

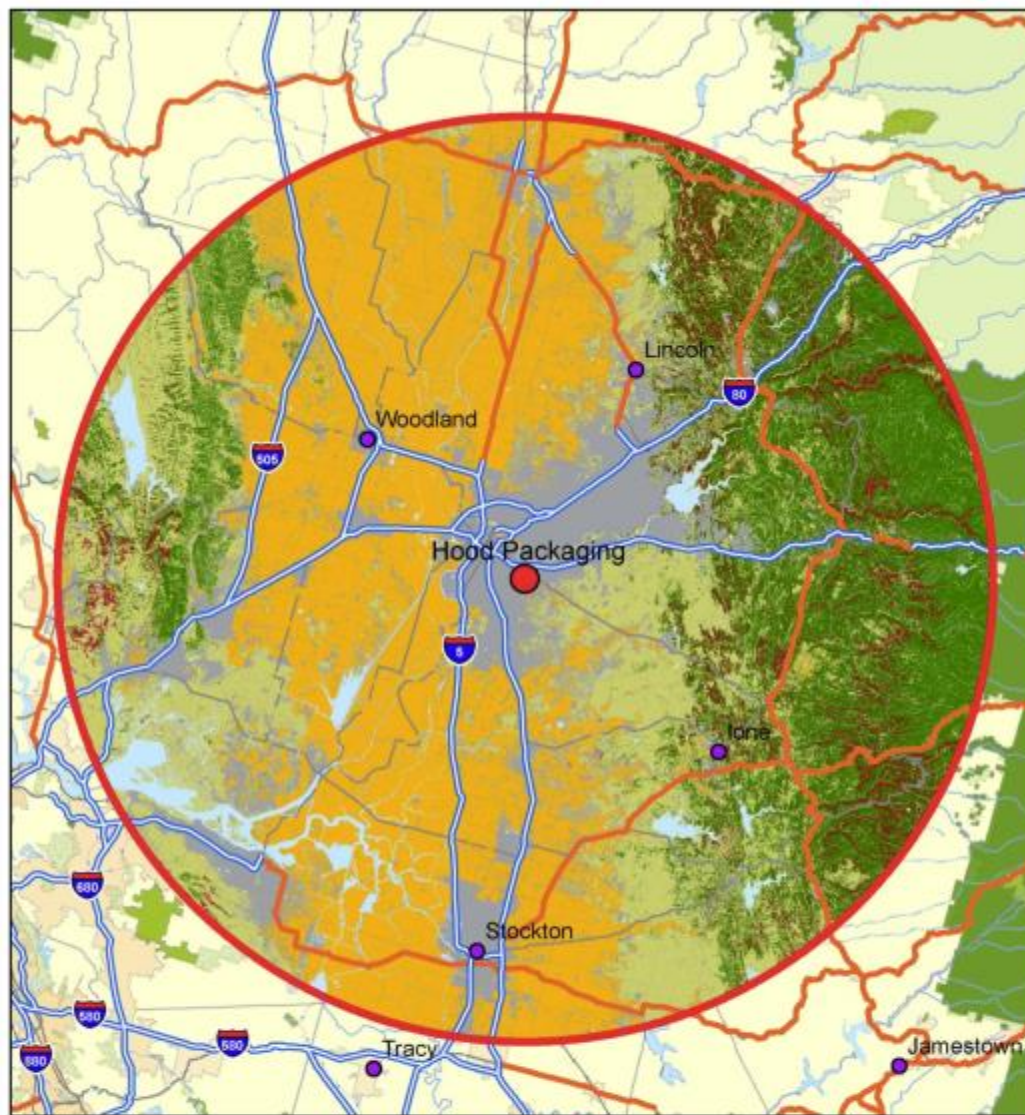
WOODY BIOMASS POWER POTENTIAL IN SACRAMENTO AREA

BIOMASS TECHNICAL ADVISORY GROUP
2ND QUARTER MEETING
SMUD HEADQUARTERS
JUNE 23, 2016

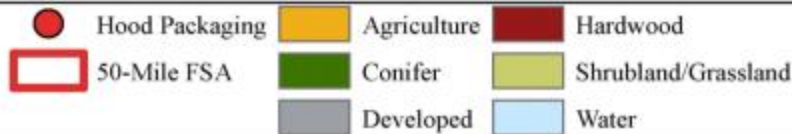
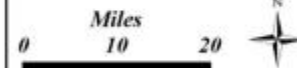
FREDERICK TORNATORE
CHIEF TECHNICAL OFFICER
TSS CONSULTANTS



VEGETATION COVER TYPE 50 MILE RADIUS



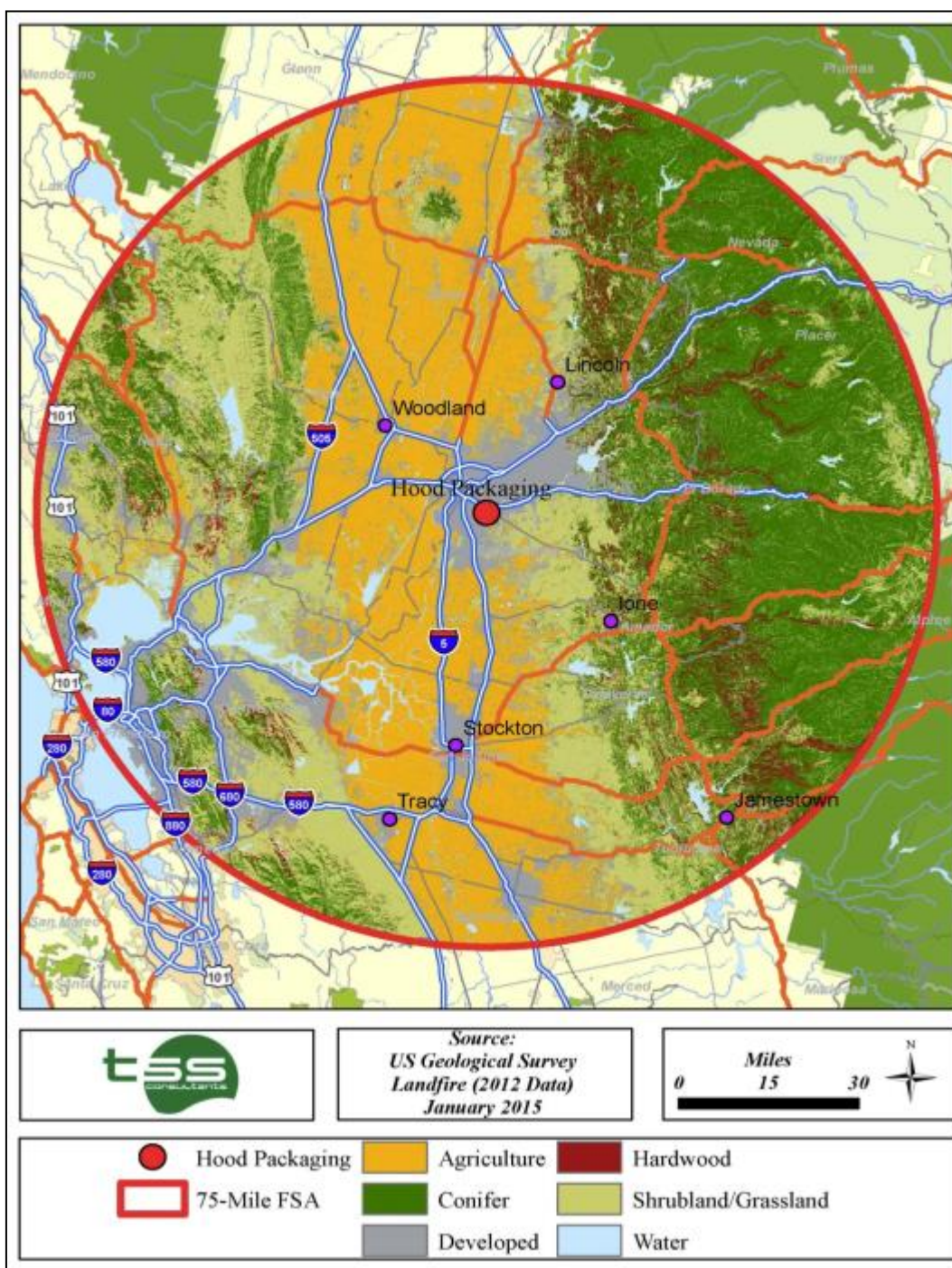
Source:
US Geological Survey
Landfire (2012 Data)
January 2015



AVAILABLE BIOMASS IN 50 MILE RADIUS

Source	Gross Availability (BDT/yr)	Technical Availability (BDT/yr)	Economic Availability (BDT/yr)
Agricultural	566,564	422,305	236,113
Urban	1,195,999	531,920	449,774
Forest	141,467	91,954	71,780
Totals	1,904,030	1,046,179	757,667
MW Equivalents	287 MW	158 MW	114 MW

VEGETATION COVER TYPE 75 MILE RADIUS

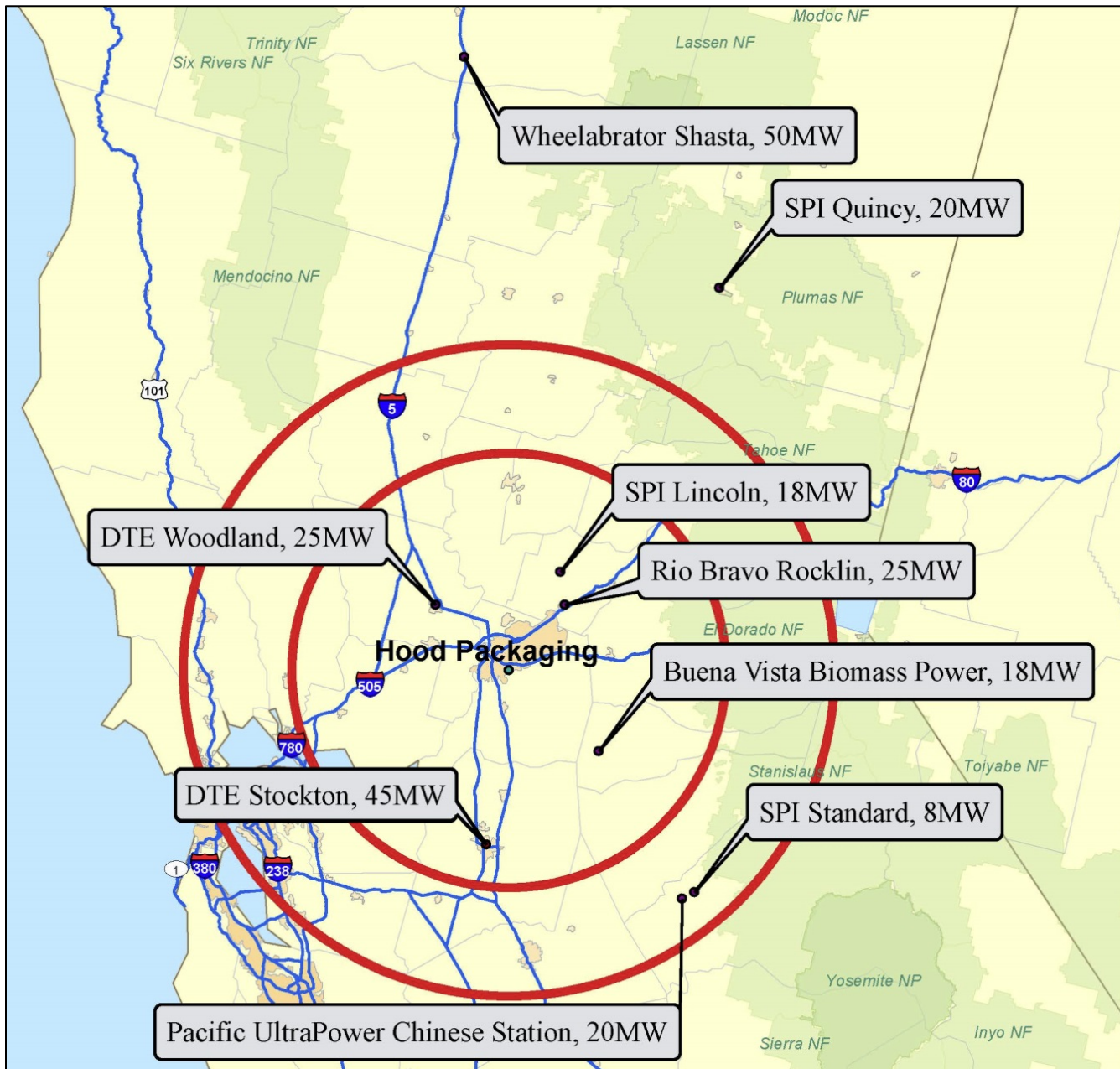


AVAILABLE BIOMASS IN 75 MILE RADIUS

Source	Gross Availability (BDT/yr)	Technical Availability (BDT/yr)	Economic Availability (BDT/yr)
Agricultural	1,148,377	901,041	544,776
Urban	2,513,340	1,117,808	945,181
Forest	276,726	179,872	135,207
Totals	3,938,443	2,198,721	1,625,164
MW Equivalents	595 MW	332 MW	245 MW

More than doubles going from 50 to 75 miles

BIOMASS POWER PLANT FEEDSTOCK COMPETITION



COMPETITION WITHIN 50 MILE RADIUS

Market	Plant Name	Location	MW	Total Demand	Demand in FSA		
				Feedstock (BDT/yr)	Agricultural (BDT/yr)	Forest (BDT/yr)	Urban (BDT/yr)
Biomass Power Plants	Buena Vista Biomass Power	Ione, CA	18	145,000	15,000	5,000	70,000
	DTE Stockton	Stockton, CA	45	380,000	20,000	0	40,000
	DTE Woodland	Woodland, CA	25	200,000	30,000	0	70,000
	Pacific Ultrapower Chinese Station	Jamestown, CA	20	160,000	5,000	0	10,000
	Rio Bravo Rocklin	Rocklin, CA	25	200,000	2,000	2,000	140,000
	SPI Quincy	Quincy, CA	20	160,000	0	0	2,000
	SPI Standard	Sonora, CA	8	65,000	3,000	0	0
	SPI Lincoln	Lincoln, CA	18	145,000	10,000	5,000	1,500
	Wheelabrator Shasta	Anderson, CA	50	400,000	10,000	0	12,500
Landscaping					0	0	25,000
Composite Wood Products					0	2,000	2,500
Firewood					1,500	0	0
Totals					96,500	14,000	383,500

COMPETITION WITHIN 75 MILE RADIUS

Market	Plant Name	Location	MW	Total Demand	Demand in FSA		
				Feedstock (BDT/yr)	Agricultural (BDT/yr)	Forest (BDT/yr)	Urban (BDT/yr)
Biomass Power Plants	Buena Vista Biomass Power	Ione, CA	18	145,000	35,000	14,500	95,000
	DTE Stockton	Stockton, CA	45	380,000	85,000	0	250,000
	DTE Woodland	Woodland, CA	25	200,000	30,000	0	120,000
	Pacific Ultrapower Chinese Station	Jamestown, CA	20	160,000	10,000	4,000	110,000
	Rio Bravo Rocklin	Rocklin, CA	25	200,000	2,000	4,500	140,000
	SPI Quincy	Quincy, CA	20	160,000	0	0	2,000
	SPI Standard	Sonora, CA	8	65,000	8,000	3,500	2,000
	SPI Lincoln	Lincoln, CA	18	145,000	10,000	2,500	1,500
	Wheelabrator Shasta	Anderson, CA	50	400,000	80,000	8,200	15,000
Landscaping					0	0	45,000
Composite Wood Products					0	7,500	10,000
Firewood					4,000	0	0
Totals					264,000	44,700	790,500

AVAILABLE BIOMASS WITH COMPETITION

50 MILE RADIUS

Source	Economic Availability Before Competition (BDT/yr)	Competition (BDT/yr)	Net Economic Availability (BDT/yr)
Agricultural	236,113	96,500	139,613
Urban	449,774	383,500	66,274
Forest	71,780	14,000	57,780
Totals	757,667	494,000	263,667
MW Equivalents	114 MW	74 MW	39 MW

AVAILABLE BIOMASS WITH COMPETITION

75 MILE RADIUS

Source	Economic Availability Before Competition (BDT/yr)	Competition (BDT/yr)	Net Economic Availability (BDT/yr)
Agricultural	544,776	264,000	280,776
Urban	945,181	790,500	154,681
Forest	135,207	44,700	90,507
Totals	1,603,739	1,099,200	525,964
MW Equivalents	245 MW	166 MW	79 MW

More than doubles going from 50 to 75 miles

POWER PLANT SHUTDOWNS

■ BUENA VISTA BIOMASS POWER

- TOTAL – 145,000 BDT
- 50 MILE – 90,000 BDT
- 75 MILE – 144,500 BDT

■ PACIFIC ULTRA POWER CHINESE STATION

- TOTAL – 160,000 BDT
- 50 MILE – 15,000 BDT
- 75 MILE – 154,000 BDT

■ WHEELABRATOR SHASTA

- TOTAL – 400,000 BDT
- 50 MILE – 22,500 BDT
- 75 MILE – 103,200 BDT

■ Rio Bravo Rocklin

- TOTAL – 200,000 BDT
- 50 MILE – 144,000 BDT
- 75 MILE – 146,600 BDT

Additional MW available

@ 50 mile – 75 MW v. 39 MW

@ 75 mile – 161 MW v. 79 MW

SOME OTHER POSITIVES AND NEGATIVES

- 50 to 75 mile radius better for larger plants due to economies of scale. Smaller plants benefit from a smaller supply area as transportation costs are large part of feedstock costs
- Small scale biomass needs higher price for its electricity
- SMUD territory does not benefit from a BioMAT type program – however, SMUD is looking into their own bioenergy incentive program
- When Rio Bravo shuts down there will be a glut of low cost urban feedstock. Its local volume alone is around 18 MW
- Forest-sourced biomass is the highest cost feedstock, in large part due to transportation.
- There also exists the future possibility of woody biomass waste conversion to biomethane which can be injected into the SMUD natural gas pipeline and used as substitute for fossil natural gas at the Consumnes Power Plant