Forest Biomass and Energy in California

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Biomass Working Group
May 28, 2013

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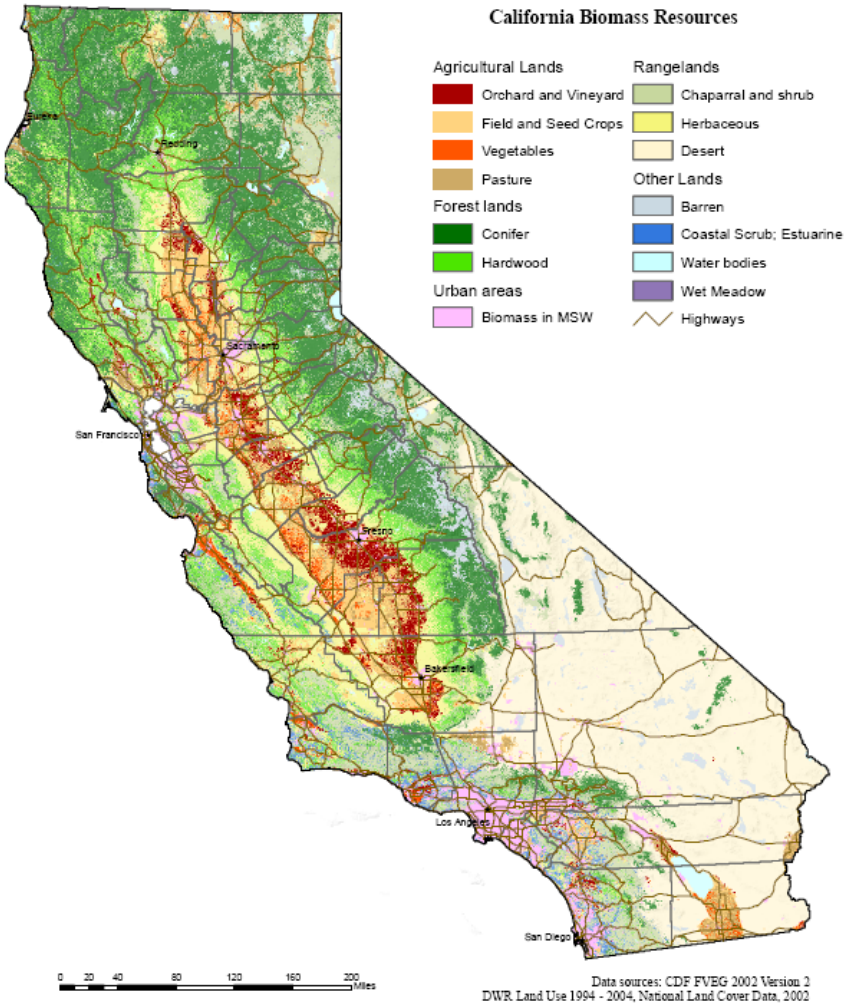
CALIFORNIA BIOMASS COLLABORATIVE

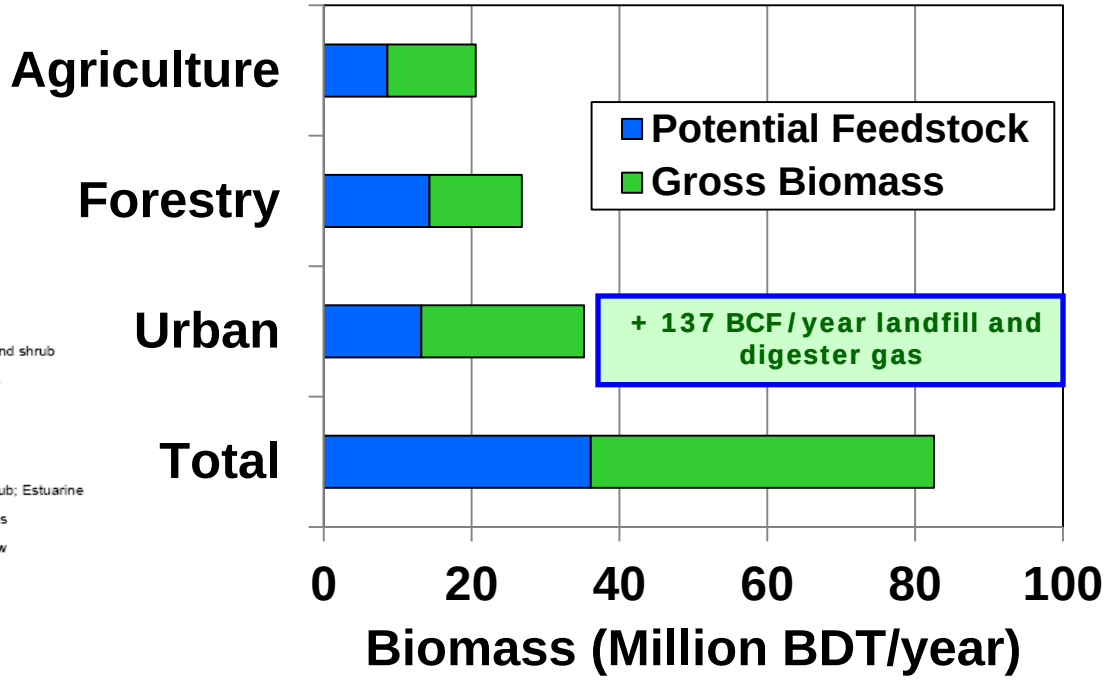
Forest Biomass and Energy

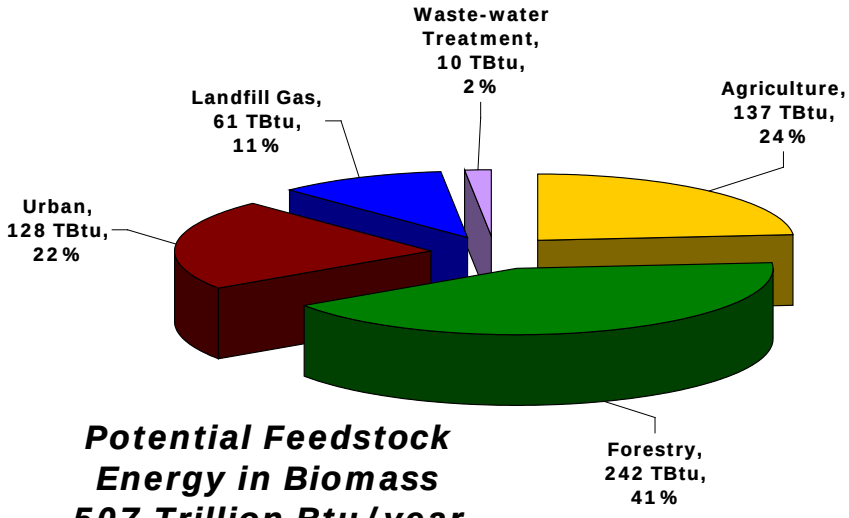
- Overview
- Biomass Management Zones
- California Biorefinery Siting Model

CALIFORNIA
BIOMASS COLLABORATIVE

California Biomass Resources Are Diverse







Potential Feedstock Energy in Biomass 507 Trillion Btu/year

Jenkins et al. (2006) A roadmap for the development of biomass in California

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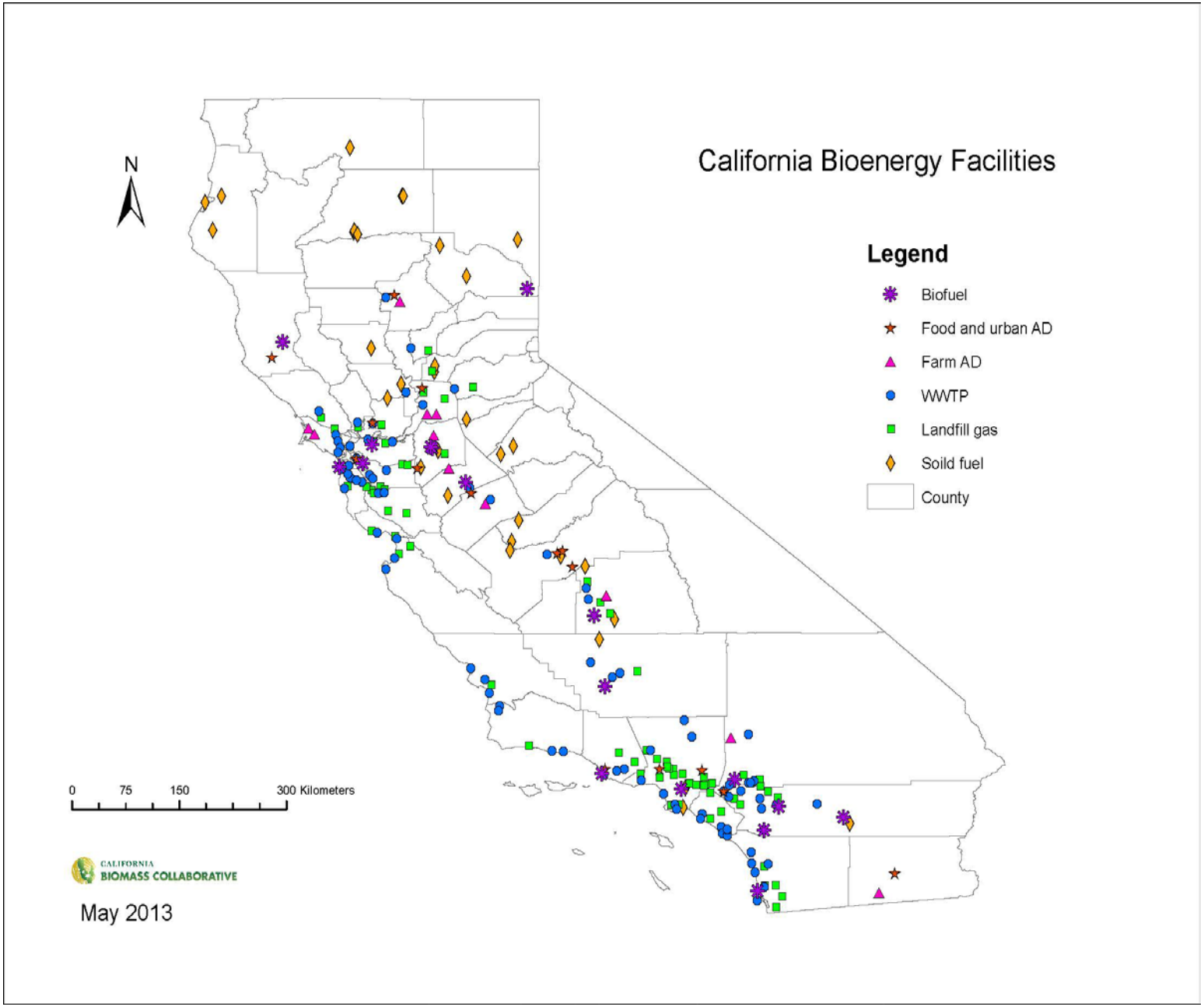
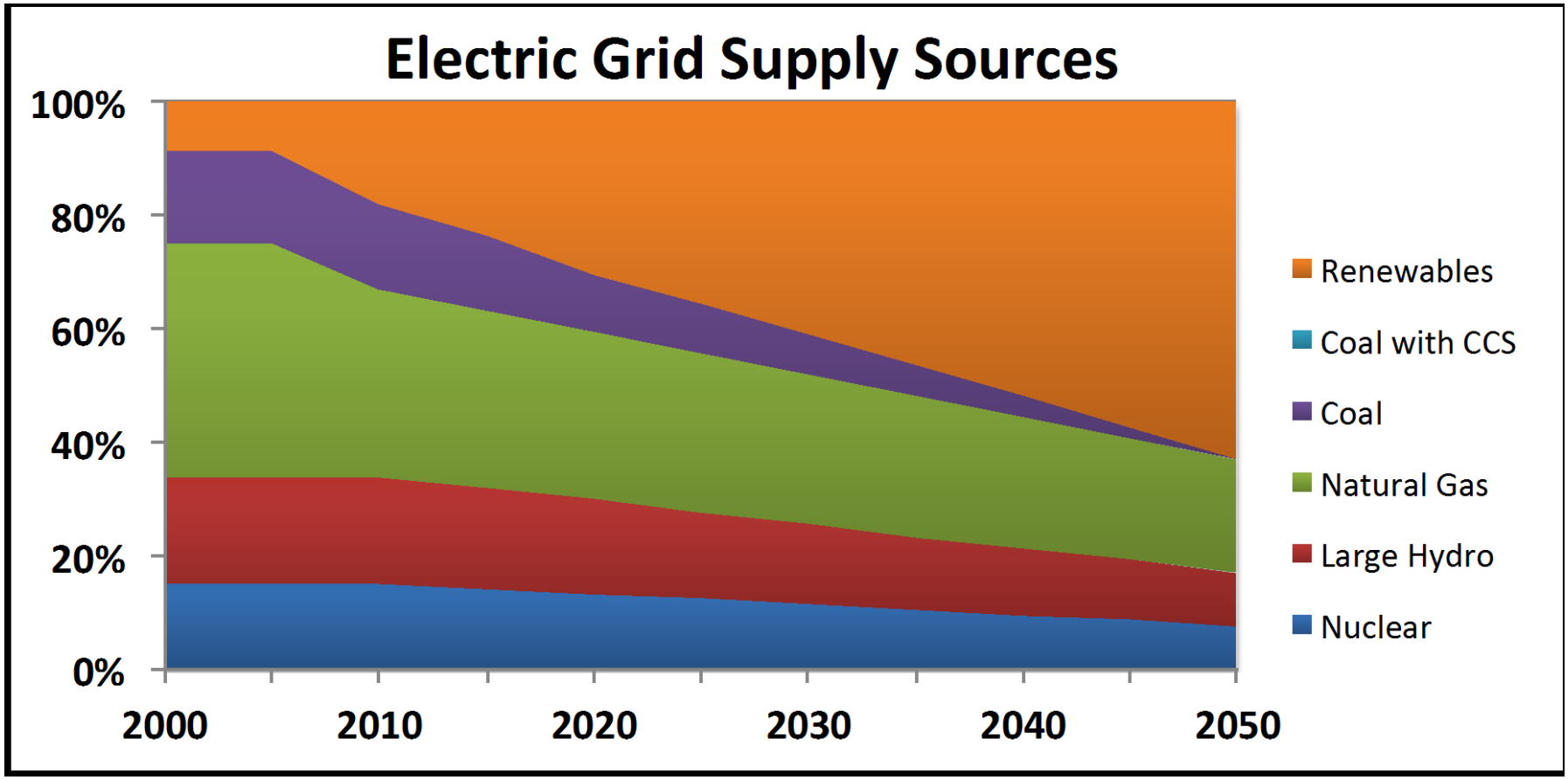

California Bioenergy Facilities
N
Legend
Biofuel
Food and urban AD
Farm AD
WWTP
Landfill gas
Soild fuel
County
0 75 150 300 Kilometers
CALIFORNIA BIOMASS COLLABORATIVE
May 2013

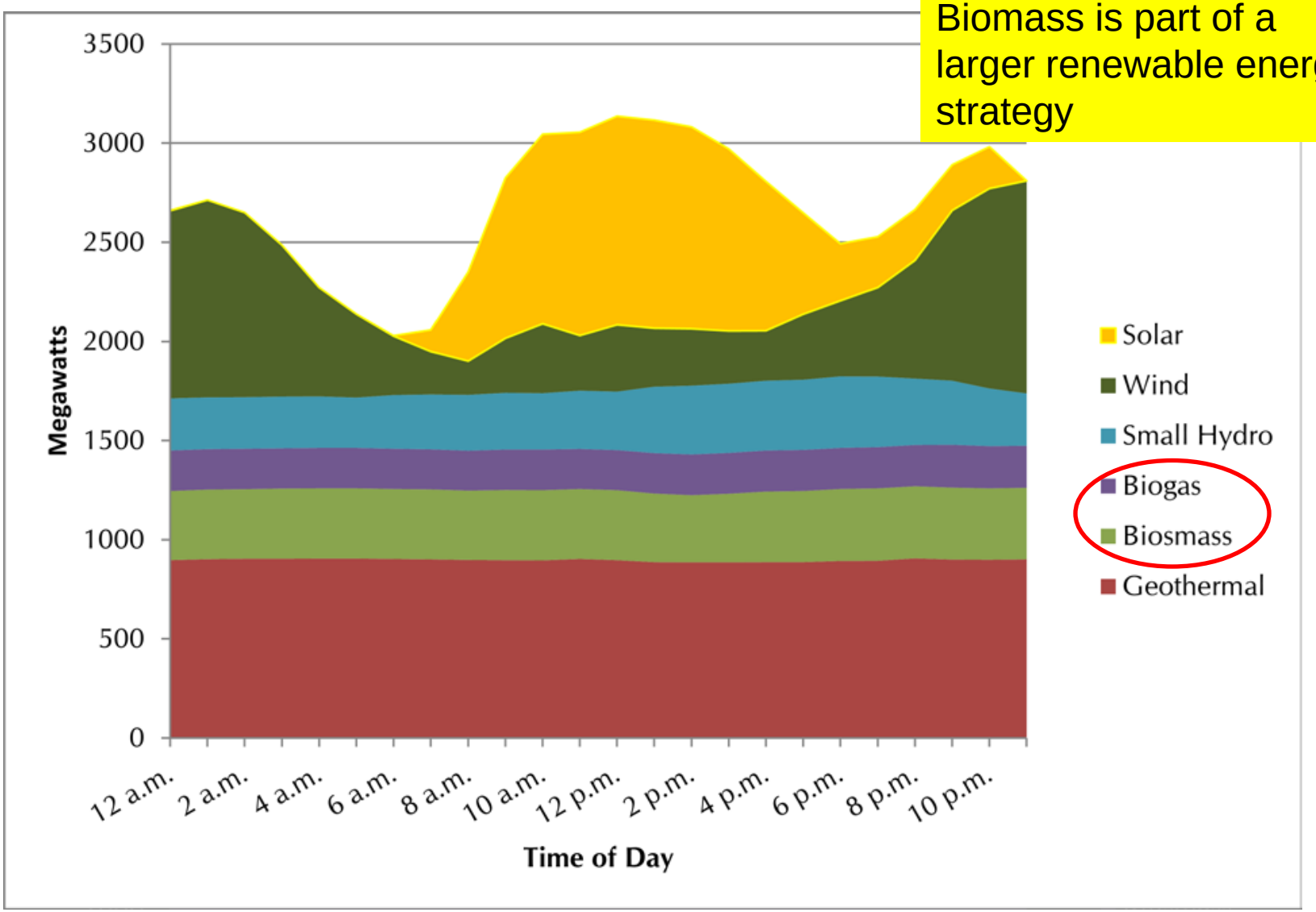
Possible Grid Power Sources in California to comply with AB 32 and LCFS Mandates



CARB projection

Hourly Breakdown of Renewable Resources for Operating Day September 13, 2012

Biomass is part of a larger renewable energy strategy



Source: California Independent System Operator. "Renewables Watch." Website accessed September 13, 2012.
http://www.caiso.com/market/Pages/ReportsBulletins/DailyRenewablesWatch.aspx Little Hoover Commission, December 2012

Current Biopower Capacity in California

5.8 TWh of in-state biopower production (17% of in-state renewable power and 2% of full California power mix)

Biopower Facilities		
Facility Type	**Net (MW)**	**Facilities**
Solid Fuel (forest, urban & ag)	574.6	27
LFG Projects (a)	371.3	79
Waste Water Treatment Facilities (b)	87.8	56
Farm AD (c)	3.8	11
Food Process/Urban AD (c)	0.7	3-5
Totals	1038	175

Solid Fuel (MSW) (mass burn facilities / organic fraction only)	63	3

* Includes: (a) LFG: 12 direct-use or CNG/LNG facilities; (b) WWTF: 8 heat or pipeline application; (c) AD: 12 Direct-use heat or fuel

Annual technically available forest biomass in CA*

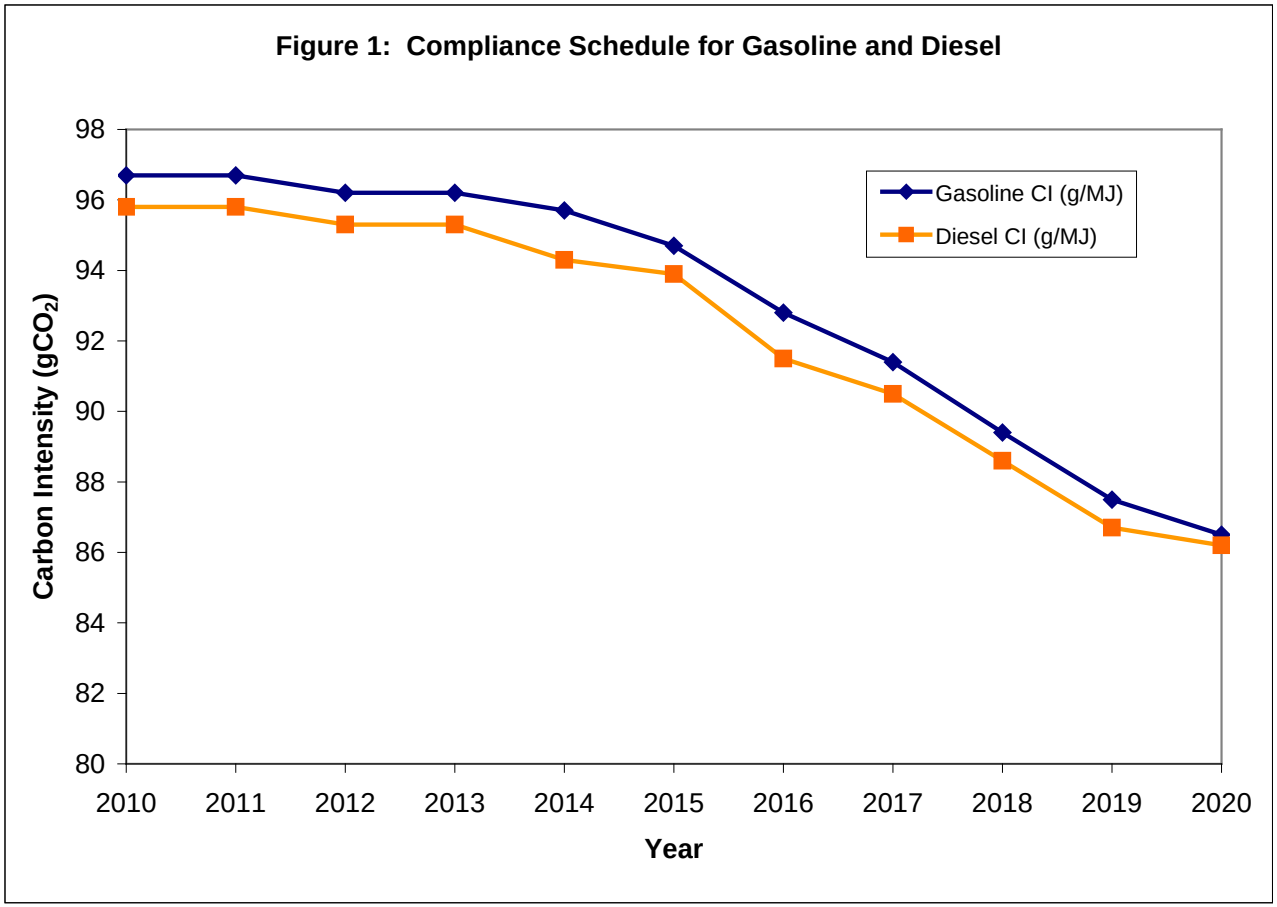
Ownership	Slash & thinnings (BDT)	Mill Waste (BDT)	Shrub (BDT)	Total (BDT)	%
Private	5,870,000	1,391,611	1,211,457	8,473,069	59.4
Federal	2,385,689	1,907,786	1,296,354	5,589,892	39.2**
State	101,777	29,771	71,905	203,453	1.4
Total	8,357,466	3,329,168	2,579,716	**14,266,351**	100
%	58.6	23.3	18.1%	100	

* CBC/CDFFP data and assumptions; **excluding federal reserves, wilderness areas, parks, etc.,

CARB projections for the need for low carbon intensity biofuels under the Low Carbon Fuel Standard

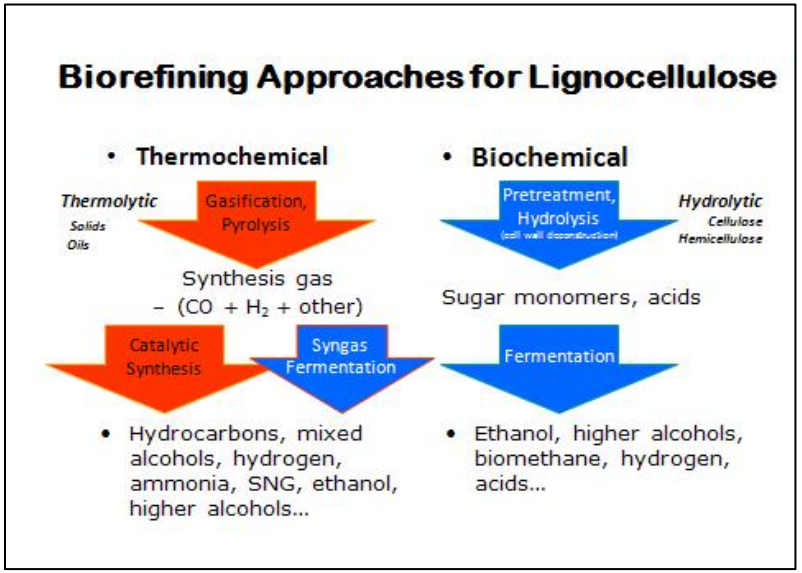
Year	Displaced Petroleum (bgge)	Sources
2009	0.6	Conventional biofuels (100%)
2020	3.0	Conventional biofuels (20%) CNG, electricity, H2: (10%) Advanced biofuels: (70%)*

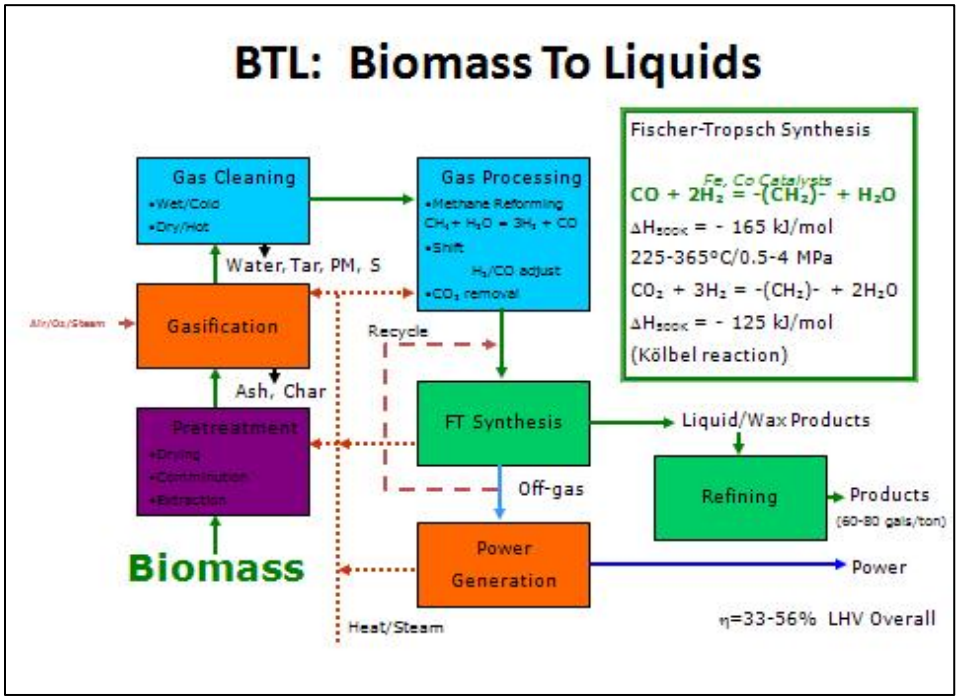
*MSW, Forestry Wastes, cellulosic biofuels, other ?



The LCFS should stimulate he production of lower carbon fuels and supporting industries. With time, low carbon intensity biofuels should command a premium price. Most compliance scenarios include biofuels. But where will the fuels come from? Brazil? We should produce some of the fuel we consume in California in-state to create new wealth and jobs.

Some potential conversion pathways for lignocellulosic residues





Courtesy of B. Jenkins

Estimated Gross Ethanol Potential from Cellulosic Residues in California---Williams et al, (2007)-AB 118 Report

Biomass Source (residues)	Potential Feed stock (MBDT/yr)	Potential Ethanol (Mgal/yr)	Gasoline equivalent (Mgge/yr)
Field and seed crops	2.3	160	105
Orchard/vine prunings	1.8	125	83
Landfills: mixed paper	4.0	320	213
Landfills: wood& green waste with ADC	2.7	216	144
Forest biomass residues	14.2	990	660
Total	24.9	1,814	1,205*

*1.5 M acres of dedicated cellulosic energy crops could add 400 to 900 Mgge to potential.

These are not estimates of economically recoverable or sustainable biomass.

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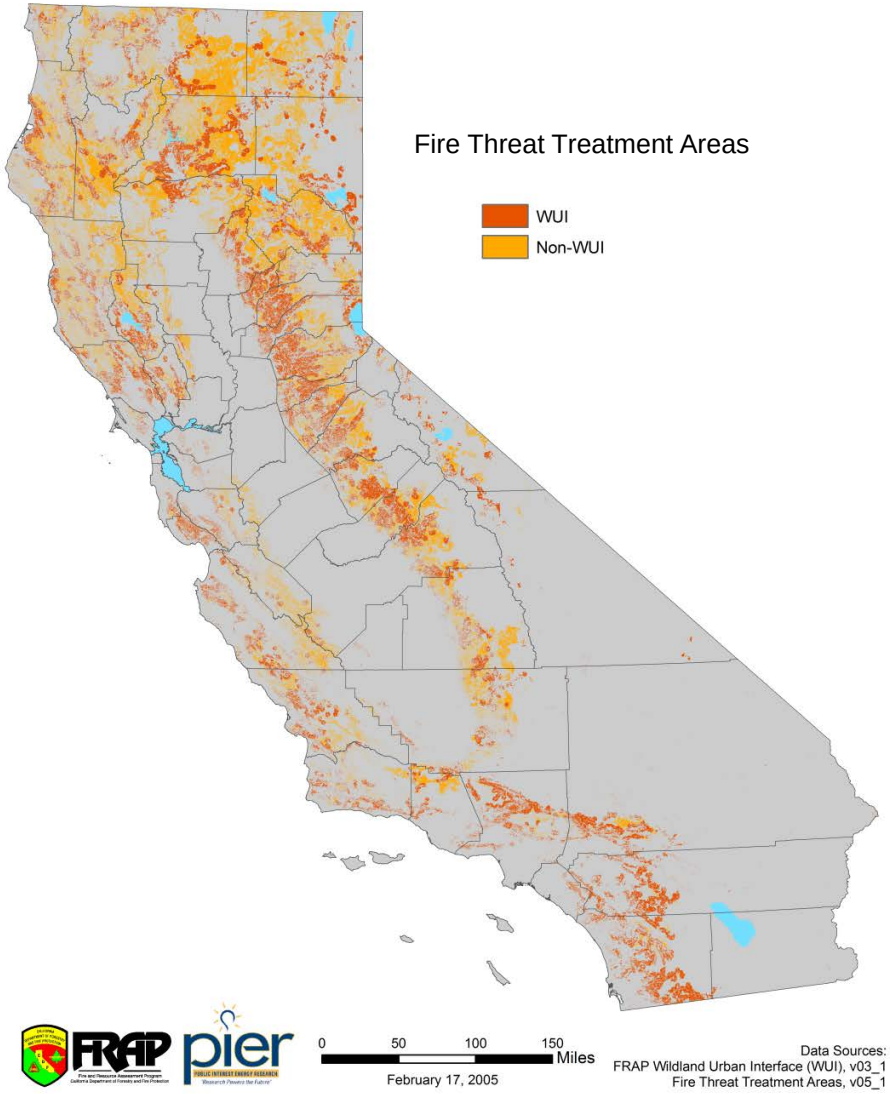
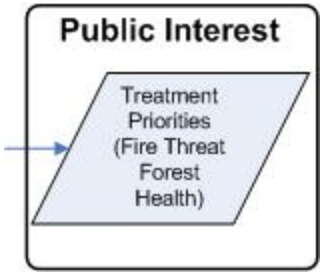
Chronic forest fires destroy large amounts of biomass annually in California, altering ecosystems, and causing public health problems. Reducing risk of fire through fuel load reduction is one way to link harvesting biomass for energy with other environmental and economic goods.

Treatment Priorities

Example treatment priorities map





Estimates for treatment priorities are reported within hauling distance

Potential Priority Areas

- Fire Threat
- Forest Health
- Insect and Disease Risk

Biomass Management Zones

Biomass Management Zones (BMZ) have been defined as 'sustainably managed woodsheds and other biomass production regions' that will support the sustainable management of urban interface woodlands and forested lands to reduce fuel loading and the potential of uncontrolled wildfire, utilize biomass and residues from forest management/products to produce bio-energy and bio-products and to stimulate local economic activity and long-term stability.

Warming and Earlier Spring Increases Western U.S. Forest Wildfire Activity

A. L.Westerling,1,2* H. G. Hidalgo,1 D. R. Cayan, 1,3 T. W. Swetnam4 1Scripps Institution of Oceanography, La Jolla, CA 92093, USA. 2University of California, Merced, CA 95344, USA. 3US Geological Survey, La Jolla, CA 92093, USA. 4Laboratory of Tree-Ring Research, University of Arizona, Tucson, AZ 85721,USA. Science Express, July, 2006

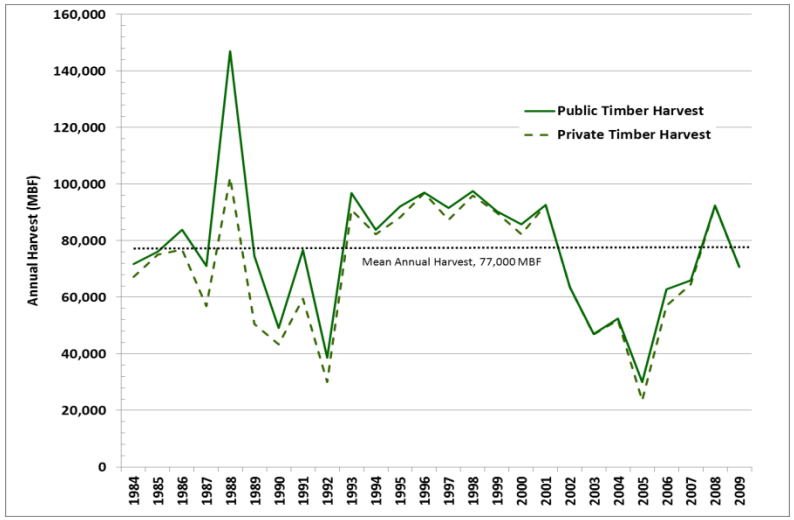
Common elements and concerns in previous/current BMZ studies

There are several common elements in BMZ studies:

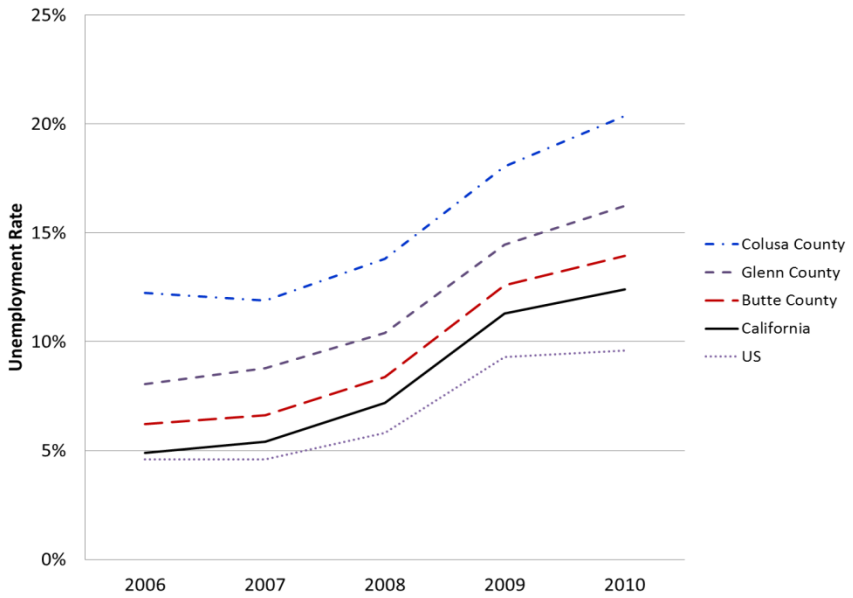
- They involved the participation of multiple individuals, groups, non-governmental and governmental agencies. Most were originated within rural communities. Considerable care and attention was given to group process and documentation of activities, data review, and outcomes.
- Creative interactions and group learning are essential to success and were emphasized. A rationally defined BMZ allows for groups and individuals to self-organize.
- Most studies concluded that large amounts of diverse biomass were available, and that if accessible in sufficient quantities, economically viable systems for collection, transformation and use were possible.

Common elements and concerns in previous/current BMZ studies

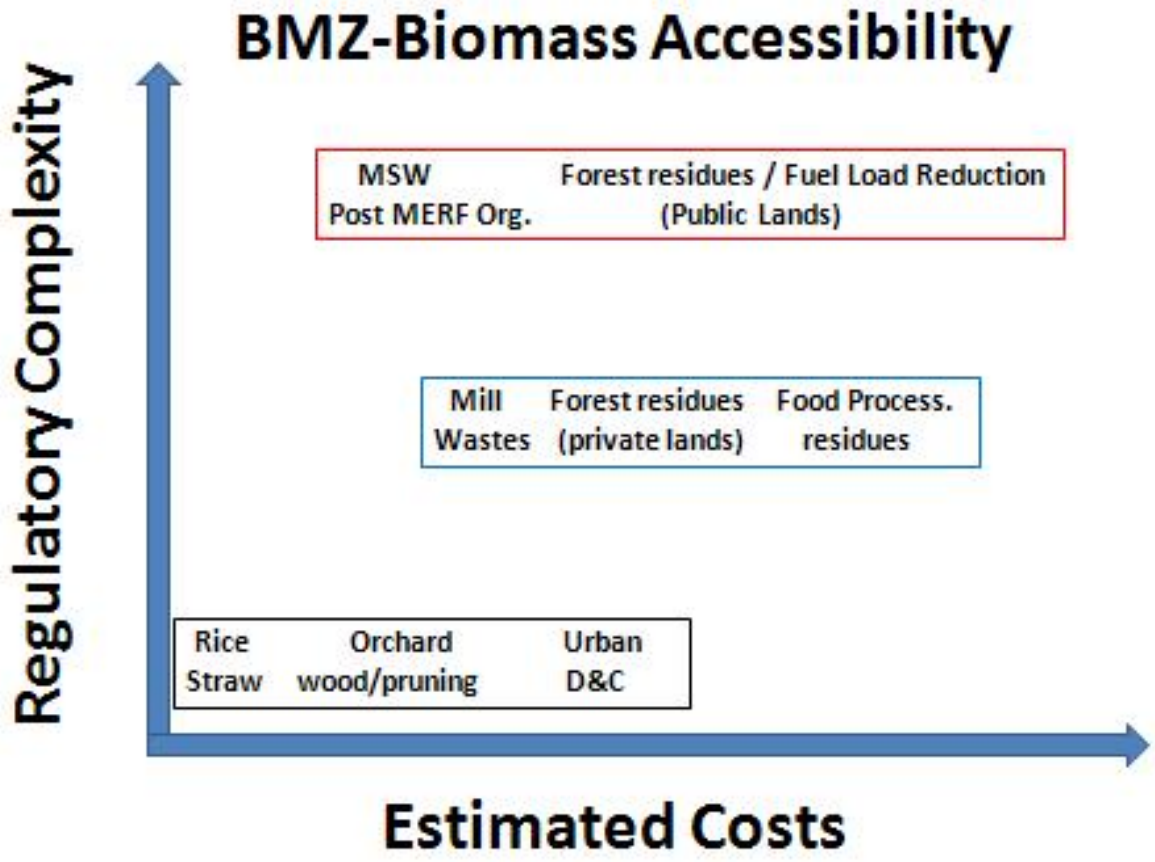
- All studies emphasize the vulnerability of large amounts of forest biomass to loss and the adverse ecological consequences of intense wildfire in the regions they study.
- It is reasonable to assume that there is a widespread consensus among knowledgeable and affected communities about the need for intervention and management in many forested regions in California to prevent senseless losses and ecosystem degradation.
- Additionally, all studies define and highlight employment gains in rural regions as an additional benefit of management

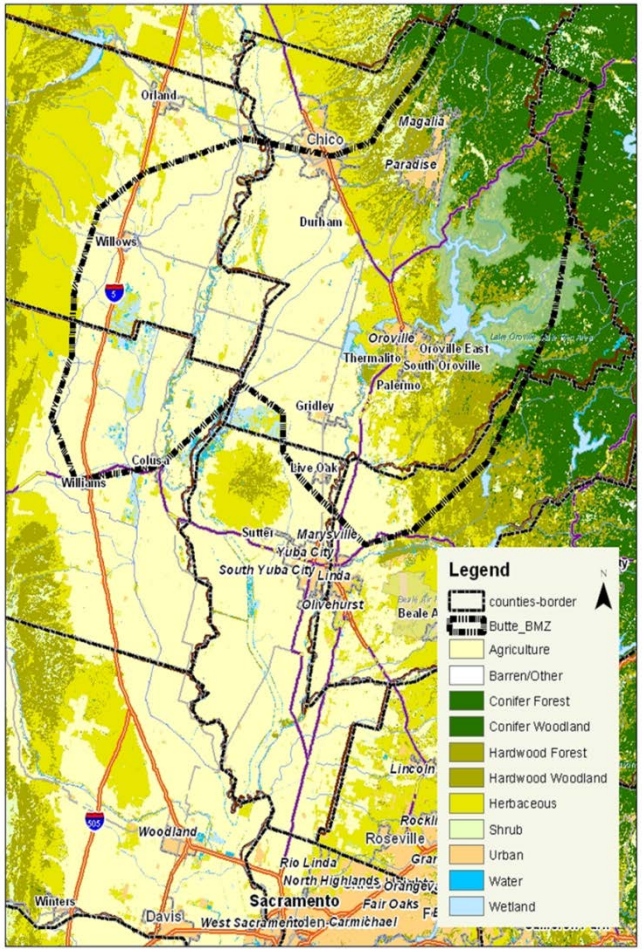


Timber harvest trends in the BMZ region

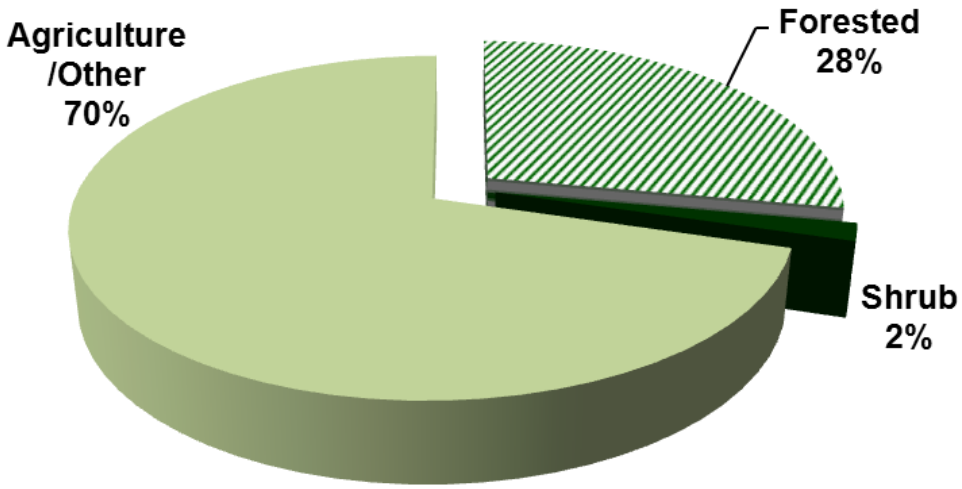


Growth in unemployment in BMZ region


BMZ-Biomass Accessibility
Regulatory Complexity
MSW
Post MERF Org.
Forest residues / Fuel Load Reduction
(Public Lands)
Mill
Wastes
Forest residues
(private lands)
Food Process.
residues
Rice
Straw
Orchard
wood/pruning
Urban
D&C
Estimated Costs



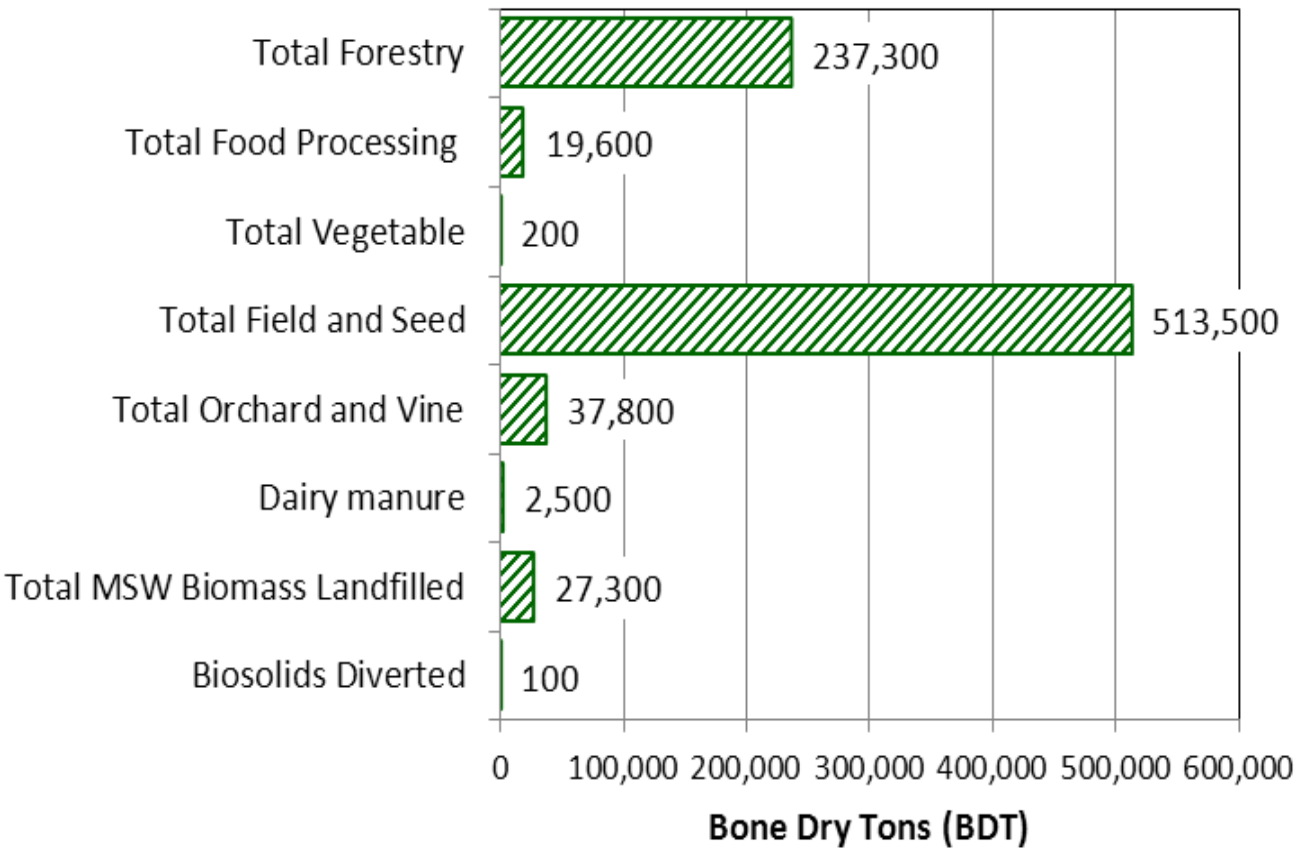
Chico-Oroville BMZ including diverse sources of biomass, all with different levels of cost and varying potential for acquisition. This region has had several severe wildfires in recent years.



Land composition in the Oroville BMZ

County	Acres	% of BMZ	Forested	Shrub	Agricultural /Other
Butte	797,517	61.1%	303,045	19,075	475,397
Glenn	222,624	17.1%	1,840	0	220,783
Colusa	154,346	11.8%	0	0	154,346
3 main counties	*1,174,487*	*90.0%*			
Yuba	76,157	5.8%	22,471	250	53,436
Plumas	40,067	3.1%	36,536	2,700	831
Sutter	14,942	1.1%	0	0	14,949
3 other counties	*131,166*	*10.0%*			
Total, acres	**1,305,653**		**363,892**	**22,025**	**919,742**
Total, percent			27.9%	1.7%	70.4%

Summary of biomass resources in the Oroville BMZ



Woody Biomass Availability and Potential Power Production Summary

Biomass Fuel Type	Economical Availability (BDT/Y)		MW	MW
	Low range	High range	Low	High
Timber Harvest Residuals	32,000	32,000	6	6
Orchard	279,000	279,000	52.1	52.1
Urban Wood	40,000	40,000	7.5	7.5
Subtotal of Established Biomass	***351,000***	***351,000***	***65.6***	***65.6***
Fuels Reduction*	90,000	90,000	18.8	18.8
Sawmill Residuals**	11,700	109,000	2.1	20.3
Total Biomass and Power	**452,700**	**550,000**	**86.5**	**104.7**

** Assumes scenario of treatment on lands 0-45% slopes with SMZ's ~ 4900 acre/year (30 year treatment) in the Wildland-Urban Interface and ~ 2580 acres/year (50 year treatment) outside the Wildland-Urban Interface*

Other potential biomass energy sources within the BMZ: Rice straw and food processing residues. Anaerobic digestion is modeled but lignified residues would be available to woody biomass facilities. More than one conversion system might be employed at a facility.

Estimated benefits from anaerobic digestion of rice straw.

		Feedstock BDT	Power Capacity, MW	Heat Value MMBTU	CH4 Avoided Mg CH4
1, Rice straw AD unit	Power production	50,000	1.9		55,000
140 tons/day	Heat production	50,000		177,000	53,000
All BMZ rice straw	Power production	223,000	8.5		245,000
4.5 AD units	Heat production	223,000		788,000	236,000

Feedstocks, biogas volumne in million standard cubic feet (Mscf), or energy value in million btu (MMBtu) for BOD, HMS, and LMS by county (Amon, et. al, 2011)

	BOD tons/year	BOD Volume (Mscf)	BOD Energy (MMBtu)	HMS dry tons/year	HMS Volume (Mscf)	HMS Energy (MMBtu)	LMS dry tons/year	LMS Volume (Mscf)	LMS Energy (MMBtu)
Butte	1,900	32.96	20,880	1,050	13.51	8,560	3,840	49.41	31,300
Colusa	1,390	23.98	15,190	2,690	34.58	21,900	5,230	67.29	42,620
Glenn	950	16.52	10,460	1,840	23.66	14,990	950	12.17	7,710
Totals	4,240	73.46	46,530	5,580	71.75	45,450	10,020	128.87	81,630

Additional agricultural sources within the BMZ

Feedstock volumes, energy value, and potential power capacity for almond hulls, almond shells, and walnut shells in the BMZ counties (Amon, et. al, 2011).

	Almond BDT	Almond MMBTU	Almond MW	Almond BDT	Almond MMBTU	Almond MW	Walnut BDT	Walnut MMBTU	Walnut MW
Butte	71,690	1,232,930	12.1	17,160	295,030	2.9	21,510	369,880	3.6
Colusa	108,360	1,863,470	18.3	25,930	445,900	4.4	4,020	69,100	
Glenn	61,240	1,053,080	10.4	14,650	251,990	2.5	10,010	172,180	1.7
Sutter	6,680	114,840	1.1	1,600	27,490		17,050	293,150	2.9
Yuba							7,610	130,790	1.3

2012 Bioenergy Action Plan

Bioenergy Interagency Working Group

Ann Chan, Chair, Bioenergy Interagency Working Group
Deputy Secretary, California Natural Resources Agency

Cliff Rechtschaffen
Senior Advisor to Governor Edmund G. Brown
Karen Ross
Secretary, Department of Food and Agriculture
Matthew Rodriquez
Secretary, California Environmental Protection Agency
Mary Nichols
Chair, California Air Resources Board
Mark Ferron
Commissioner, California Public Utilities Commission
Carla Peterman
Commissioner, California Energy Commission
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Director, Department of Forestry and Fire Protection
Caroll Mortensen
Director, Department of Resources Recycling and Recovery
Pamela Creedon
Executive Officer, Central Valley Regional Water Quality Control Board
Stephen Kaffka
Director, California Biomass Collaborative

It is state policy to promote the sustainable use of bioenergy

2012 Bioenergy Action Plan
prepared by the Bioenergy Interagency Workgroup

The plan outlines state agency actions that:

1) stimulate cost-effective utilization of the state's diverse biomass resources for conversion to "low-carbon" biofuels, biogas, and renewable electricity;
2) increase research, development and demonstration of bioenergy toward commercializing new technologies;
3) streamline the regulatory and permitting processes; and
4) quantify and monetize the benefits of bioenergy.

The importance of some of the key findings of the 2011 BAP are supported by this BMZ assessment:

- Biomass of diverse types is abundant;

- The use of biomass has diverse benefits, including many that have not been adequately quantified and incorporated into the price for bioenergy;

- Electric grid interconnection issues and the overall cost to collect and transport biomass feedstock remain economic barriers to the development of bioenergy projects in California;

- Regulatory uncertainty continues to reduce options to finance projects in the predevelopment stage, further inhibiting the development of bioenergy and other distributed energy projects; and

- Additional actions will be needed by the Bioenergy Interagency Working Group and the Legislature to streamline permitting for distributed energy projects. These are difficult challenges.

Nathan CA BSM slides here.