Assessment of Critical Barriers and Opportunities to Accelerate Biofuels and Biomethane as Transportation Fuels in California (STEPS/ITS)

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California has a large amount of potentially available biomass from urban, agricultural and forest sources. A much smaller fraction is technically available, and a yet smaller fraction from most sources is currently used for power or fuel.

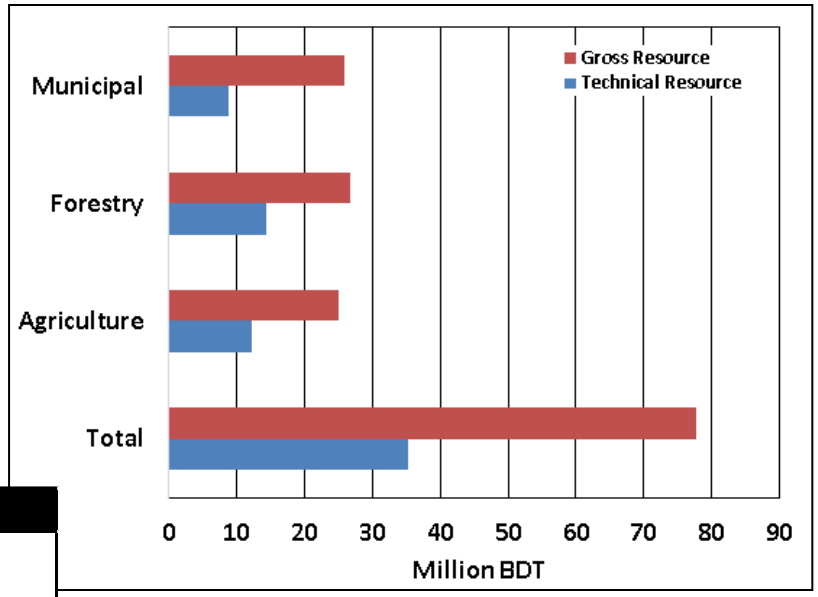

Table ES.2. Biogas Technical Potential from California Resources

Feedstock	Amount Technically Available	Biomethane Potential (billion cubic feet) CNG (gge)	Fraction in use
Animal Manure	3.4 MM BDT	19.7 (155 Mgge)	< 1%
Landfill Gas	106 BCF	53 (420 Mgge)	~60 %
Municipal Solid Waste (food, leaves, grass fraction)	1.2 MM BDT	12.6 (I00 Mgge)	< 1%
Waste Water Treatment Plants	11.8 BCF (gas)	7.7 (60 Mgge)	
Total		93 (735 Mgge)	

Williams et al., CBC, 2015.; (7.74 GGE/MMBTU)

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Grain and sweet sorghum

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On an agro-ecological basis, there are many feedstock crop possibilities in California

Current and potential in-state alternative fuel production estimates

Source (current)	in-state capacity mgy	estimated feedstock cost $/gge (2009-10)	notes
Grain-based ethanol	205		currently mostly corn grain based
Biodiesel	55-60		mostly FOG
Other			
(potential new in-state)			
New agricultural crops			
ethanol	150	0.90 to 3.90	Grain sorghum, sugarbeets, sugarcane and energy cane , use of approximately 500K ac
biodiesel	75	2.82	oilseeds (canola, Camelina)
Agricultural residues			
rice straw	6.8		as CNG (gge), 4 AD units and 200K t straw
dairy manure	155		as CNG
Additional FOG	40		Industry estimate
biodiesel from corn oil	?		
ethanol	355		
biodiesel	175		
CNG	160		

From: Kaffka et al. 2015/STEPS-CEC project

Camelina

Energy beets

Canola, mustards

Salt-tolerant perennial grasses on “marginal” lands

Potential for Biofuel Production from Forest Woody Biomass/ Mitchell et al., 2015 (STEPS/ITS)

The project developed a new statewide resource assessment of forest biomass feedstock. The assessment utilizes a knowledge base of forestry expertise developed at UC Berkeley, and the **Biomass Summarization Model (BioSum),** ***a temporally dynamic, spatially explicit, forest stand development model***…that estimates …on-site woody biomass resulting from forest operations. BioSum had not previously been applied statewide in California.

Over the **40-year simulation period**, ***California forests generate forest residue of about 177 million bone-dry-tons (BDT) on private land, and 100 million BDT on federal land, for a total of 277 million BDT. On average, this is about 7 million BDT of forest woody biomass per year across the state.***

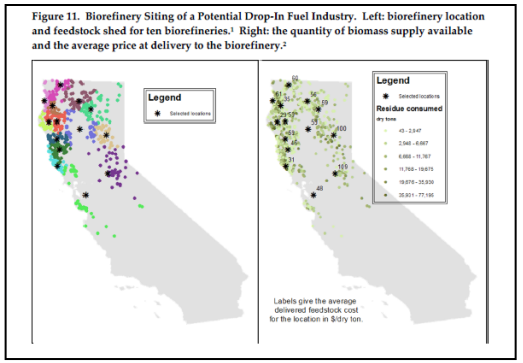

Figure 11. Biorefinery Siting of a Potential Drop-In Fuel Industry. Left: biorefinery location and feedstock shed for ten biorefineries.[1] Right: the quantity of biomass supply available and the average price at delivery to the biorefinery.[2]

The largest total cumulative amount of woody biomass comes from North Coast private lands, with over 74 million BDTs. Standardized on a per acre basis, Western Sierra private lands have the greatest output, 34 BDT/acre, and the Southern Oregon/Northeast California public lands have the least output, 12 BDT/acre.

GBSM was run for two conversion technologies; biochemical cellulosic ethanol and gasification-synthesis of drop-in fuels (Fischer-Tropsch, FTD). ***Cellulosic ethanol biofuel production ranged from 45 million gasoline gallon equivalents per year (MGGEY) to 154 MGGEY with minimum selling prices from $3.85/gge to $4.85/gge. FTD production estimates ranged from 17 MGGEY to 241 MGGEY with minimum selling prices from $3.40/gge to $4.80/gge.***

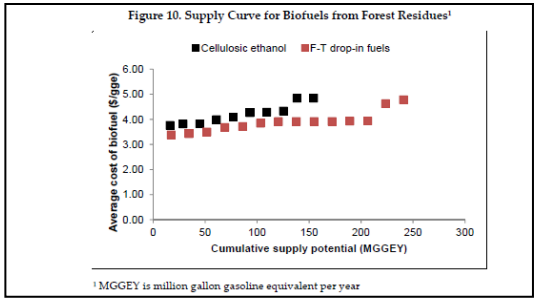

Figure 10. Supply Curve for Biofuels from Forest Residues[1]

[1] MGGEY is million gallon gasoline equivalent per year

The value of biofuels would need to be greater than those observed in the current market to make the system profitable. However, prices of $20.00 per Low Carbon Fuel Standard credit and $0.75 per Renewable Fuel Standard cellulosic RIN would provide residue-based biofuels an additional value of roughly $1.25/gge. The best performing biorefineries analyzed here are economic with the $1.25/gge subsidy.

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