
CHP and Biomass: Market Drivers and Outlook

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Is Biopower Poised for Investment Surge?

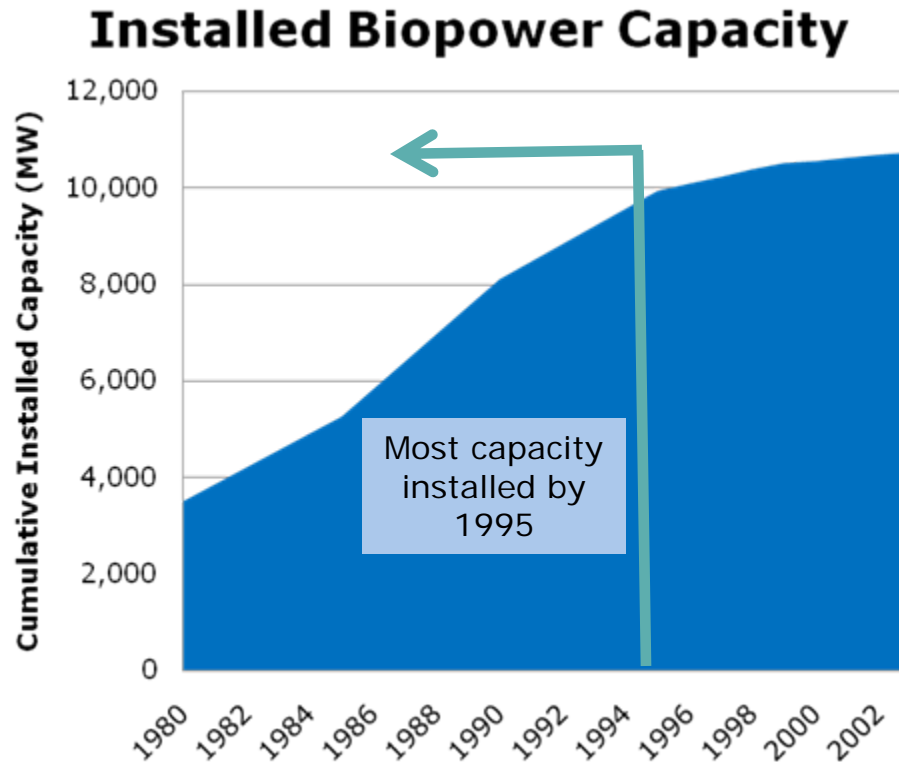
Clean Energy Source	U. S. Investments (\$ Billion)	
	2007	2008
Wind	9.4	17.7
Ethanol	7.3	8.2
Biopower	0.3	0.4

□ Source for capacity data: EIA (units over 1 MW), RFA (for ethanol)

□ Investment inflows based on 2007 capacity installations, with wind at \$1,800/kW installed, ethanol at \$1.75/mill gal annual, biopower installed at \$2,000/kW

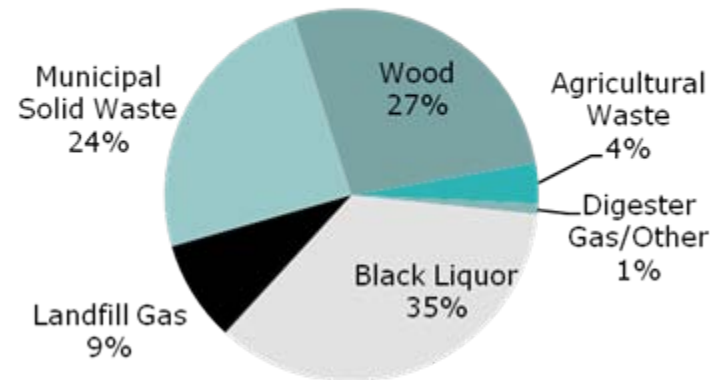
- Biopower is power generation from biomass, biogas, municipal solid waste, black liquor, and other bio-based fuels
- Lack of scale and inadequate incentives are major impediments, and biopower still favors local or regional markets, and can employ CHP to improve economics

Unlike Other Clean Energy, Growth in Biopower Capacity Has Slowed



Source: NREL REPIS Database

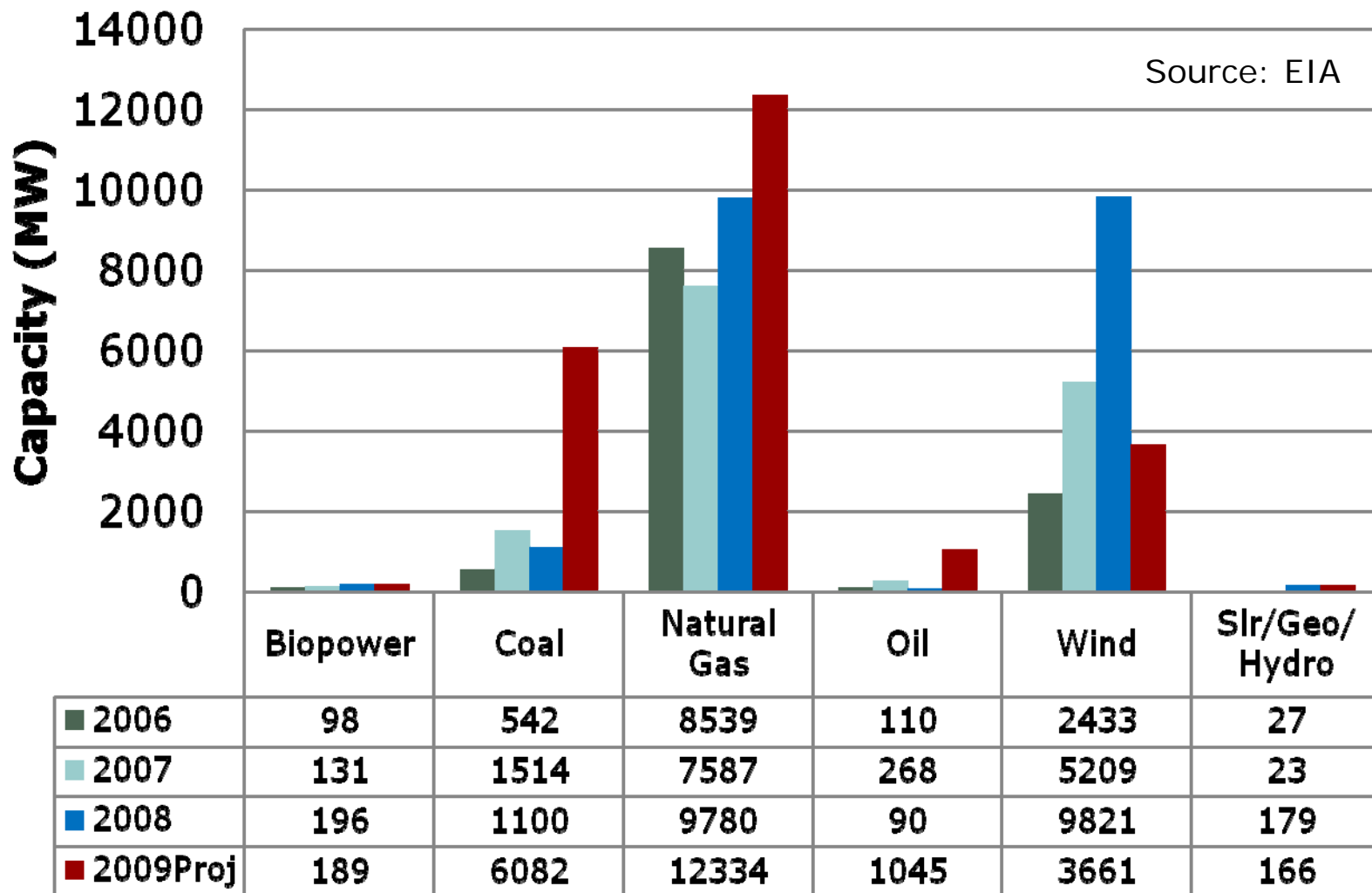
Components of 2005 Biopower Capacity



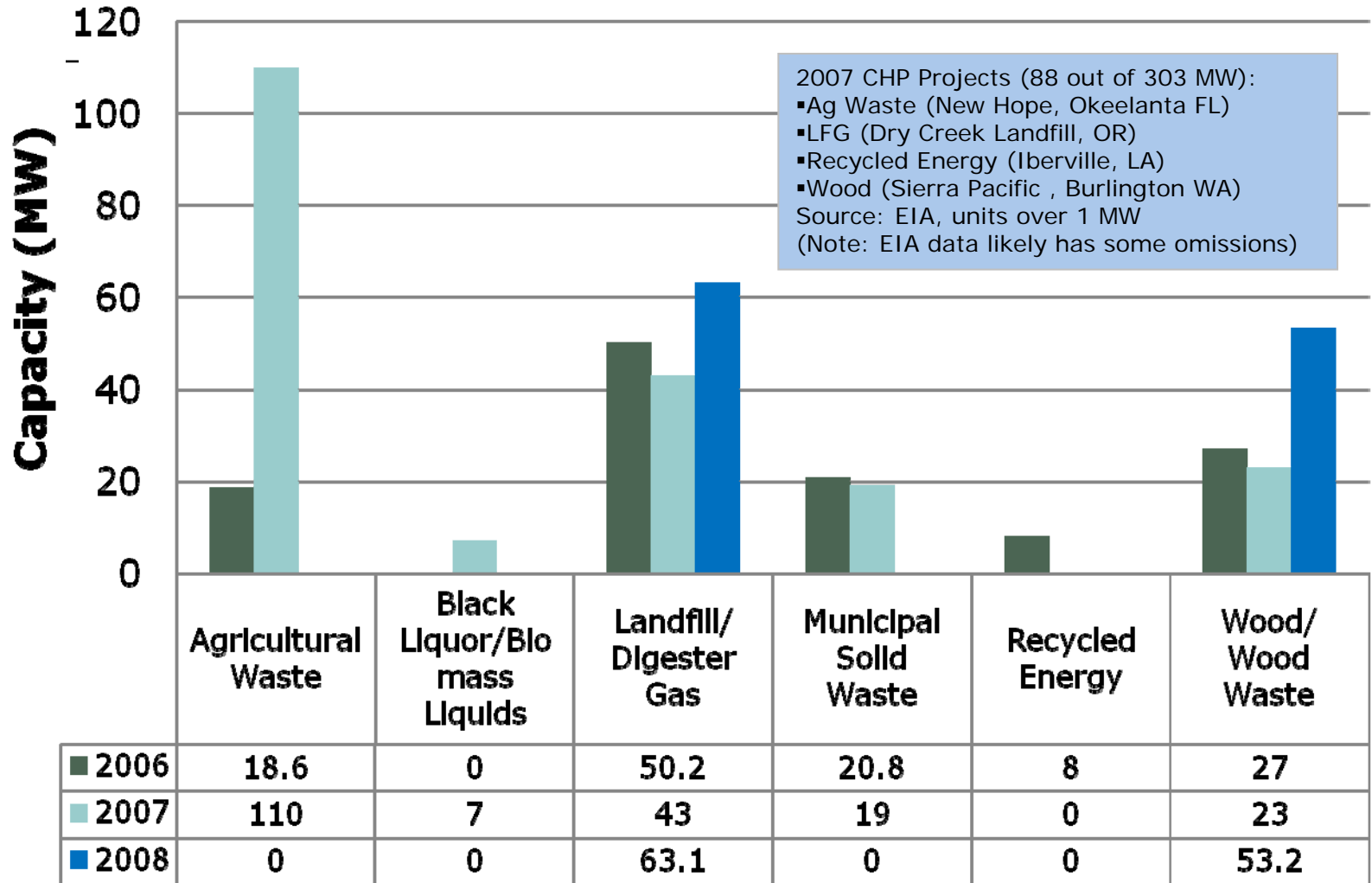
Source: EIA 860 Data, Units Over 1 MW

One third of existing biopower employs CHP

Recent Biopower Lagging Other New Capacity



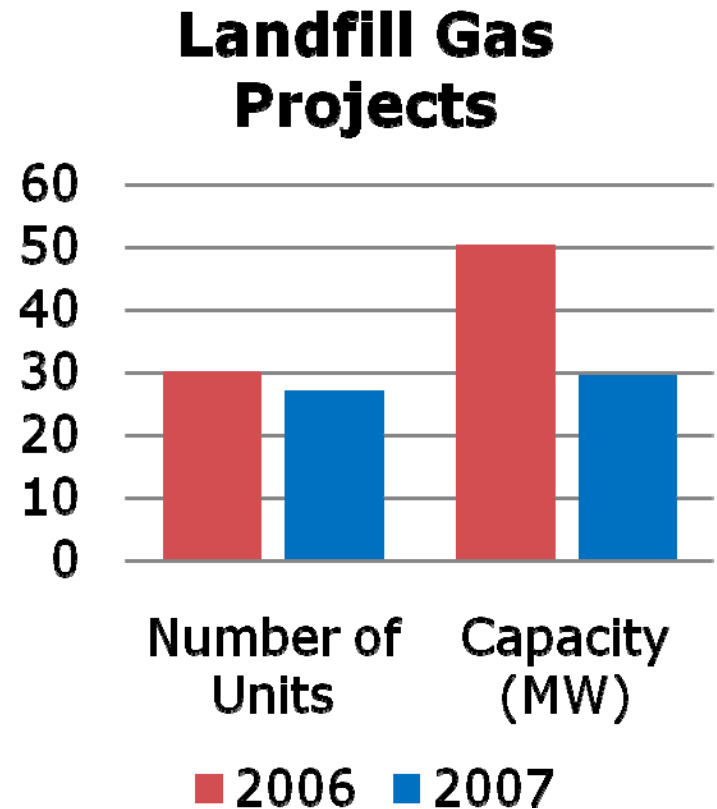
New Biopower Capacity: Diverse and Employs CHP



Almost one third of new biopower employs CHP

Landfill Gas Project Development Has Been Consistent

- About 40 to 60 MW went in 2006-2008
- Mostly 1-3 MW IC engines
- WMI announced initiative to install hundreds of MW over 5 years at company landfills
- Not many use CHP



Recent Biomass Project Announcements

Project	Capacity (MW)	CHP?	Location
Lakeview Biomass / Collins Lumber	13	Yes	Lakeview, OR
Seneca Sawmill	18.8	Yes	Eugene, OR
Stoltze Land and Lumber	12	Yes	Flathead, MT
Roseburg Forest Products	10	Yes	Weed, CA
Simonds Int. / Fitchburg Airport Industrial Park	15	Yes	Fitchburg, MA
ADAGE / Energy Northwest Partnership	5 x 50	No	MT, ID, OR, WA
Oglethorpe Power Georgia Power	3 x 100 96	No	GA
American Renewables / Nacodoches Power	3 x 100	No	TX, FL

Sources: Company presentations and press releases covering units with expected operation between 2010 and 2017

Long Term, ACORE Outlook Calls for 100 GW of New Biopower by 2025

Sector	Application	Renewable Fuel Source	Projected New Capacity (GW) by 2025
Commercial and Industrial Facilities (except Pulp & Paper and Biofuels Production)	CHP	Biomass (Forest and Agriculture Residues)	26.0 ¹
		Landfill and Digester Gas (Farms, Wastewater)	1.5 ¹
Pulp and Paper Mills	CHP	Black Liquor, Bark, and Other Mill Wastes	21.3 ²
Bio-fuel Production (for transportation uses)	CHP	Corn and other Biomass	NA ³
Wholesale Power Generators	CHP and Non-CHP	All Biomass, except Municipal Waste	37.3 ⁴
Solid Waste Disposal	CHP and Non-CHP	Municipal Solid Waste	10.1 ⁵
		Landfill Gas	2.0 ⁶
TOTAL			98.2

¹Resource Dynamics Corporation, 2006

²Larson and Raymond (1998)

³This sector could host a large share of biopower which has yet to be estimated.

⁴Biomass R&D Technical Advisory Committee, based on 7 percent goal for utility biomass for heat and power generation.

⁵EIA 860, assuming a four times increase in this level.

⁶EIA 860 assuming a doubling of this level.

Source: ACORE, The Outlook on Renewable Energy In America, 2006

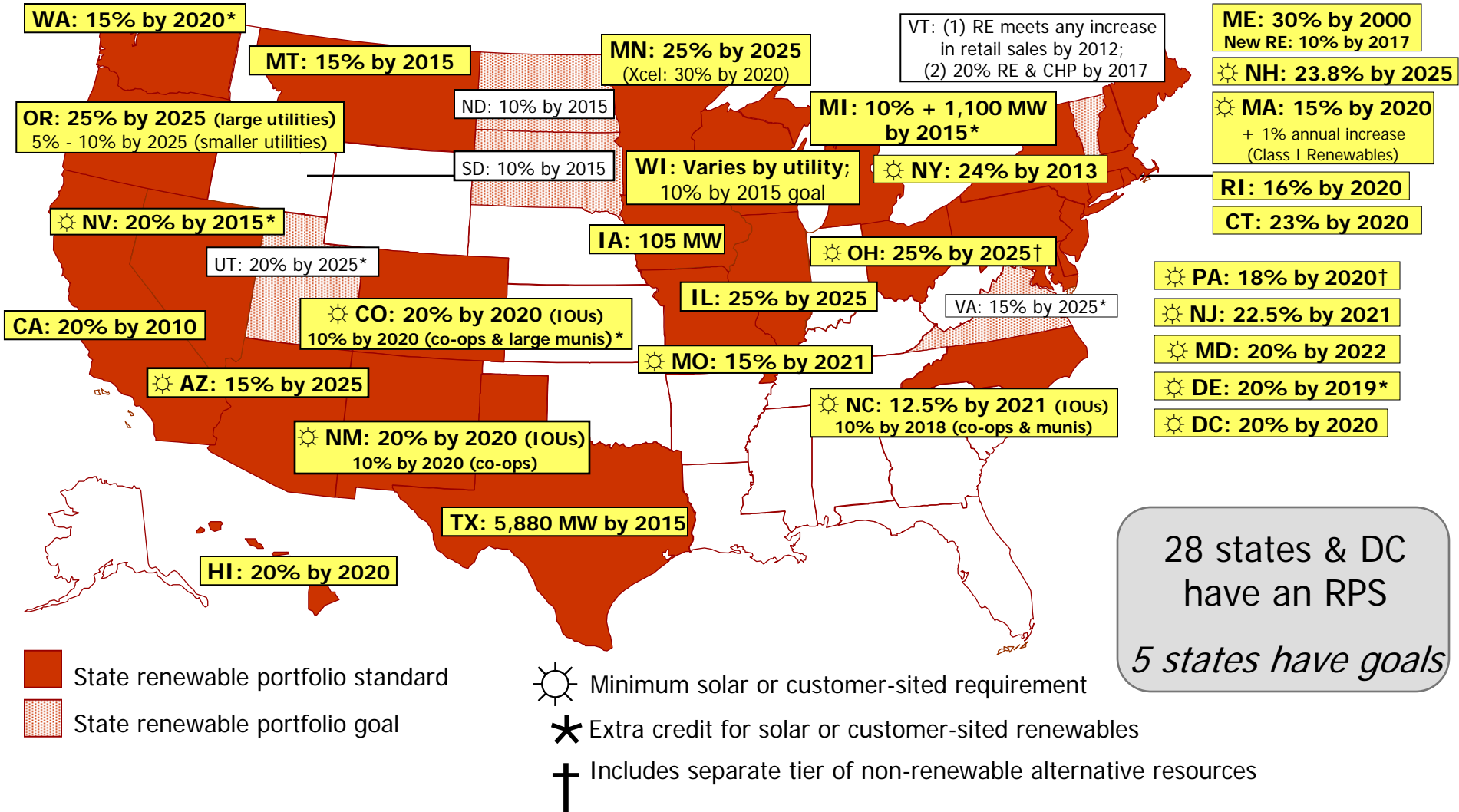
Assumes adoption of national RPS and continued PTC, and other incentives.

Near Term Biomass Project Development: Effective Policies?

- As RPS mandates grow, more activity likely
 - In many states, wind projects getting most of RPS
 - Excess supply driving down prices of RECs in some states; others provide adequate incentives for biopower
- Production tax credits have been an issue
 - Developers challenged to meet deadlines, look to redeploy older plants or may plan greenfield projects without tax credits
 - Investors may not have tax appetite to use credits
 - If generating on site for heat/power host, IRS netting rule may limit creditable production
 - Recent extension of PTC is very positive, with option to convert to investment tax credit or grant
- Fuel supply challenges
 - Long term fuel supply often required for financing
 - Siting near surplus fuel supply is becoming practice, may need public lands for supply
 - Project scale could be larger but limited by fuel supply factors

Renewable Portfolio Standards Have Spread Throughout U.S.

www.dsireusa.org / April 2009



28 states & DC have an RPS
5 states have goals

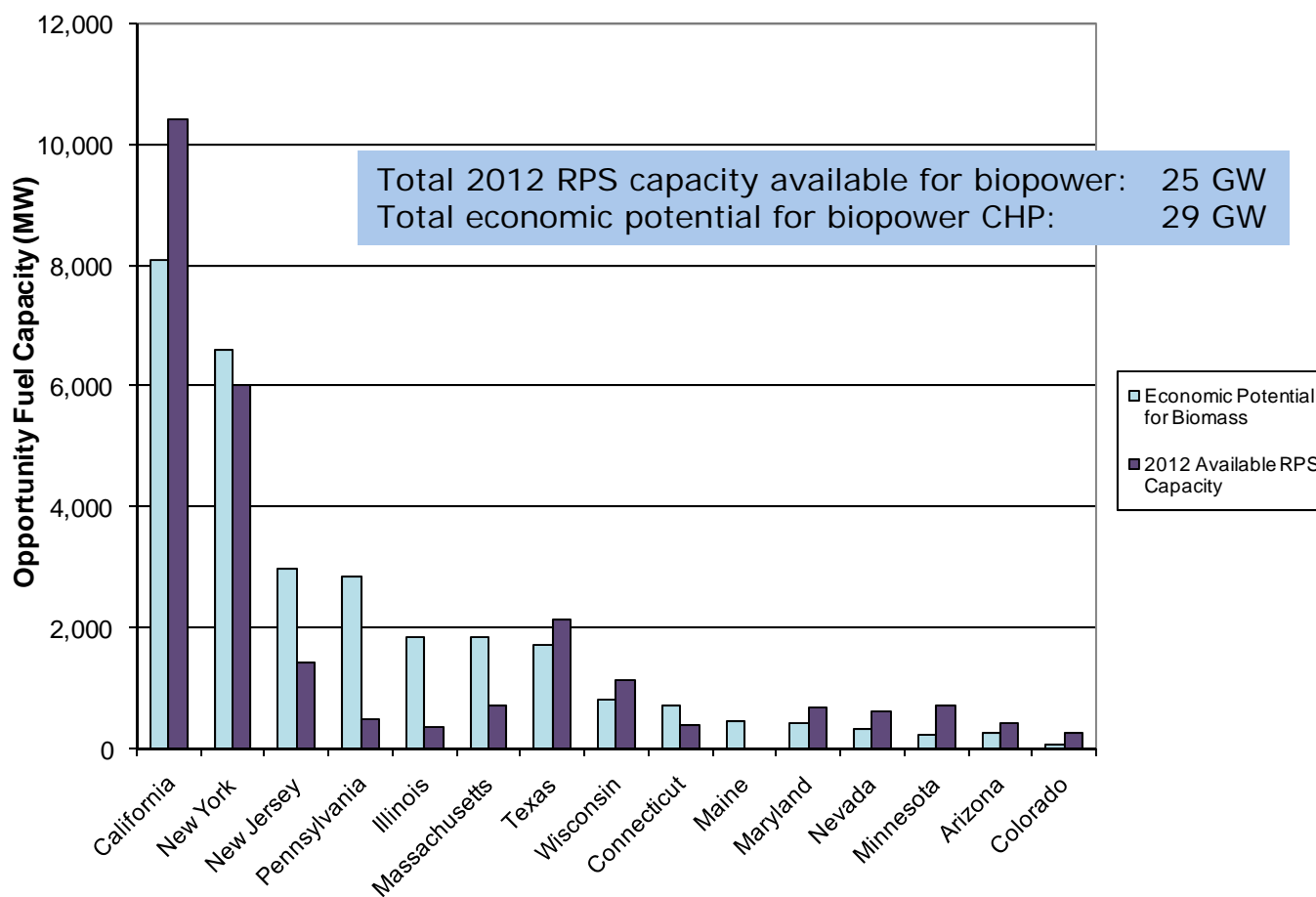
California Biomass RPS Activity (Facilities Operating After 2006)

Facility Name	Location (City)	ST	Operation Date	Capacity (MW)	Company Name
EnerTech Rialto Biopower	Bloomington	CA	6/1/2008	25	Enertech Environmental, Inc.
Weed Turbine-Generator Project	Weed	CA	7/1/2007	10	Roseburg Forest Products Company
BME Otay Mesa Biomass Facility	San Diego	CA	12/1/2008	27	Bull Moose Energy, LLC
Silicon Valley Biomass Energy Center (SVBEC)	San Jose	CA	7/1/2010	50	Zero Waste Energy, LLC
SPI - Burlington	Mt. Vernon	WA	4/3/2007	28	Sierra Pacific Industries
Kittyhawk	Vista	CA	1/1/2007	2.2	Envirepel Energy Inc.
Freemont MSW Transformation Energy Center	Freemont	CA	10/1/2009	20.4	World Waste Technologies, Inc.
Gonzales MSW Transformation Energy Center	Gonzales	CA	10/1/2009	20.4	World Waste Technologies, Inc.
Richmond MSW Transformation Energy Center	Richmond	CA	10/1/2009	20.4	World Waste Technologies, Inc.
Sacramento MSW Transformation Energy Center	Sacramento	CA	10/1/2009	20.4	World Waste Technologies, Inc.
Mt. Signal Solar	El Centro	CA	12/1/2009	49.4	MMR Power Solutions, LLC
Tacoma Cogen	Tacoma	WA	1/1/2009	55	Simpson Tacoma Kraft Company, LLC
Estancia Basin Biomass Power Project	Albuquerque	CA	6/1/2010	37	Western Water Power Production Limited, LLC
Parreira Almond Processing Company	Los Banos	CA	4/1/2009	0.75	Paul Parreira
Evergreen BioPower LLC	Lyons	OR	9/30/2007	10	Evergreen BioPower LLC

Massachusetts Biopower Activity Due to State RPS

RPS ID	Facility Description	Size (MW)	Technology	Company
LG-1071-07	East Windsor, CT Plant	3.2	Landfill Gas	Manchester Methane LLC
LG-1068-07	Albany, NY Plant	6.6	Landfill Gas	MM Albany LLC
AD-1065-07	Sheldon, VT Dairy Farm	0.33	Digester Gas	Green Mountain Dairy Farm, LLC
AD-1063-07	Richford, VT Dairy Farm	0.6	Digester Gas	Berkshire Cow Power, LLC
BM-1048-06	Ellicottville, NY Plant	5.5	Biomass	Laidlaw Energy & Environmental, Inc.
BM-1053-06	Schiller Station Unit 5 (Portsmouth, NH)	50	Biomass	Public Service of New Hampshire
BM-1043-06	Livermore Falls, ME Plant	40	Biomass	Boralex
LG-1045-05	Youngstown, NY Plant	6.4	Landfill Gas	Modern LFG
LG-1041-05	Cahoes, NY Plant	4.8	Landfill Gas	Colonie
LG-1040-05	Stanley, NY Plant	5.6	Landfill Gas	Ontario Landfill Gas Facility
BM-1039-05	Greenville, ME Plant	20	Biomass	Greenville Steam Company
LG-1035-05	Binghamton, NY Plant	2.1	Landfill Gas	Nanticoke LFG

As RPS Mandates Mount, Biopower CHP Could Play Larger Role



Source: Resource Dynamics Corporation, Potential Impact of Renewable Portfolio Standards on Biomass Combined Heat and Power Applications, developed for ORNL and DOE, 2006.



Other Market Growth Factors for New Biomass Power

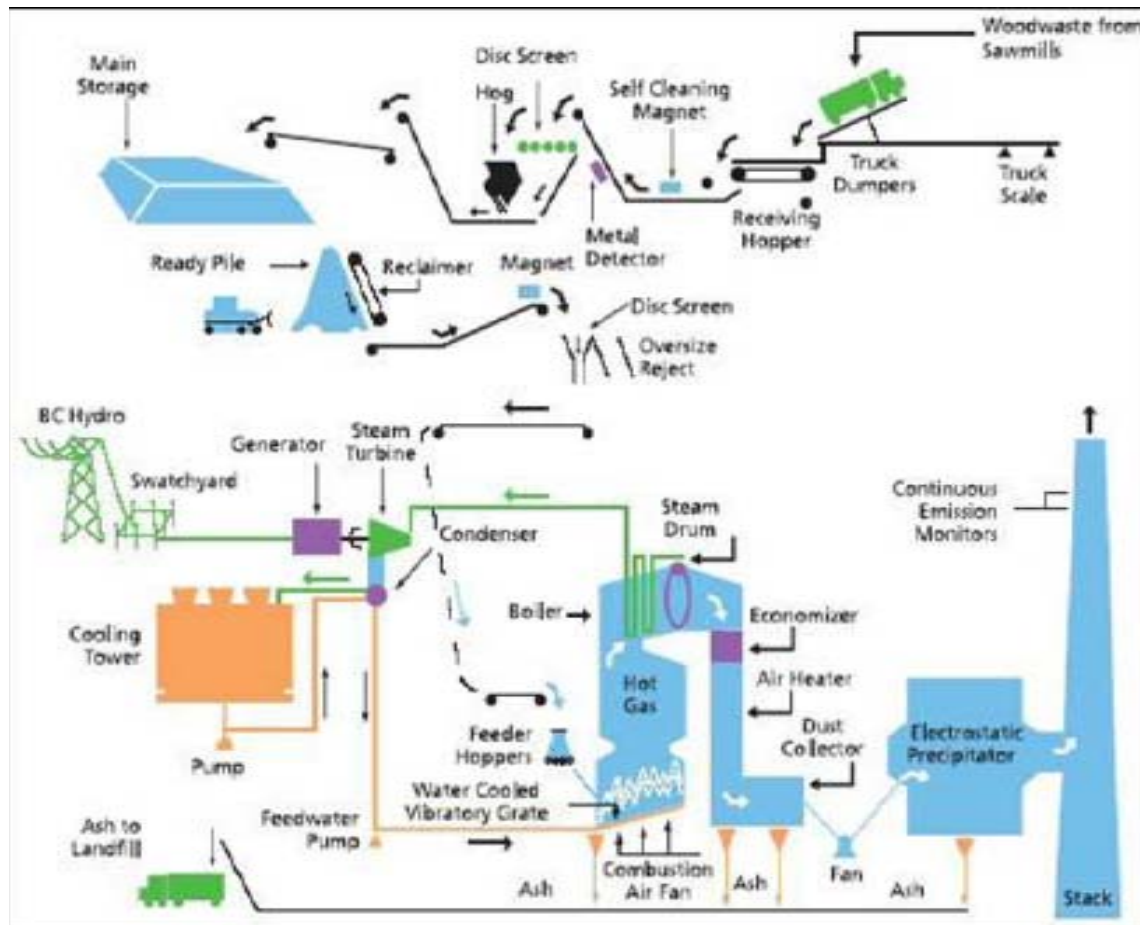
- Fossil fuel prices have risen and increased in volatility
- Electric rate caps expiring in many states, and wholesale prices increasing as more natural gas is on the margin
- Climate change legislation is expected to incent low carbon options such as biopower
- Waste disposal issues mounting
- New developments in conversion technology



Technical Challenges for Biomass

- New generation of conversion technology exists
 - Gasification or staged combustion
 - Few facilities employ advanced combustion using petcoke or demonstration units
 - Can meet advanced specs with older technology plus emissions controls
- Cost and complexity still an issue, as well as lack of requirements for its use
- Recent study of Massachusetts renewable markets assumes 2013 commercial deployment

Lakeview (OR) Plant to Employ Mature Combustion Technology



Sources: Marubeni

New Biomass Challenges, and Role for CHP

- Currently, many new biomass projects are either dedicated power generation or thermal only
- Ideally, power and thermal output can be used on site for maximum value
 - If not, finding market for power in high price area (biomass power can cost 7-9 cents/kWh)
 - Obtaining host for thermal output improves economics but can make siting challenging
 - Thermal only projects can add backpressure turbines to become CHP
- Arranging for fuel supply, preferably obtaining tipping fees or siting near low cost fuel sources



Biomass Issues and Challenges

- Biomass lacks scale for large investment business model to compete in low-cost wholesale markets, still favors local or regional use of power and thermal output
- CHP can make project economics more favorable
- Policy and market growth factors include renewable incentives, increasing bulk power costs, waste disposal revenues, hedge against high purchased fuel and power costs, and climate change benefits



CHP and Biomass: Questions?

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