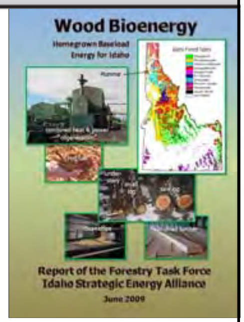
Forest biomass estimate for Idaho. . .



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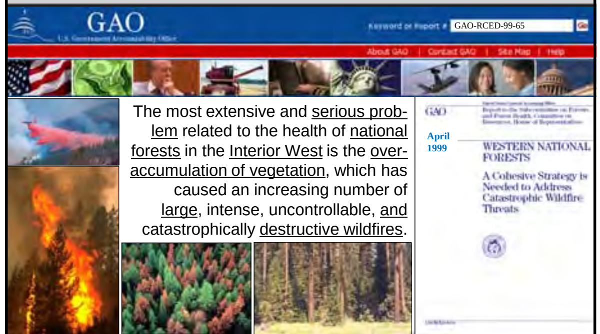
Fire & fuels



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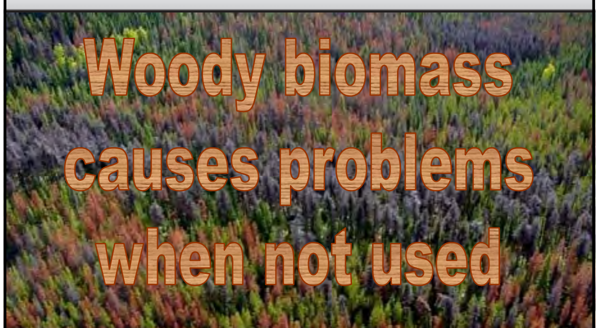
Fire & fuels



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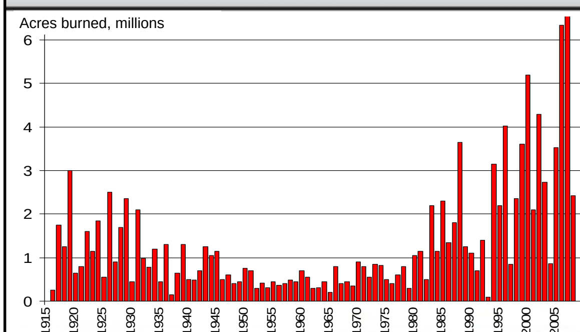
Wildfires in 11 western states, 1916-2008



Data: National Interagency Fire Center, Boise, ID

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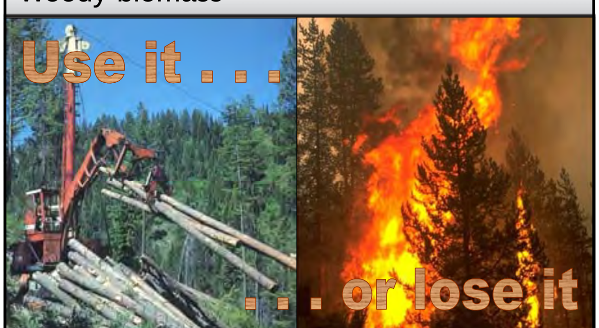
Woody biomass



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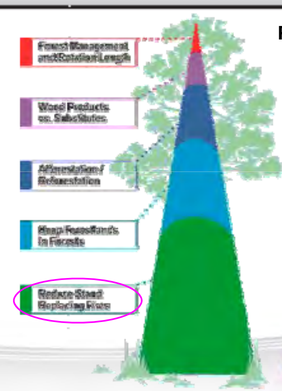
Wildfire, fuels & climate change



Relative importance of forestry strategies in affecting climate change.

Forests, Carbon and Climate Change: A Synthesis of Science Findings

2006

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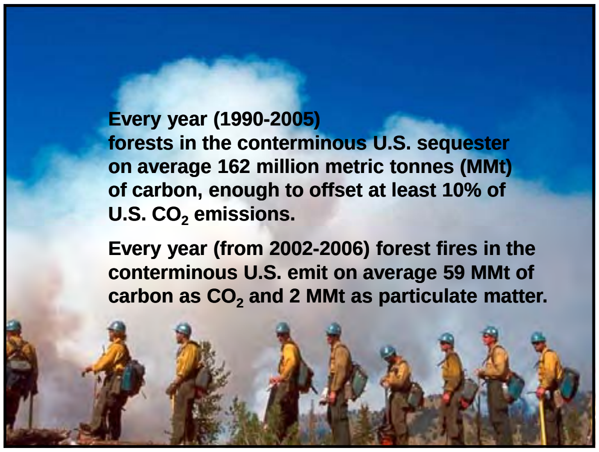

Wildfire, fuels & emissions

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Wildfire, fuels & climate change

The overall importance of climate in wildfire activity underscores the urgency of ecological restoration and fuels management to reduce wildfire hazards to human communities and to mitigate ecological impacts of climate change . . .

A.L. Westerling, et al. (2006). "Warming and earlier spring increase western U.S. forest wildfire activity." *Science* 313: 940-943.

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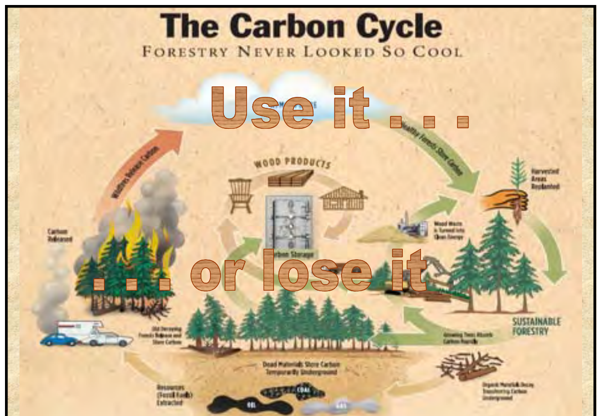
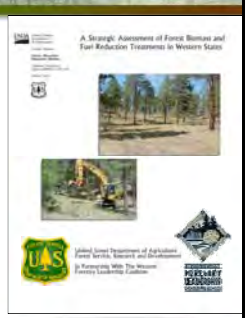


http://www.calforestfoundation.org

National Fire Plan

Implementation of any significant fuel reduction effort will generate large volumes of biomass and require the development of additional workforce and operations capacity in western forests.



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Forest biomass estimate for Idaho . . .

Sustainability "screens"

- No roadless areas
- Stocking level
- No lodgepole pine
- No spruce-fir

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Idaho forest biomass – 12 counties

Total: 1.18 million dry tons

County	Fire hazard thinning Public	Fire hazard thinning Private	Thinning (general) Private	Logging residue Public	Logging residue Private	Unused mill residues	TOTAL
Adams	9,575	0	1,479	1,126	11,609	0	23,789
Boise	8,096	1,092	2,034	18,598	14,255	0	44,075
Valley	7,003	1,029	359	15,480	11,240	488	35,599
Washington	[illegible]	0	0	0	1,652	0	21,897
4-county subtotal	44,919	2,121	3,872	35,204	38,756	488	125,360
Benewah	4,332	10,970	10,276	6,885	57,956	264	90,683
Bonner	101,828	25,119	6,784	0	64,825	170	198,726
Boundary	29,120	2,790	3,219	7,113	20,921	610	63,773
Clearwater	60,010	26,869	0	21,908	74,950	42	183,779
Idaho	64,578	8,538	4,394	3,971	35,331	122	116,934
Kootenai	30,178	12,809	5,684	1,849	66,301	3,936	120,757
Latah	9,663	20,842	8,189	5,288	45,621	0	89,603
Shoshone	74,236	36,101	2,267	3,394	76,278	0	192,276
TOTAL	418,864	146,159	44,685	85,612	480,939	5,632	1,181,861

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Idaho forest biomass – 12 counties

1.18 million dry tons/year
@ $30/ton "roadside" for
fire hazard thinnings and
@ $10/ton for logging slash

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Idaho forest biomass – statewide

Total: 1.33 million dry tons



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Idaho forest biomass – statewide

Total: 1.33 million dry tons



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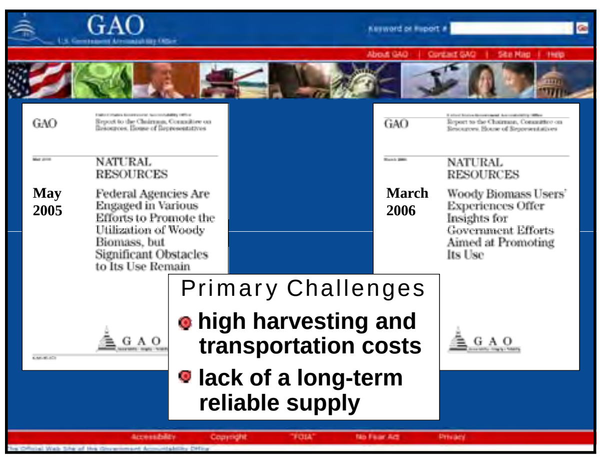
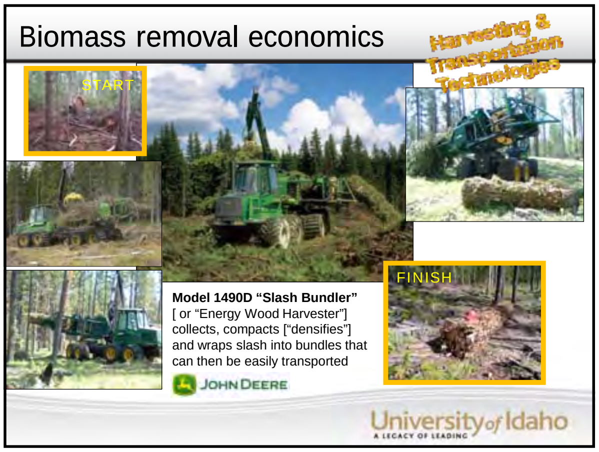


Primary Challenges

- high harvesting and transportation costs
- lack of a long-term reliable supply


Biomass removal economics
Harvesting & Transportation Technologies
START
FINISH
Model 1490D "Slash Bundler"
[or "Energy Wood Harvester"]
collects, compacts ["densifies"]
and wraps slash into bundles that
can then be easily transported
JOHN DEERE
University of Idaho
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Biomass removal economics
9. Economics
Combining removal of more valuable products with biomass removal can make projects feasible.
Synthesis of Knowledge from Woody Biomass Removal Case Studies
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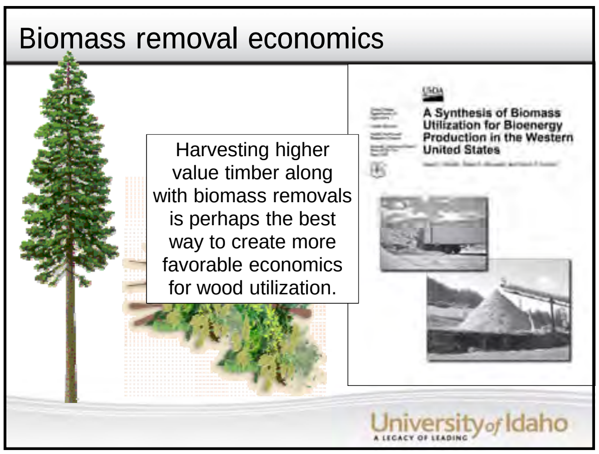
Biomass removal economics
Harvesting higher value timber along with biomass removals is perhaps the best way to create more favorable economics for wood utilization.
USDA
A Synthesis of Biomass Utilization for Bioenergy Production in the Western United States
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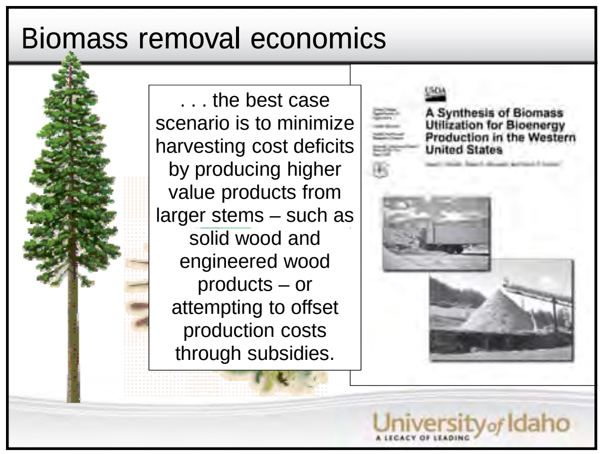
Biomass removal economics
. . . the best case scenario is to minimize harvesting cost deficits by producing higher value products from larger stems – such as solid wood and engineered wood products – or attempting to offset production costs through subsidies.
USDA
A Synthesis of Biomass Utilization for Bioenergy Production in the Western United States
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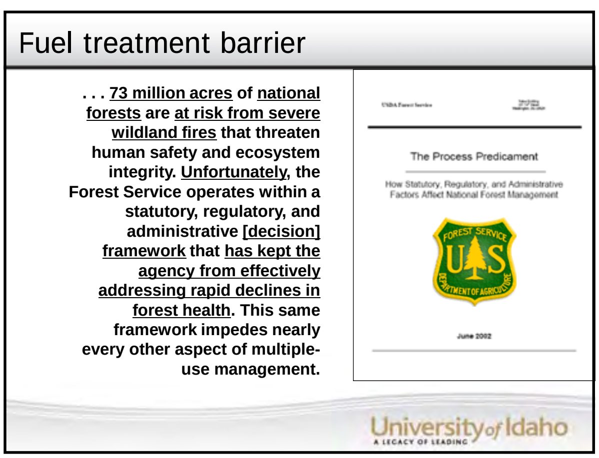
Fuel treatment barrier
. . . 73 million acres of national forests are at risk from severe wildland fires that threaten human safety and ecosystem integrity. Unfortunately, the Forest Service operates within a statutory, regulatory, and administrative [decision] framework that has kept the agency from effectively addressing rapid declines in forest health. This same framework impedes nearly every other aspect of multiple-use management.
USDA Forest Service
The Process Predicament
How Statutory, Regulatory, and Administrative Factors Affect National Forest Management
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
June 2002
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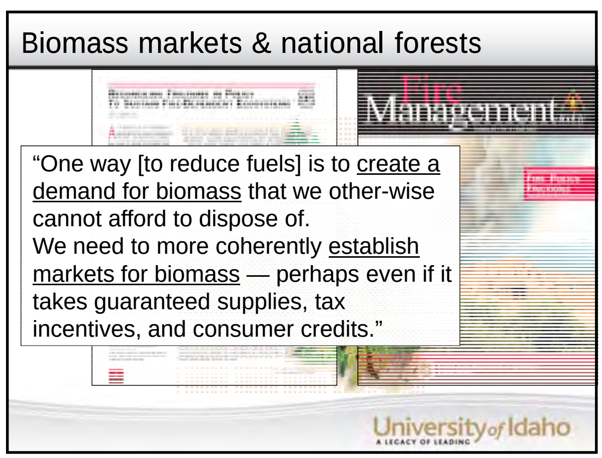
Biomass markets & national forests
Fire Management today
"One way [to reduce fuels] is to create a demand for biomass that we other-wise cannot afford to dispose of.
We need to more coherently establish markets for biomass — perhaps even if it takes guaranteed supplies, tax incentives, and consumer credits."
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Forest biomass economics

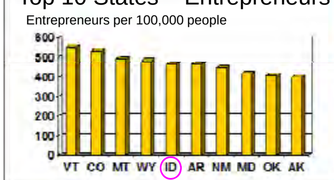
Create demand for biomass?
Establish markets . . .?

Biomass markets & national forests

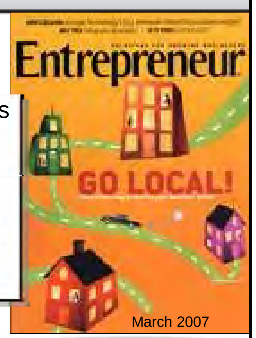
- Identify desired forest conditions: inventory, species, age classes, etc.
- Using current conditions, project future conditions under various scenarios
- Identify departures between trajectories from current to desired conditions
- For "overstocked" forests, estimate:
  - Quantity & size of material to remove
  - Schedule for removals ("levelize" – CROP)
- Allow contractors flexibility in attaining desired "end results" conditions
- Work with stakeholders early and often

Biomass markets & national forests

Top 10 States – Entrepreneurs

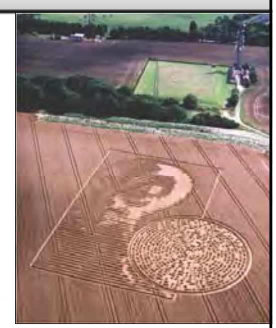


http://money.cnn.com/magazines/fsb/fsb_beststates/2007/



March 2007

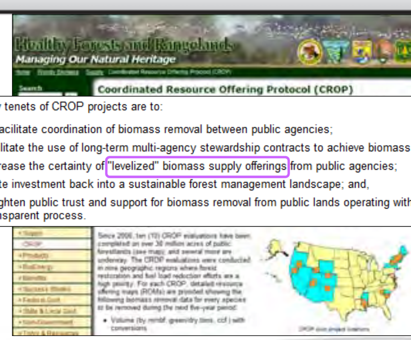
What is a CROP circle?



What is a CROP circle?

In 2006, the U.S. Forest Service and Bureau of Land Management undertook a series of CROP pilot projects as a means of addressing the growing fuel load problem within major forest systems and the realized potential for fostering catastrophic wildfires within these systems across the United States. Focused on biomass removal (versus biomass inventory), the CROP model was initially developed in 2003 by Oregon-based Mater Engineering targeting unlevelized, uncoordinated, and erratic resource offerings from public forest lands at landscape scale.

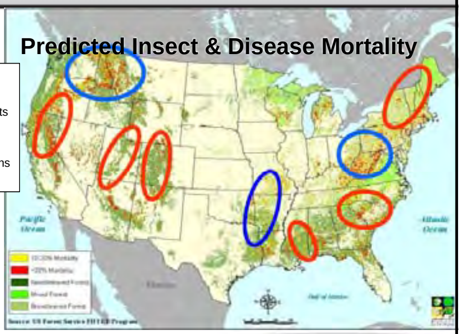
What is a CROP circle?



The key tenets of CROP projects are to:

1. to facilitate coordination of biomass removal between public agencies;
2. facilitate the use of long-term multi-agency stewardship contracts to achieve biomass removal;
3. increase the certainty of "levelized" biomass supply offerings from public agencies;
4. invite investment back into a sustainable forest management landscape; and,
5. heighten public trust and support for biomass removal from public lands operating within a transparent process.

Mortality & CROP projects



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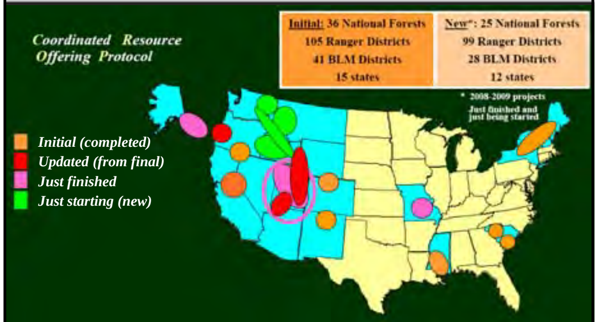
Idaho "CROP" projects



Mater, C. (June 9, 2009 presentation to Woody BUG) IDAHO Strategic Energy Alliance

"CROP" projects, Washington-Idaho-Montana*

Coordinated Resource Offering Protocol

* Planned for 2009 implementation

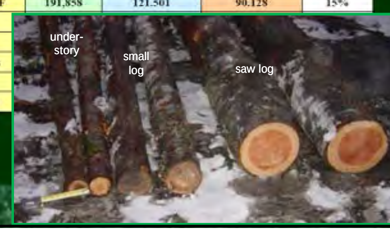
IDAHO Strategic Energy Alliance

Northeast Washington CROP

11

Who's providing what?

Agency	5-yr total Biomass (gT)	5-yr total Small Log (mmbf)	5-yr total Large Log (mmbf)	% of 5-yr total
Idaho BLM	1,520	10.657	1.02	1%
Oregon/Washington BLM	1,000	19.38	5.32	1%
Colville NF	126,350	100.13	26.79	9%
Idaho Panhandle NF	191,858	121.501	90.128	15%
Kootenai NF				
Okanogan NF				
Idaho Dept. Lands				
Montana DNRC				
Washington DNR				



June 2009

Southwest Idaho CROP

11

Who's providing what?

Agency	5-yr total Biomass (gT)	5-yr total Small Log (mmbf)	5-yr total Large Log (mmbf)	% of 5-yr total
Idaho BLM	10,700	11.781	13.141	4%
Boise NF	73,437	113.253	86.494	33%
Payette NF	122,603	79.275	52.272	24%
Salmon-Challis NF	56,291	33.456	3.616	7%
Sawtooth NF	16,525	14.48	2.145	3%
Idaho Dept. of Lands	127,300	13.757	146.244	28%

July 2009 Mater Ltd. Catherine M. Mater

North Central Idaho CROP

10

Who's providing what?

Agency	5-yr total Biomass (gT)	5-yr total Small Log (mmbf)	5-yr total Large Log (mmbf)	% of 5-yr total
Idaho BLM	28,199	10.119	5.553	3%
Clearwater NF	7,688	35.012	78.350	17%
Nez Perce NF	10,482	15.976	41.927	9%
Idaho Dept. of Lands	221,460	20.511	398.186	70%

July 2009 Mater Ltd. Catherine M. Mater

CROP summary — Idaho National Forests

National Forest	5-yr total biomass *(g tons)**	5-yr total small log *(mmbf)*	5-yr total large log *(mmbf)*
Idaho Panhandle NF	191,858	121.501	90.128
Clearwater NF	7,688	35.012	78.350
Nez Perce NF	10,482	15.976	41.297
Payette NF	122,603	79.275	52.272
Boise NF	73,437	113.253	86.494
Sawtooth NF	16,525	14.480	2.145
Salmon-Challis NF	56,291	33.456	3.616
Caribou-Targhee NF	?	?	?
Total	478,884	412.951	354.302

**1 g ton = 160 bf*

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CROP summary — Idaho National Forests

National Forest	5-yr total biomass *(g tons)*	5-yr total small log *(mmbf)*	5-yr total large log *(mmbf)*
Idaho Panhandle NF	191,858	[illegible]	[illegible]
Clearwater NF	[illegible]	[illegible]	78.350
Nez Perce NF	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	52.272
Boise NF	[illegible]	113.253	86.494
[illegible]	16,525	14.480	2.145
Salmon-Challis NF	56,291	33.456	3.616
Caribou-Targhee NF	?	?	?
Total	478,884	412.951	354.302

Assume all planned projects are implemented (NEPA & $)

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Idaho forest biomass – 12 counties

County	Fire hazard thinning Public	Fire hazard thinning Private	Thinning (general) Private	Logging residue Public	Logging residue Private	Unused mill residue	TOTAL
Adams	9,575	0	1,479	[illegible]	[illegible]	0	23,789
Boise	8,096	1,092	[illegible]	[illegible]	14,255	0	44,075
Valley	[illegible]	[illegible]	559	15,480	[illegible]	[illegible]	35,599
Washington	[illegible]	0	0	[illegible]	[illegible]	0	21,897
4-county subtotal	44,919	[illegible]	[illegible]	35,204	38,756	[illegible]	[illegible]
Benewah	[illegible]	[illegible]	10,276	[illegible]	[illegible]	264	90,683
Bonner	[illegible]	25,119	[illegible]	[illegible]	[illegible]	170	[illegible]
Boundary	29,120	[illegible]	[illegible]	7,113	[illegible]	[illegible]	[illegible]
Clearwater	[illegible]	26,869	0	[illegible]	[illegible]	42	183,779
Idaho	64,578	[illegible]	[illegible]	5,971	35,331	122	116,934
Kootenai	[illegible]	[illegible]	5,684	1,849	66,301	3,936	120,757
Latah	[illegible]	20,842	8,189	5,288	45,621	0	89,603
Shoshone	74,236	36,101	2,267	3,394	76,278	0	192,276
TOTAL	418,864	146,159	44,685	85,612	480,939	5,632	1,181,861

1.18 million dry tons/year
@ $30/ton "roadside" for
fire hazard thinnings and
@ $10/ton for logging slash

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CROP summary — Idaho National Forests

National Forest	5-yr total biomass *(mmbf)*	5-yr total small log *(mmbf)*	5-yr total large log *(mmbf)*	5-yr total everything *(mmbf)*
Idaho Panhandle NF	30.697	121.501	90.128	242.326
Clearwater NF	1.230	35.012	78.350	114.592
Nez Perce NF	1.677	15.976	41.297	58.950
Payette NF	19.616	79.275	52.272	151.613
Boise NF	11.750	113.253	86.494	211.497
Sawtooth NF	2.644	14.480	2.145	19.269
Salmon-Challis NF	9.007	33.456	3.616	46.079
Caribou-Targhee NF	?	?	?	?
Total	76.621	412.951	354.302	843.874

4.8% of gross annual growth

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Are national forests sustainable?

"We have some 73 million acres of national forest land at risk from wildland fires that could compromise human safety and ecosystem integrity. . . .

"The situation is simply not sustainable — not socially, not economically, not ecologically."

Bosworth, Dale (2003). "Fires and forest health: Our future is at stake." *Fire Management Today* 63(2):4 –11.

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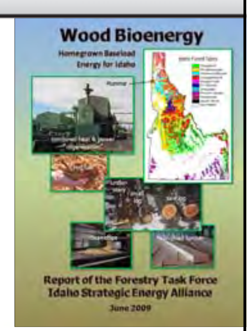
Executive Summary

- Current Situation
- Potential
- Barriers and Challenges to Development
- Options for Development



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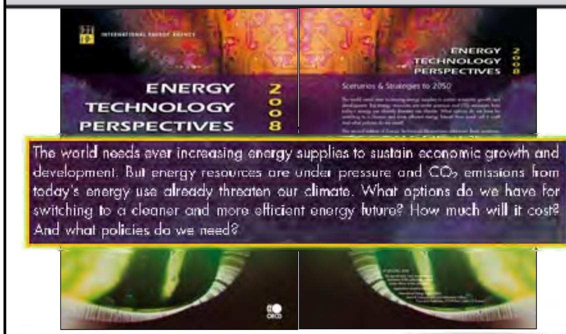
Social disagreement about forestry . . .

Energy perspectives – Int'l Energy Agency



http://www.iea.org/Textbase/techno/etp/index.asp

Forests' role in climate change mitigation

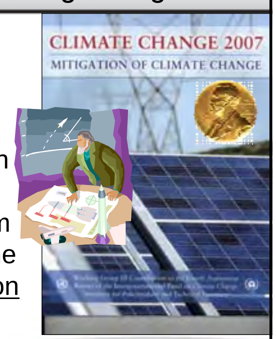
Forests contain three-fourths of the earth's plant biomass, about half of which is carbon.

Consequently, forests play a key role in the global carbon cycle by capturing, storing, and cycling carbon.

http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=190806

Forests' role in climate change mitigation

". . . a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber fibre or energy from the forest, will generate the largest sustained mitigation benefit."



http://www.ipcc.ch/ipccreports/ar4-wg3.htm

Forests' role in climate change mitigation

Safe storage of carbon on, in, or deep under the soil create roles for forestry.

Five types of carbon reservoirs are preferable to storing carbon in the atmosphere:
1) new forestry plantations,
2) new timber structures and other durable wood products,
3) underground wood burial, perhaps in abandoned strip mines,
4) biochar storage in soil reservoirs with co-produced bio-oil, and
5) carbon capture and storage in deep geological strata or as bicarbonates in the ocean or insoluble carbonates on land in played-out coal mines

Earthscan 2009

Forests' role in climate change mitigation

Safe storage of carbon on, in, or deep under the soil create roles for forestry.

In addition, the existing fossil carbon reservoir is maintained *in situ* through technology chains that involve bioenergy and other renewable sources of energy that substitute for fossil fuel.

Earthscan 2009

Wood bioenergy: back to the future

THE INDEPENDENT ON SUNDAY CLIMATE CHANGE

Phase out coal and burn trees instead, urges leading scientist

Current targets on emissions are 'a recipe for global disaster, not salvation'

By Geoffrey Lean, Environment Editor

Sunday, 14 September 2008 – Humanity must urgently embark on a massive programme to power civilisation from wood to stave off catastrophic climate change, says one of the world's top scientists. Twenty years ago, Dr. James Hansen was the first leading scientist to announce that global warming was taking place. Now he has issued a warning that a back-to-the-future return to one of the oldest fuels is imperative because the world has exceeded the danger level for carbon dioxide in the atmosphere.

http://www.independent.co.uk/environment/climate-change/phase-out-coal-and-burn-trees-instead-urges-leading-scientist-929889.html

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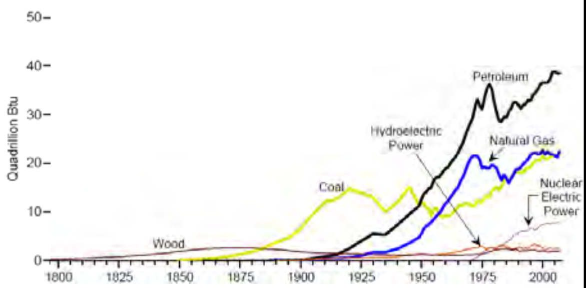
Who is James Hansen?

Historic U.S. energy consumption by source



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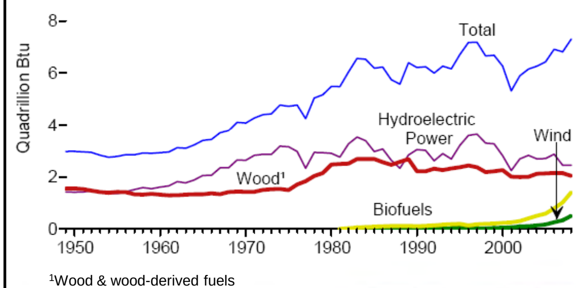
Renewable energy sources, 1949-2008



[1]Wood & wood-derived fuels

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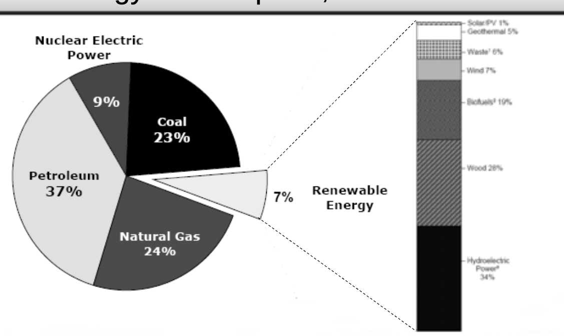
U.S energy consumption, 2008



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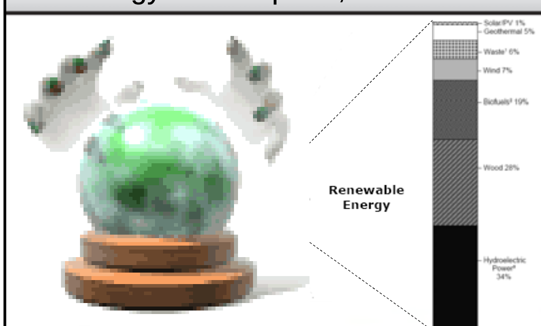
U.S energy consumption, 2008



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U.S. energy consumption projections

Fuel source	2006	2007	2010	2015	2020	2025	2030	Annual Growth 2007-2030 %/year
	Reference Case (quadrillion Btu)							
Renewable energy	6.77	6.69	8.43	9.84	11.33	13.11	14.10	✔ 3.3%
Petroleum.	40.13	40.11	36.66	37.18	36.87	36.91	38.17	(0.2%)
Natural gas.	22.26	23.70	23.20	23.40	24.09	25.36	25.04	0.2%
Coal	22.46	22.74	22.91	23.59	23.98	24.45	26.56	0.7%
Nuclear power.	8.21	8.41	8.45	8.68	8.99	9.04	9.47	0.5%
Total	100.0	101.9	99.85	102.9	105.4	109.0	113.6	0.5%

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U.S. energy consumption projections

Fuel source	2006	2007	2010	2015	2020	2025	2030	Annual Growth 2007-2030 %/year
	Reference Case (quadrillion Btu)							
Renewable energy	6.77	6.69	8.43	9.84	11.33	13.11	14.10	3.3%
Hydropower.	2.87	2.46	2.67	2.94	2.95	2.96	2.97	0.8%
Biomass.	3.02	3.26	4.22	5.27	6.64	8.20	8.94	✔ 4.8%
Other renewables	0.88	0.97	1.54	1.63	1.74	1.95	2.19	3.6%
Municipal waste.	0.31	0.33	0.35	0.36	0.36	0.36	0.36	0.7%
Geothermal.	0.31	0.31	0.38	0.41	0.43	0.44	0.51	2.1%
Solar.	0.00	0.01	0.01	0.02	0.02	0.03	0.03	4.9%
Wind.	0.26	0.32	0.80	0.84	0.92	1.12	1.29	6.3%
Petroleum.	40.13	40.11	36.66	37.18	36.87	36.91	38.17	(0.2%)
Natural gas.	22.26	23.70	23.20	23.40	24.09	25.36	25.04	0.2%
Coal	22.46	22.74	22.91	23.59	23.98	24.45	26.56	0.7%
Nuclear power.	8.21	8.41	8.45	8.68	8.99	9.04	9.47	0.5%
Total	100.0	101.9	99.85	102.9	105.4	109.0	113.6	0.5%

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U.S. energy consumption projections

Fuel source	2006	2007	2010	2015	2020	2025	2030	Annual Growth 2007-2030 %/year
	Reference Case (quadrillion Btu)							
Biomass.	3.02	3.26	4.22	5.27	6.64	8.20	8.94	4.8%
Wood (heat & power)	1.86	1.87	1.93	2.29	2.99	3.26	3.41	2.6%
Residential heat	0.39	0.43	0.43	0.46	0.48	0.49	0.50	0.7%
Commercial heat	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.0%
Ind. heat & power	1.16	1.11	1.02	1.07	1.13	1.25	1.38	2.6%
Dedicated power	0.15	0.16	0.15	0.13	0.28	0.35	0.61	✔ 5.9%
Cofiring power	0.04	0.05	0.21	0.51	0.98	1.05	0.80	✔ 12.9%
Agric. biomass (heat)	0.66	0.75	1.07	1.29	1.59	2.01	2.09	4.6%
Industrial heat	0.36	0.35	0.32	0.34	0.36	0.39	0.43	0.9%
Biofuels heat loss	0.30	0.40	0.75	0.95	1.23	1.62	1.66	6.4%
Biofuels (transport) . .	0.50	0.64	1.23	1.68	2.06	2.93	3.43	7.6%
Cellulosic ethanol . .	0.00	0.0+	0.0+	0.03	0.18	0.42	0.43	43.9%
Corn ethanol	0.41	0.55	1.08	1.34	1.42	1.42	1.41	4.2%
Imported ethanol . .	0.06	0.03	0.00	0.01	0.06	0.32	0.63	14.5%
Other biofuels	0.03	0.06	0.15	0.30	0.40	0.77	0.96	16.3%

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Reflecting on Idaho's past . . .

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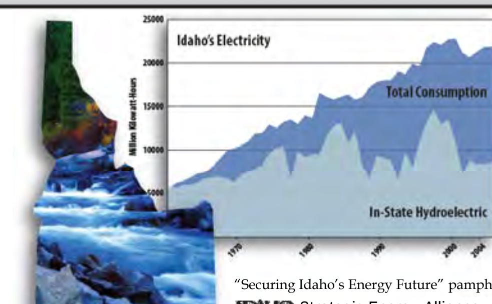
. . . to secure Idaho's energy future



"Securing Idaho's Energy Future" pamphlet

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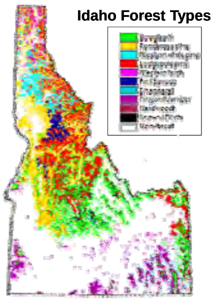
. . . to secure Idaho's energy future



. . . proven, cost-effective technology for providing homegrown, reliable baseload energy

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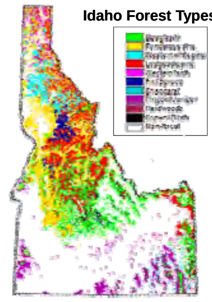
Wood bioenergy . . .



- . . . provides 1.8% of the energy consumed in the U.S. (2007)
- . . . provides 4.7% of the energy consumed in Idaho

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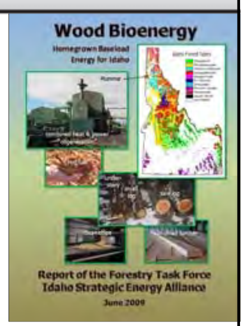
Wood bioenergy recommendations . . .

- **Create business tax credit**
- **Create biomass removal incentive**
- **Expand "Fuels for Schools" program**
- **Increase U.S. Forest Service budget for restoration**
- **Change federal biomass definitions**
- **Increase community support**



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Conclusions

- **Wood bioenergy opportunities in Idaho are substantial and sustainable.**
- **Many Idaho communities are interested in installing wood bioenergy facilities, and for several reasons.**

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Conclusions

- **Uncompensated social benefits exceed the value of thermal energy and biopower production, and include**
  - **rural employment,**
  - **improved forest conditions,**
  - **avoided costs of wildfire suppression and post-fire rehabilitation,**
  - **improved air quality, and**
  - **reduced greenhouse gas emissions.**

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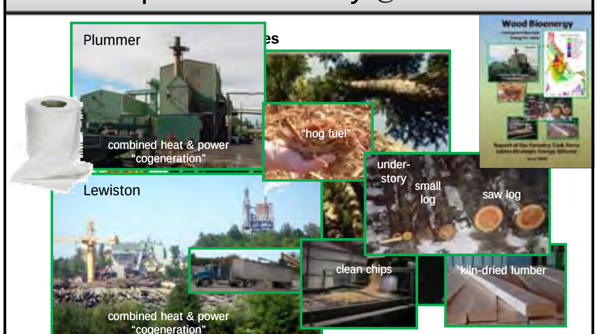
Wood biopower: electricity @ 5¢–8¢/kWh



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Electricity “avoided cost” @ 9¢/kWh

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Wood biopower: electricity @ 8¢–12¢/kWh

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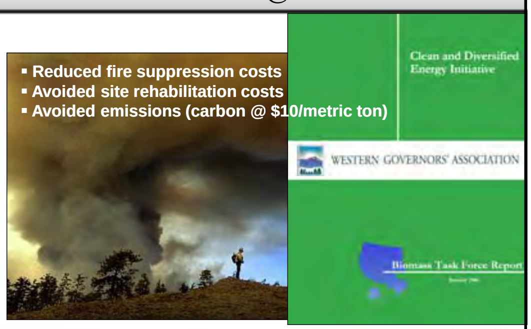
Fuel treatment benefits @ 12.6¢/kWh

- Reduced fire suppression costs
- Avoided site rehabilitation costs
- Avoided emissions (carbon @ $10/metric ton)



WGA (2006) Biomass Task Force Report

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Conclusions

- **These benefits support government investment in wood bioenergy as a *proven, cost-effective technology for homegrown, reliable baseload energy.***
- **Such support will be necessary in the short term to overcome the high cost and low reliability barriers [of forest biomass feedstocks] that currently exist.**
- **The payoff in the long-term will be increased energy security.**

IDAHO Strategic Energy Alliance

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Wood bioenergy has byproducts . . .

. . . opportunity to address three challenging issues:

- Restoring forest health, fire resiliency, and wildlife habitat
- Finding renewable energy alternatives
- Revitalizing western economies

http://www.forestry.org/pdf/dec06.pdf

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