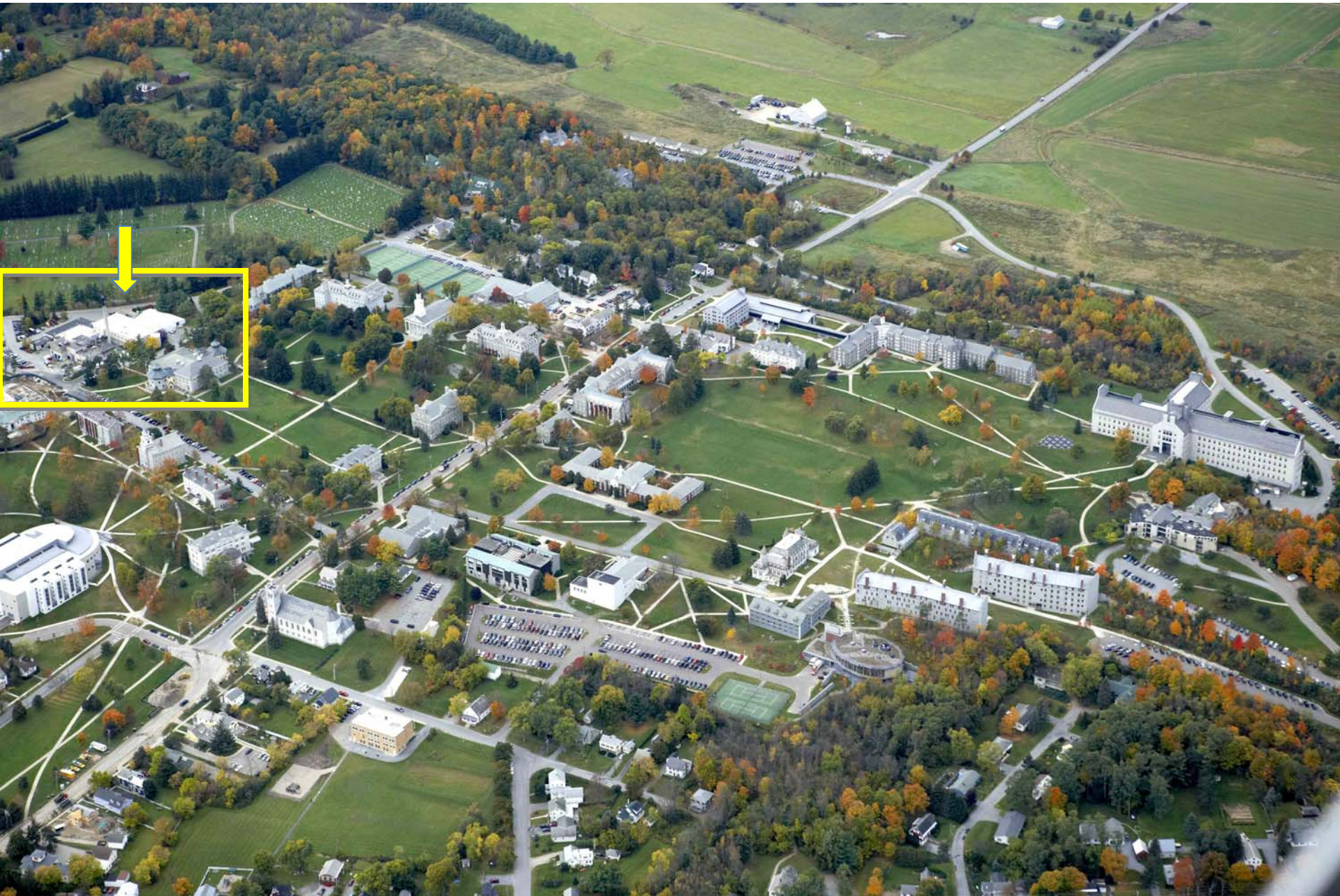
What gives a college power?

Middlebury College Biomass Gasification Combined Heat and Power Plant

Jack Byrne, Director
Sustainability Integration Office
Middlebury College
May 19, 2009

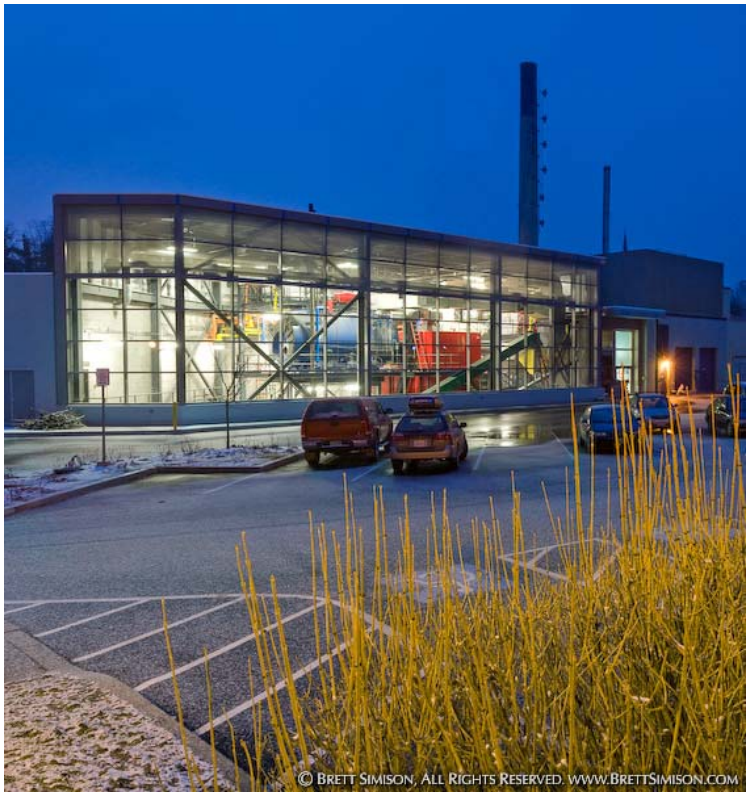
Where Is It? Why Is It There?



April 18, 2006

MIDDLEBURY COLLEGE

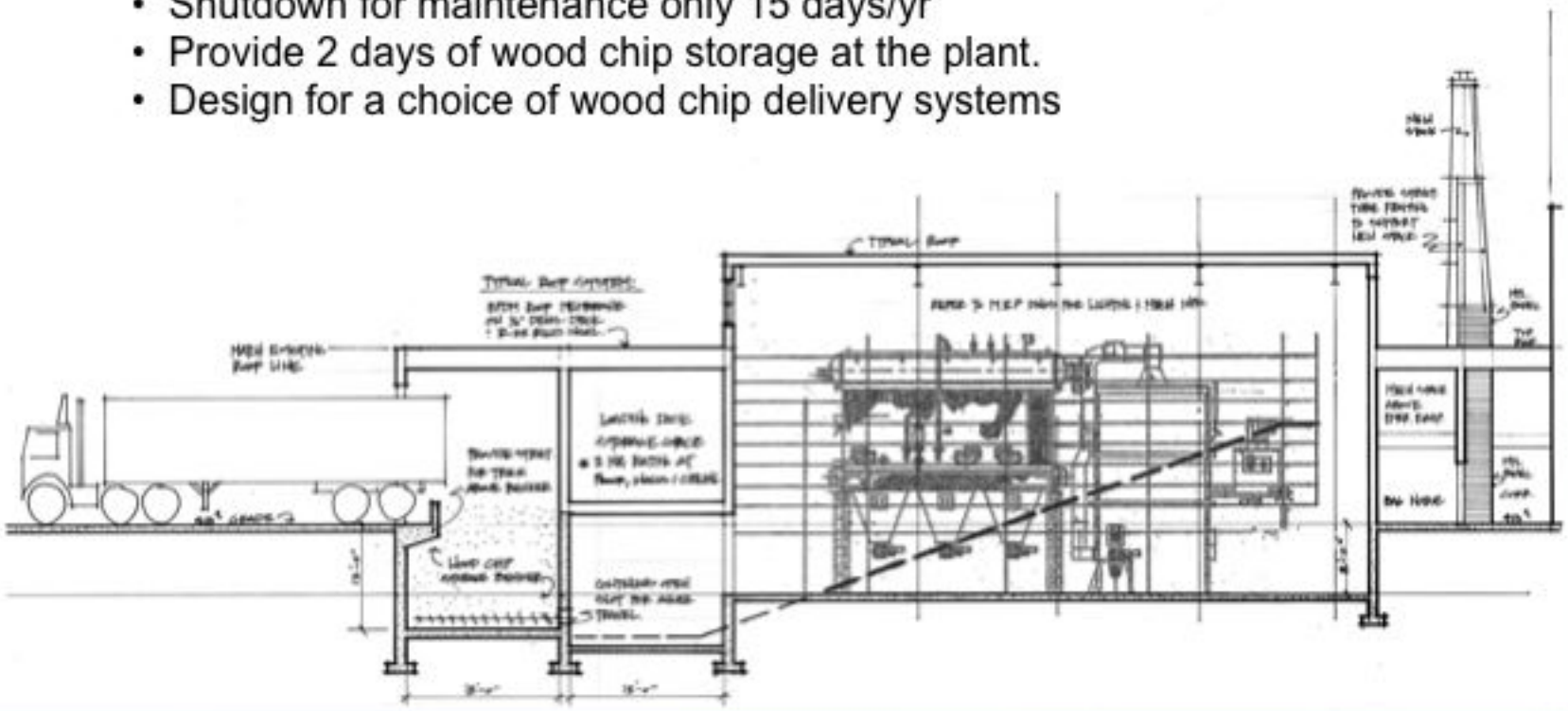
cbt

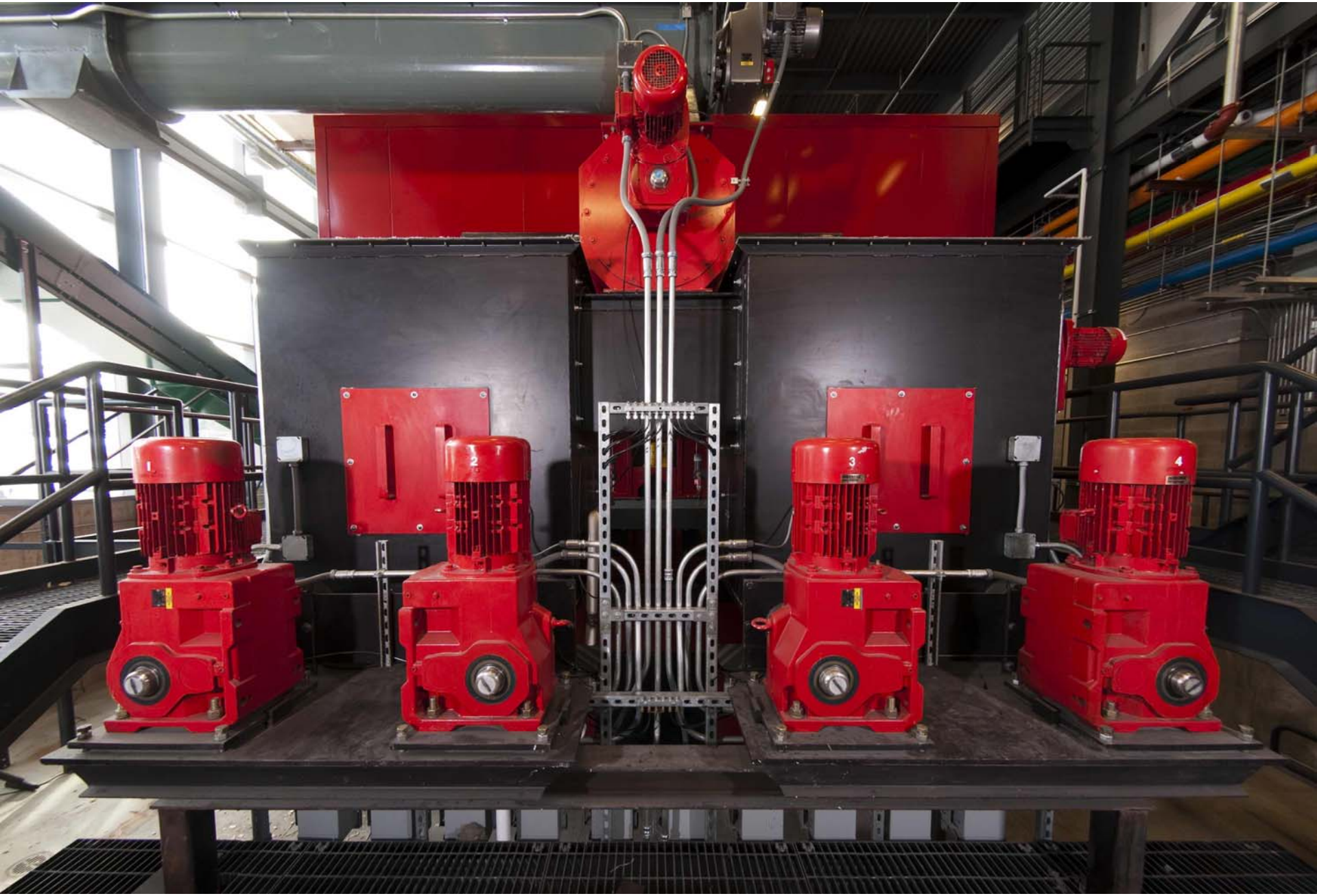


PROGRAM – Biomass Plant

Middlebury has set specific criteria for the Biomass Plant:

- Achieve an average steam capacity of 16,000 #/hr.
- Achieve approx. 50% reduction in Middlebury's oil consumption
- Operate the plant 350 days/yr.
- Shutdown for maintenance only 15 days/yr
- Provide 2 days of wood chip storage at the plant.
- Design for a choice of wood chip delivery systems





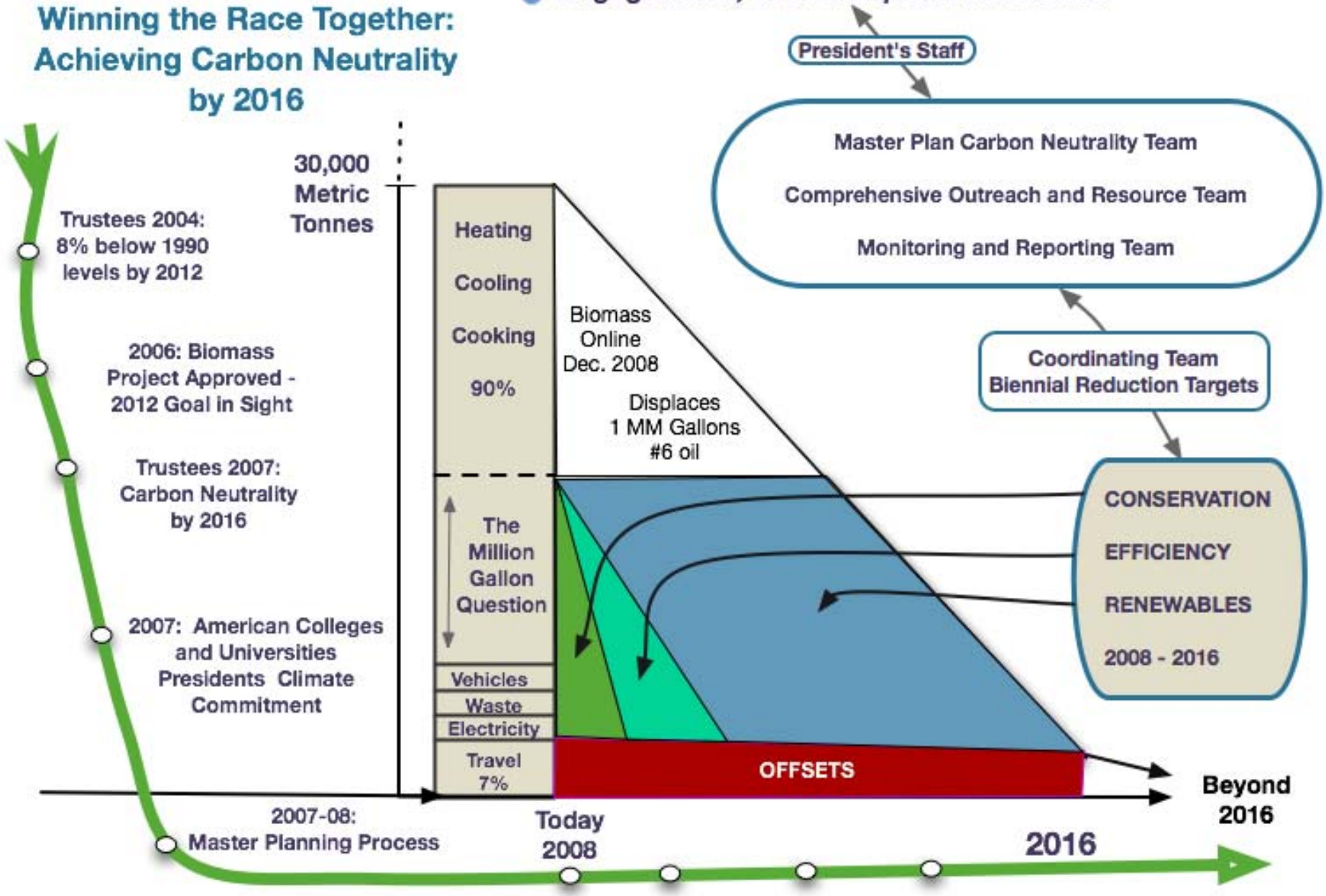

JOHNSTON
BOILER
COMPANY

Year	# 6 Oil Boiler Operating cost	Wood Fired Boiler Operating cost	Debt Service	Cap Maint & Depreciation	Annual Savings
2008	$ 1,658,763	$ 782,735	$ 788,660	$ 241,050	$ (153,682)
2009	1,708,526	806,217	788,660	241,050	(127,402)
2010	1,759,781	830,404	788,660	241,050	(100,332)
2011	1,812,575	855,316	788,660	241,050	(72,451)
2012	1,866,952	880,975	788,660	241,050	(43,733)
2013	1,922,961	907,405	788,660	241,050	(14,154)
2014	1,980,649	934,627	788,660	241,050	16,313
2015	2,040,069	962,666	788,660	241,050	47,693
2016	2,101,271	991,546	788,660	241,050	80,015
2017	2,164,309	1,021,292	788,660	241,050	113,307

Assumptions = Go live in 2008; #6 Oil $1.45 per gallon (2006), inflated 3% per year; Chips at $35 per ton (2006) inflated 3% per year; $11.1 million borrowing at 5% over 25 years; assumes annual P & I payments; cap maint . at 1.55% on $9.1 million and equip depreciation at 5% $2.0 million.

Middlebury College
Winning the Race Together:
Achieving Carbon Neutrality by 2016

Engagement , Leadership and Innovation



Biomass Gasification - Fuel Supply

Ideally:

- Single source 3-5 yr. contract
- From FSC or sustainably managed woodlands
- Price in our comfort zone
- From within a 50 mile radius
- Supplied (almost) just-in-time

Reality:

- Multiple sources - 3 yr. contract
- Sustainable practices vary
  - collaborative relationships
- Price in our comfort zone
- From within a 50-75 mile radius
- Supplied (almost) just-in-time

Biomass Feasibility Study by Vermont Family Forests and Biomass Energy Research Center 2005

Addison and Rutland counties woodshed:

- private forest acreage best suited to producing trees
  – not wetland,
  - not steep sloped,
  - not shallow soil,
  - far enough from waterways,
  - not preserved or conserved for other purposes,
  - not high quality wood better for value added uses

- 269,250 tons of low quality wood per year
- demand for low quality wood in the woodshed = 109,592 tons/yr.
- net availability of about 160,000 tons per year

Biomass Gasification - Fuel Supply

Willow Test Plot - Partnership with SUNY ESF

- Earlier test plots in upstate NY - 25 to 30 tons/ac. (45% moisture)
- 10 acre test plot - 30 varieties of willows
- Year 1 - clear and plant
- Year 2 - cut back and grow
- Year 3 - grow
- Year 4 - grow and harvest (15 to 20 ft. height)
- Harvest every three years thereafter - up to 21 years
- Use corn harvester with modified cutting head
- Three plots of 400 acres could each potentially supply 10,000 tons per year