Andy Colwell

AnnMarie Mountz

PENNSTATE
University Park
1855

CHP as a Boiler Replacement

PENNSTATE
Office of Physical Plant
OPP

Laura Miller, PE, PhD
Paul Moser, PE

April 30, 2013

Penn State District Energy

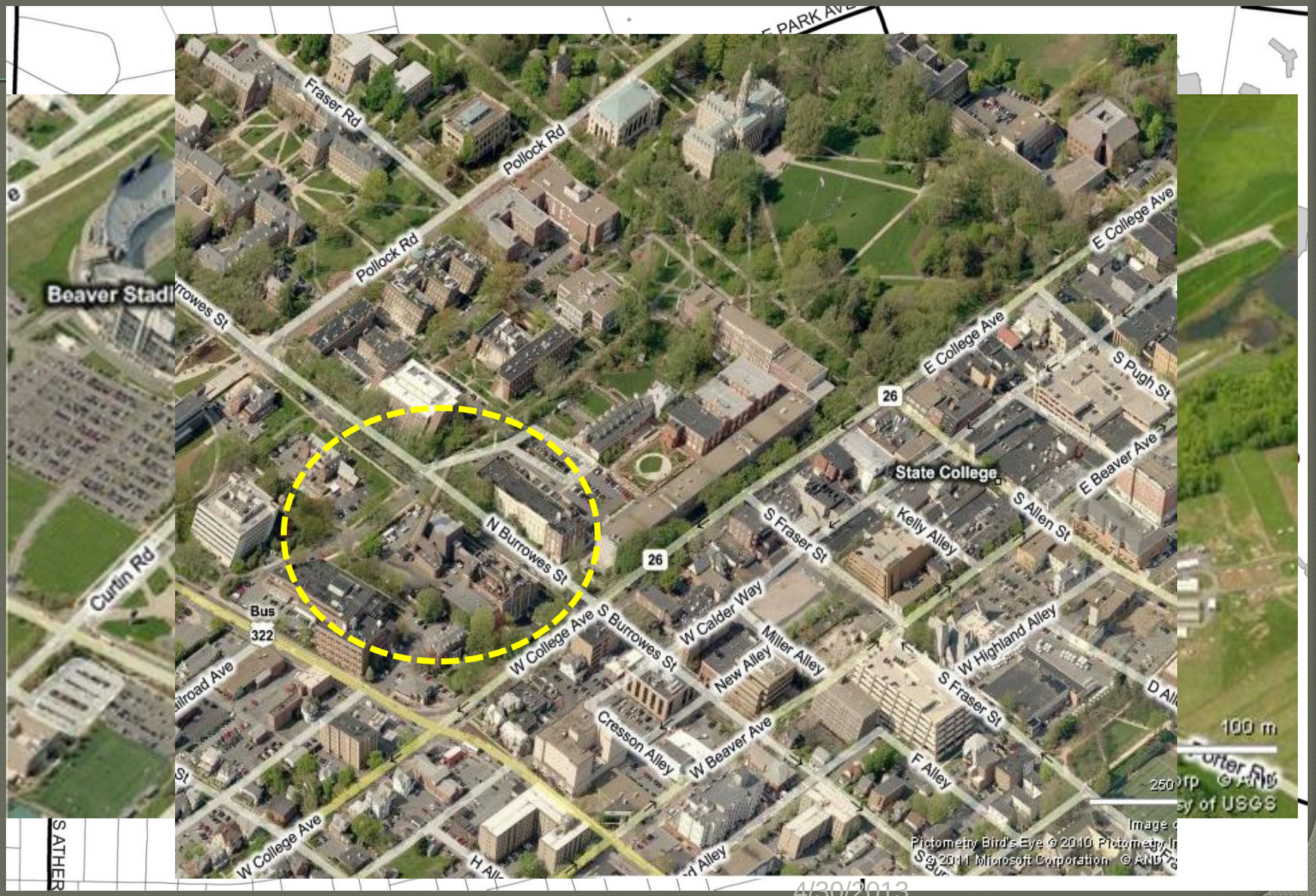
Penn State is a World Class University with more than 50,000 students, faculty and staff on campus on any given day.

As a provider of utilities, Steam Services plays an important supporting role in the success of the University's mission of teaching, research and service.

Steam Services & Engineering

- Buildings Served
  - +700 total
  - +200 served with steam
  - +19 million ft^2
- +10 engineering and technical support
- +40 Operations and Maintenance Staff
  - Power Plants
    - 18 Operators
    - 8 daylight maintenance
    - 6 Coal and Ash handlers
    - 2 supervisors
  - Distribution
    - 7 Daylight Maintenance
    - 1 supervisor
  - 2 Staff Assistants

District Energy – Penn State

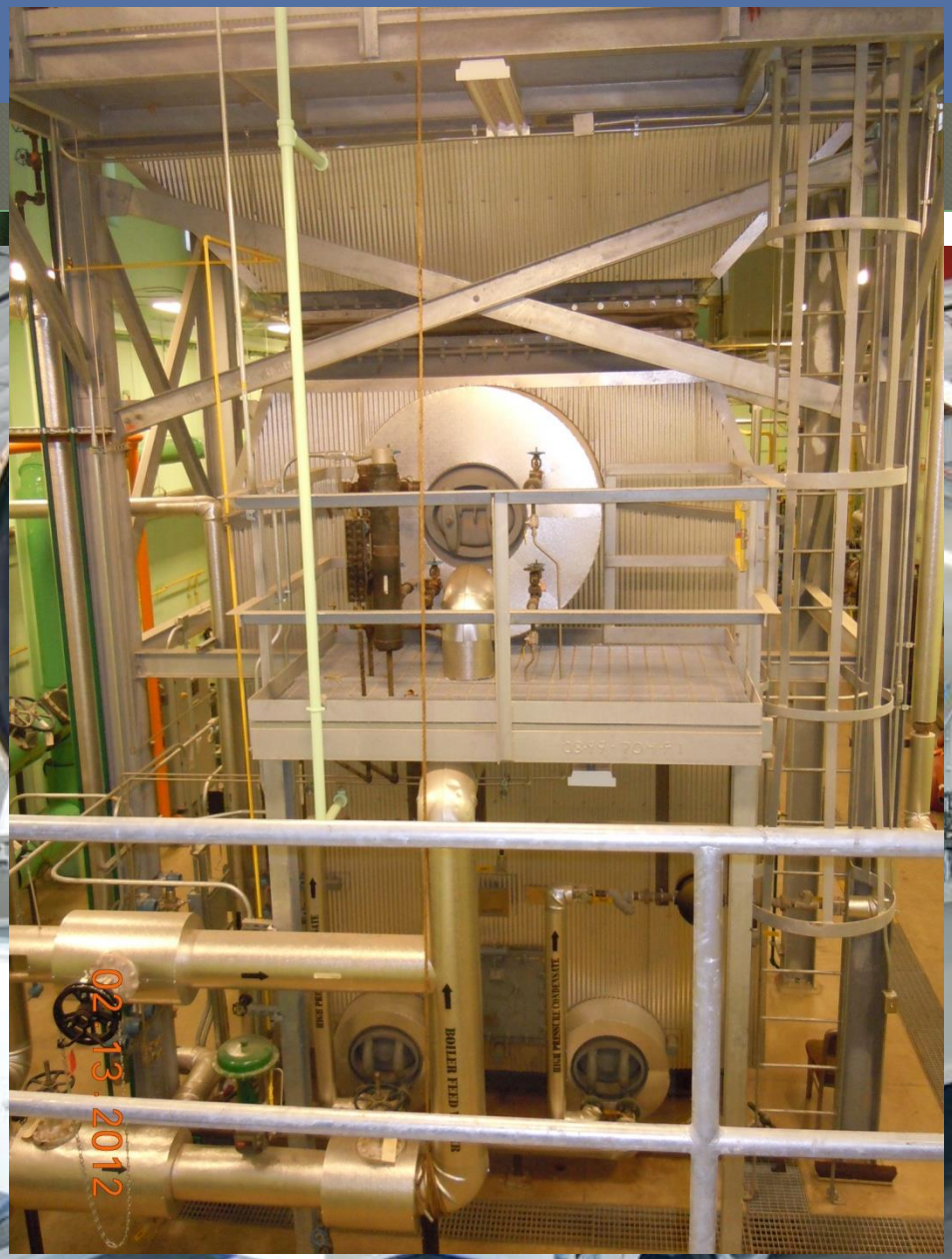


Energy Picture in 2006

- Additional Steam Capacity
  - Steam demands began to exceed firm capacity
- Aging Infrastructure
  - Last steam capacity upgrade was 1971
- Essential Services
  - Where/How to care for 10,000+ folks during a total loss of power to campus
  - Estimated we need 12 mW to do this

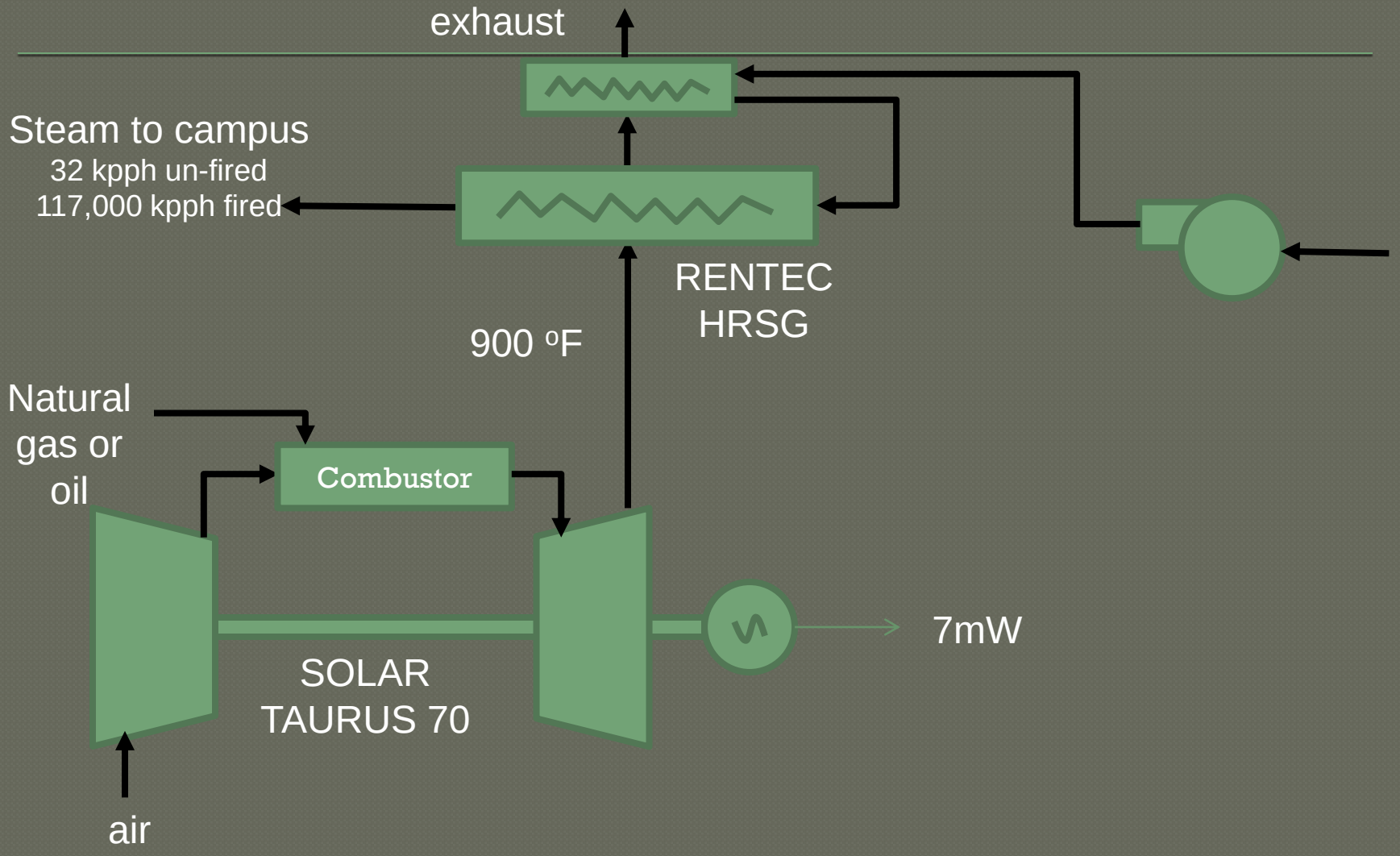
ECSP CHP

ECSP CHP



4/30/2013

ECSP CHP


exhaust
Steam to campus
32 kpph un-fired
117,000 kpph fired
RENTEC
HRSG
900 °F
Natural
gas or
oil
Combustor
SOLAR
TAURUS 70
7mW
air

ECSP Project Costs

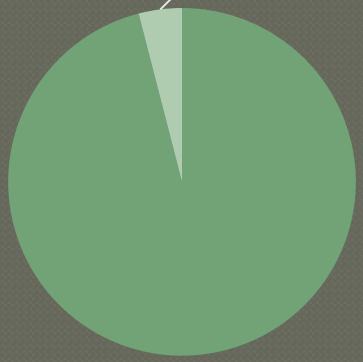
- Combustion Turbine $3.9 million
- HRSG $1.4 million
- Total Project $19 million

CT Service

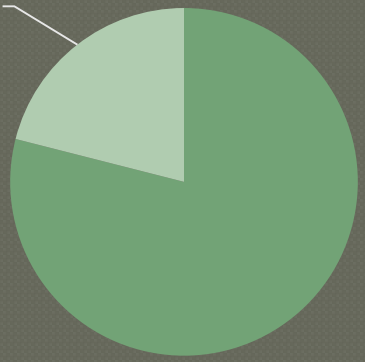
- Covers
  - Planned in-service and out-of-service maintenance
  - Service calls
  - Complete overhaul after 30,000 hours
- Costs
  - $21,000/month, $35 per hour
  - ~$600,000 per year

Projected Electric Generation

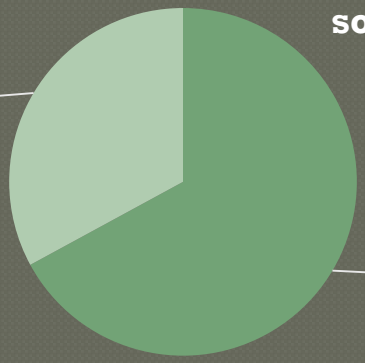
Before ECSP Upgrades Prior to 2011



After ECSP CHP After 2011

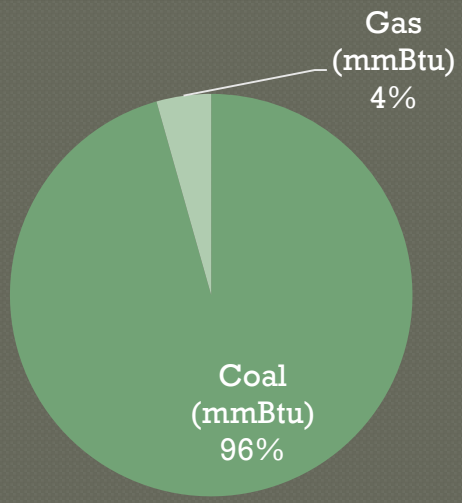


WCSP Upgrades w/ CHP sometime after 2015

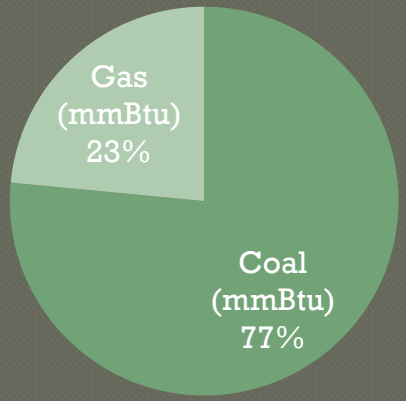


Projected Fuel Mix

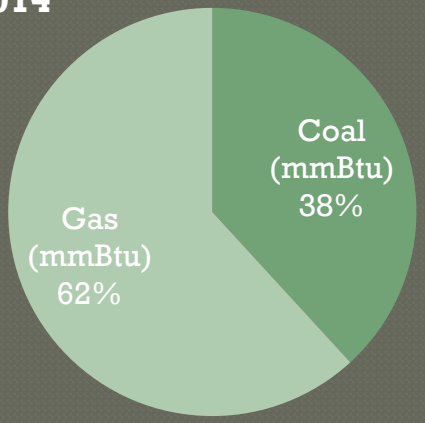
Before ECSP Upgrades prior to 2011



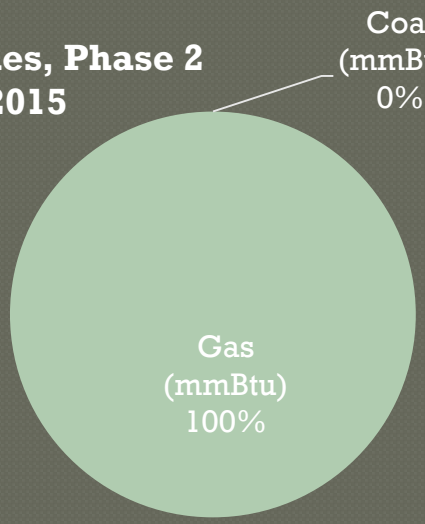
After ECSP Upgrades after 2011



WCSP Upgrades, Phase 1 2014



WCSP Upgrades, Phase 2 After 2015



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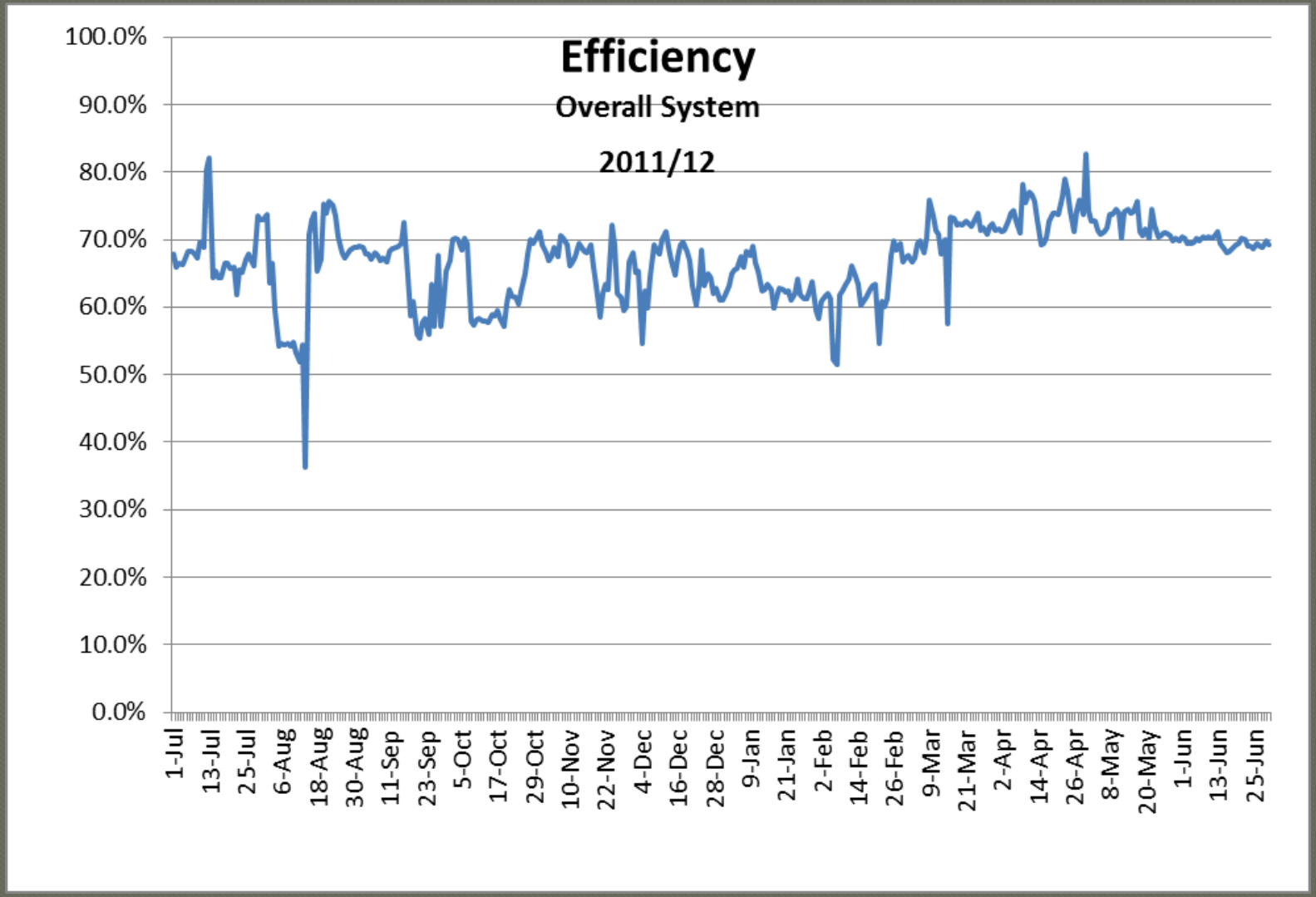
Campus Improvements



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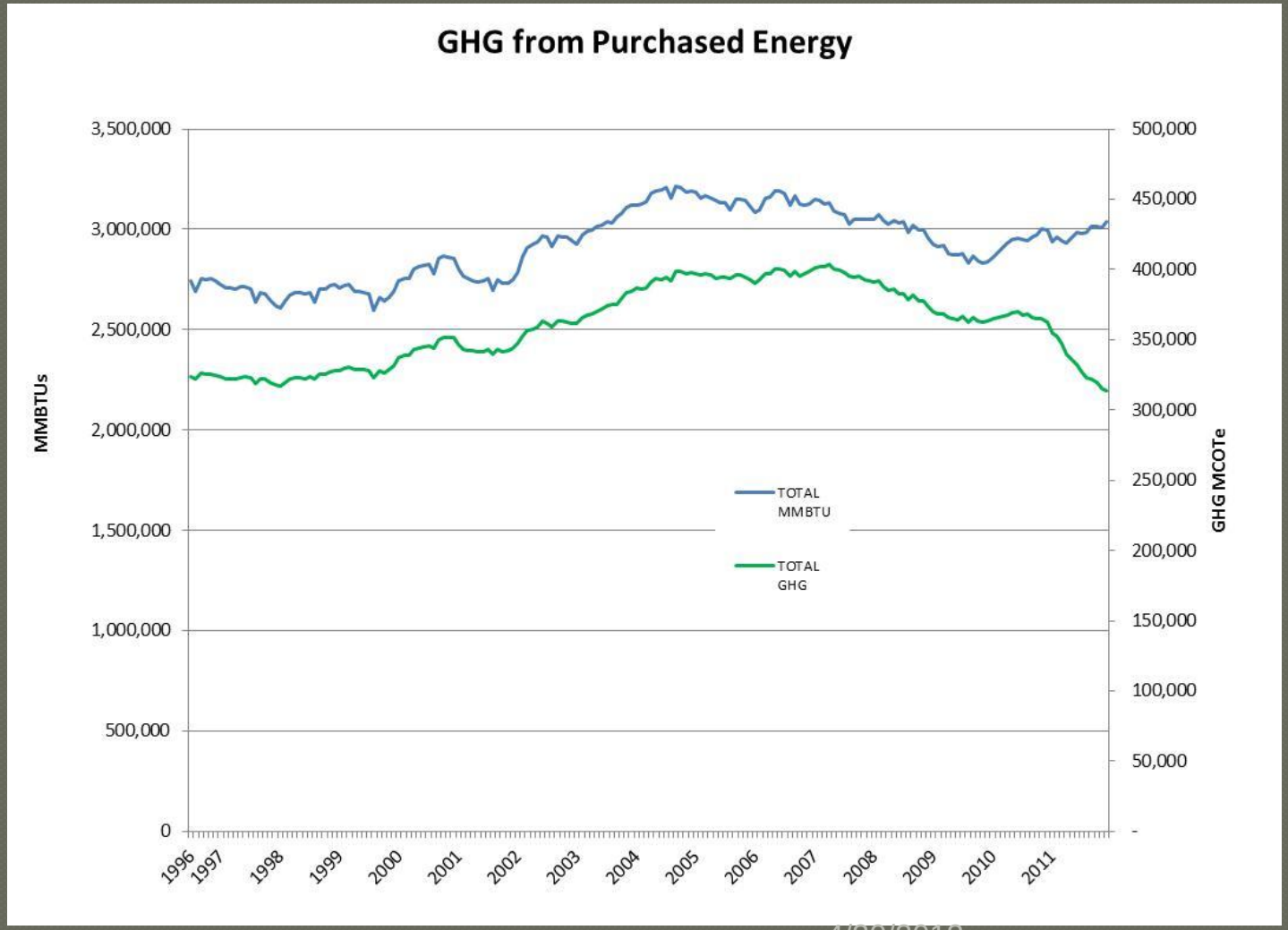
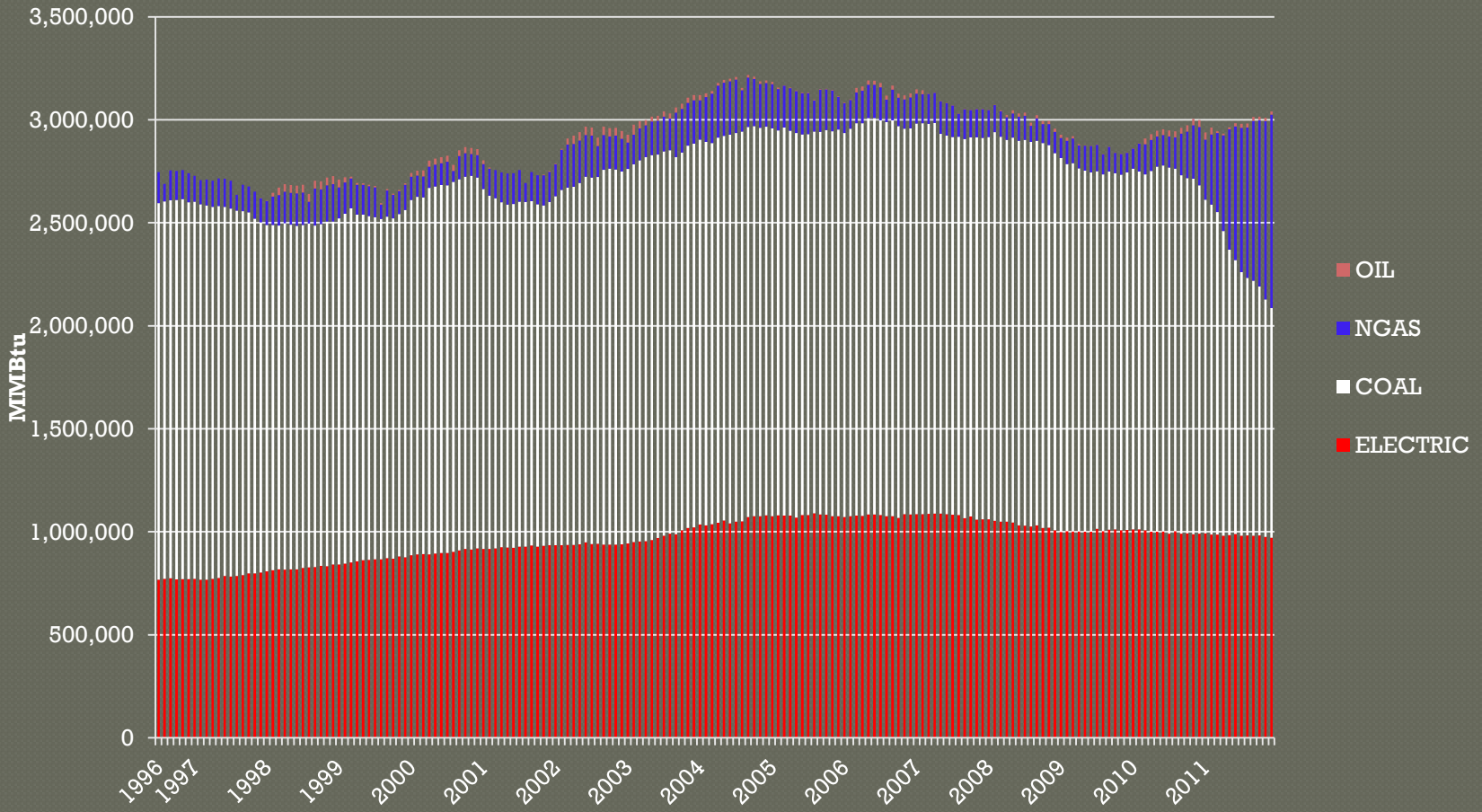


Campus Improvements

Actual Consumption MMBTUs



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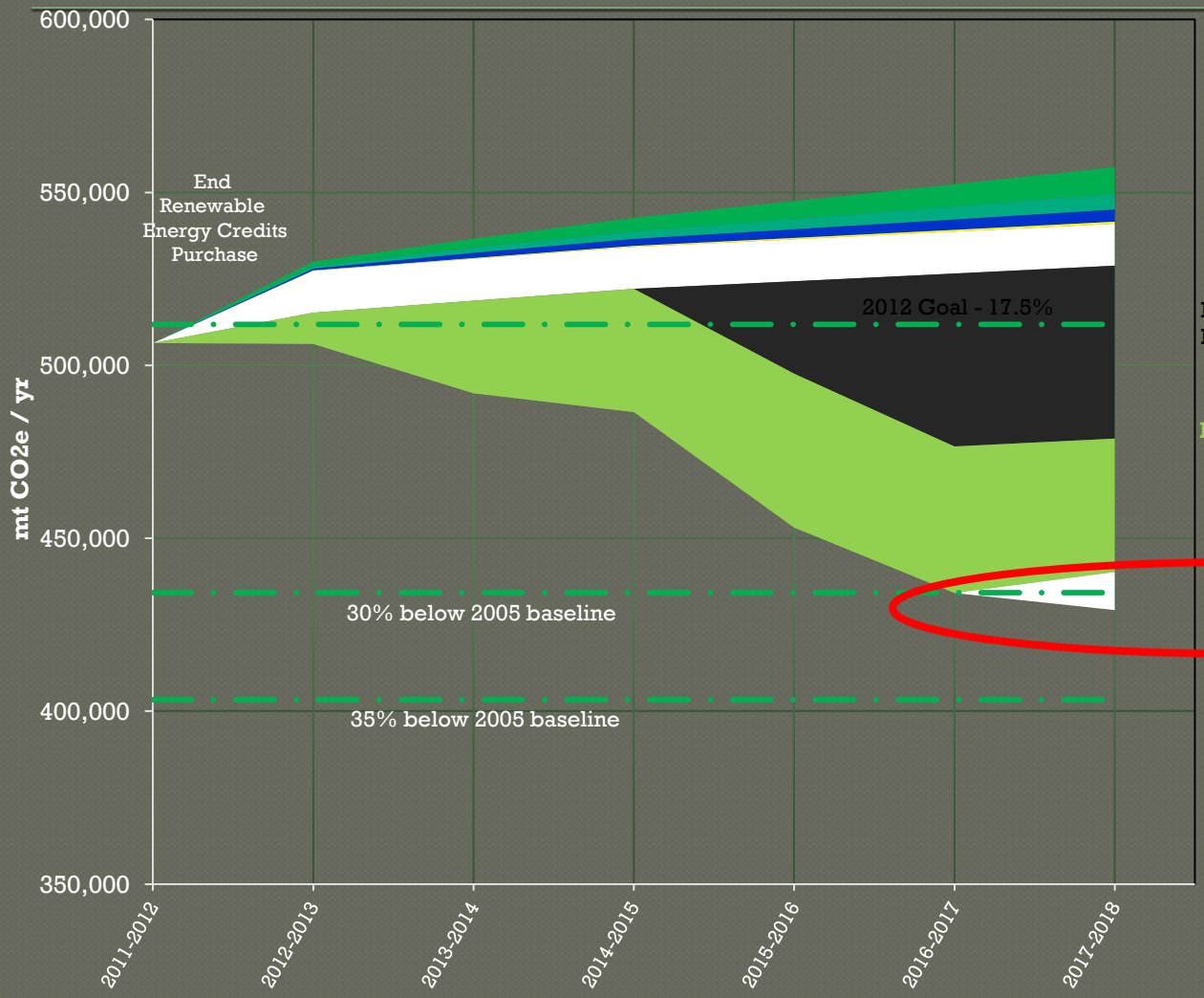
Penn State's GHG Picture



Greener Grid (AEPS)
Green Design
Campus Sustainability
Transportation \ Waste Initiatives
Combustion Turbine \ Operational changes

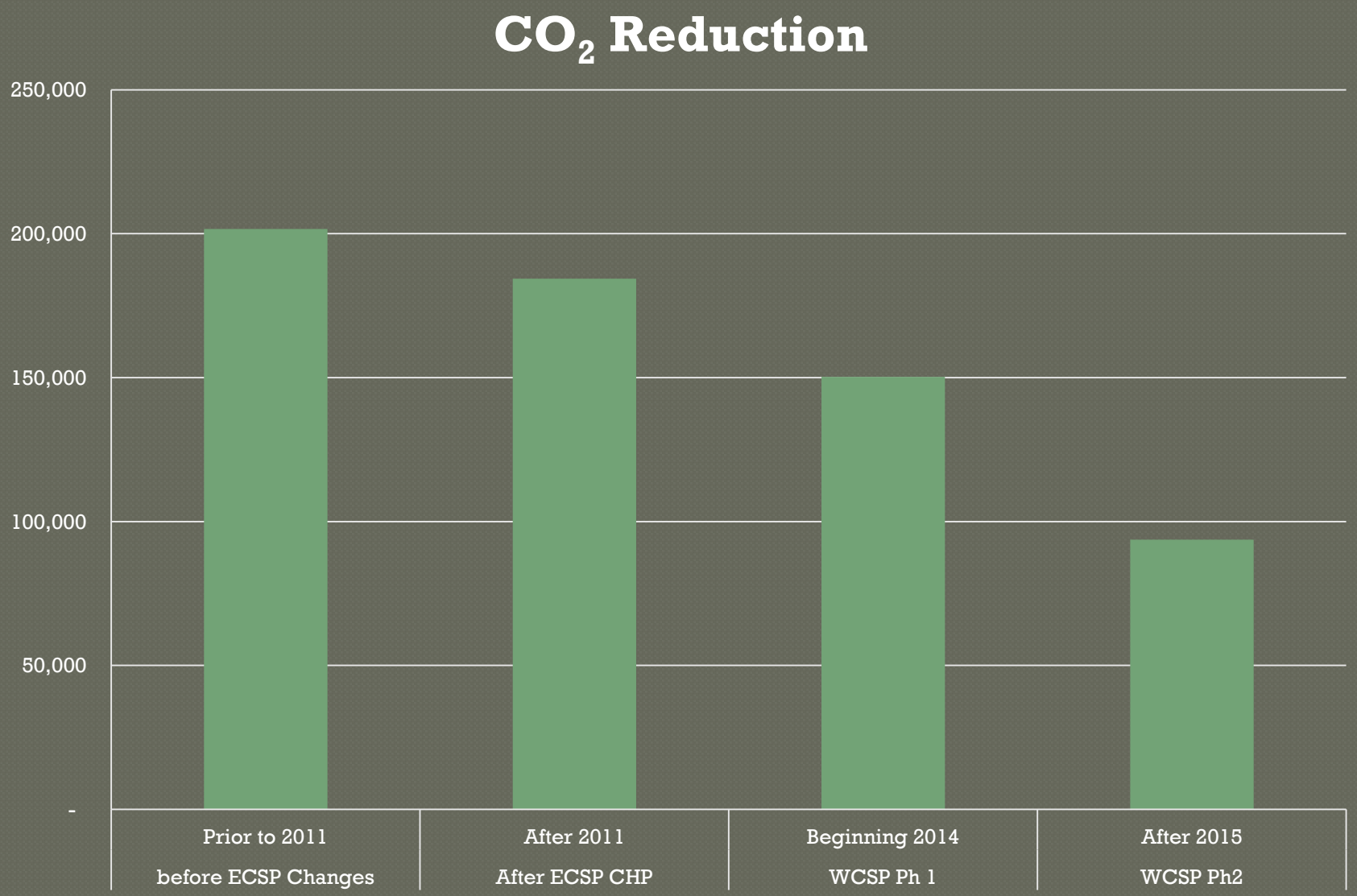
Fuel Switch -Coal to Natural Gas
Boiler MACT regulatory response

Energy Program
$7-10M\yr - Energy Savings Projects
15 yr simple payback
$1-1.5M\yr - Energy Conservation Meas
& and Continuous Commisi
5 yr simple payback

$20M - 2nd Combustion Turbine

4/30/2013

Campus Improvements

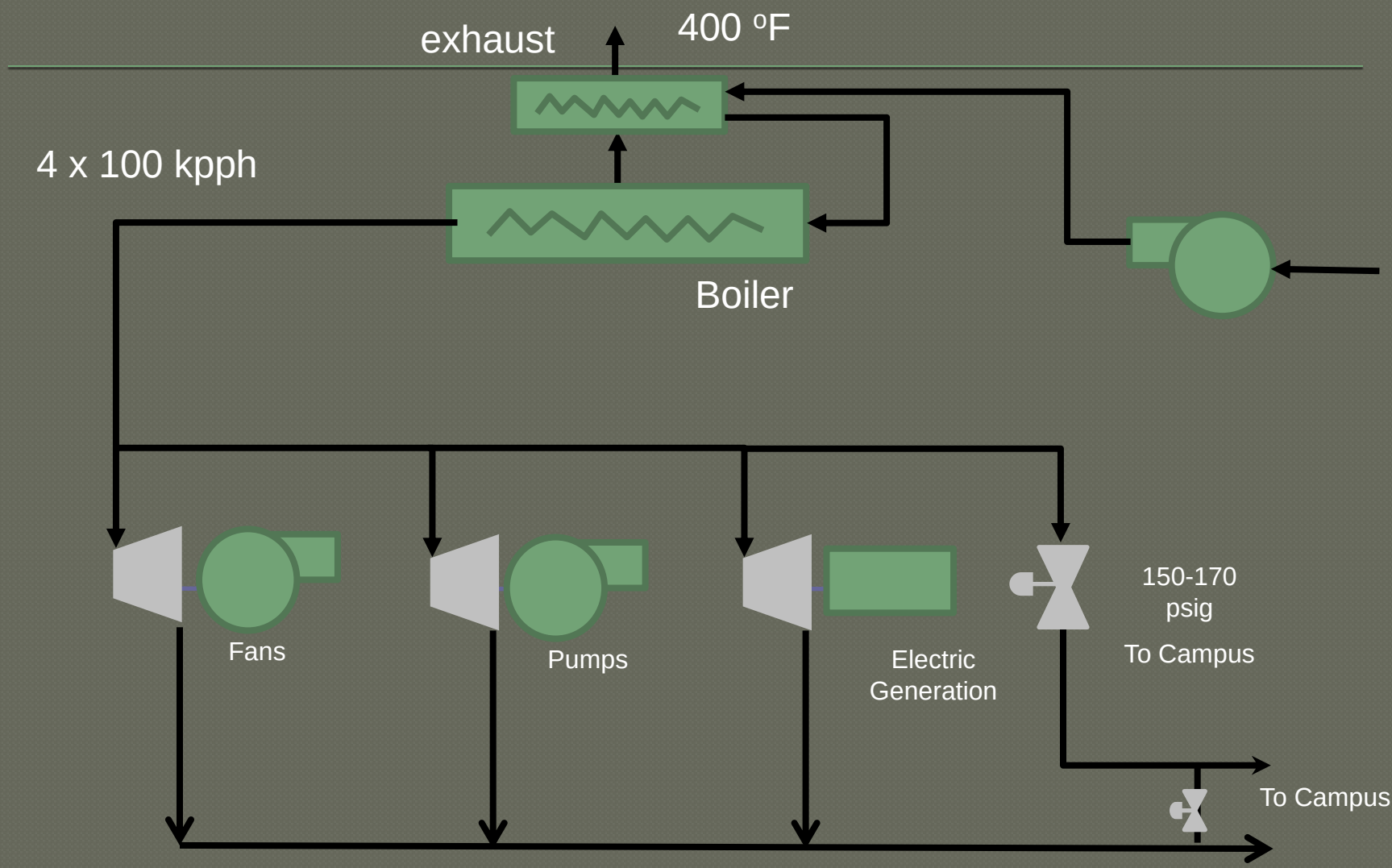


Next Steps

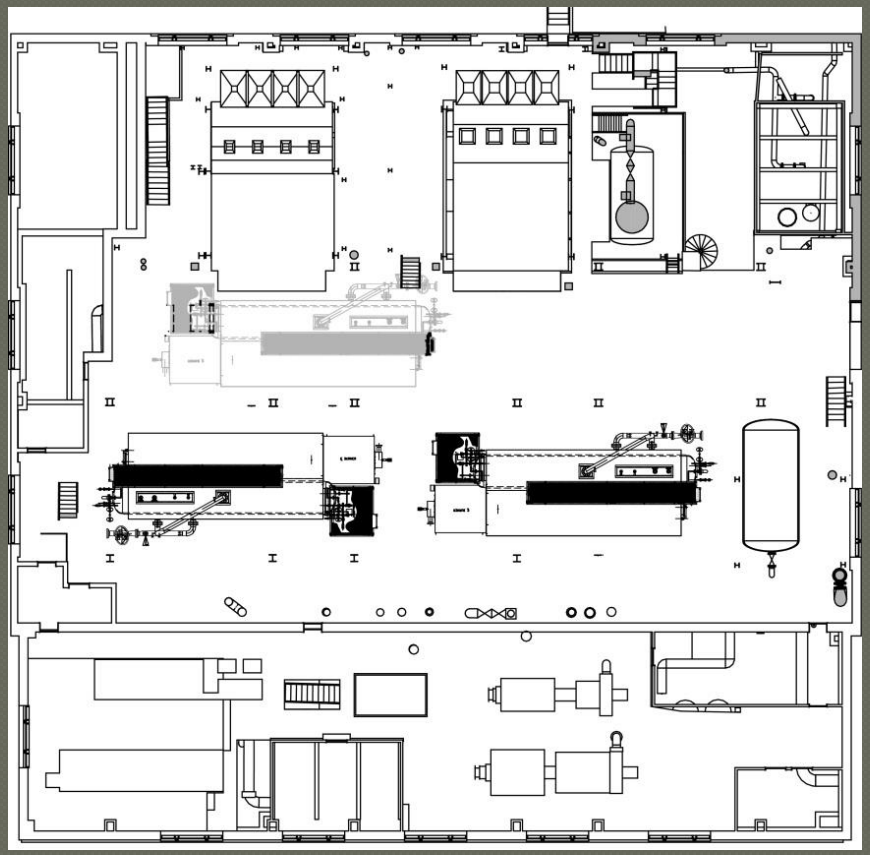
- Comply with Boiler MACT at WCSP
- Investigate a 2nd CT/HRSG installed at WCSP

West Campus Steam Plant

WCSP CHP


exhaust
400 ºF
4 x 100 kpph
Boiler
Fans
Pumps
Electric Generation
150-170 psig
To Campus
To Campus

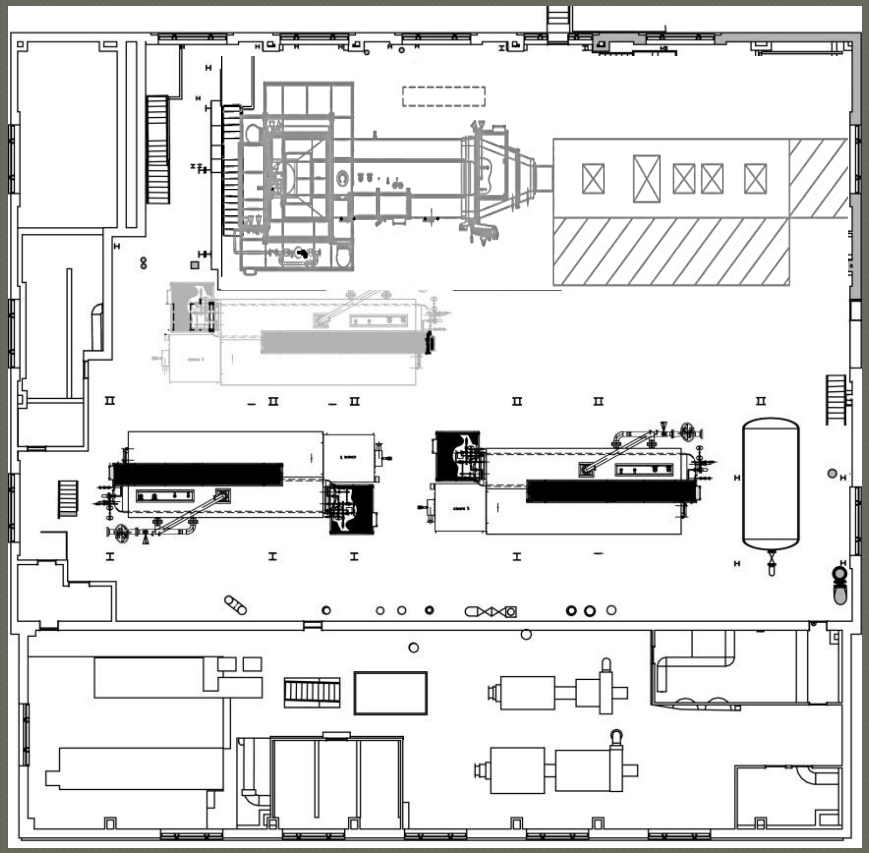
WCSP Floor Plan after Boiler MACT



New Natural Gas Boilers

Next Steps

WCSP with CT/HRSG



Future
CT/HRSG

Energy Funding – CT/HRSG

- Could meet Energy Program requirements of 8 year payback
- Could provide stability as Power Companies eliminate coal
  - PJM – 16,000 mW ~ 10% of load (retirement requests)
- Campus could operate at reduced but functional load

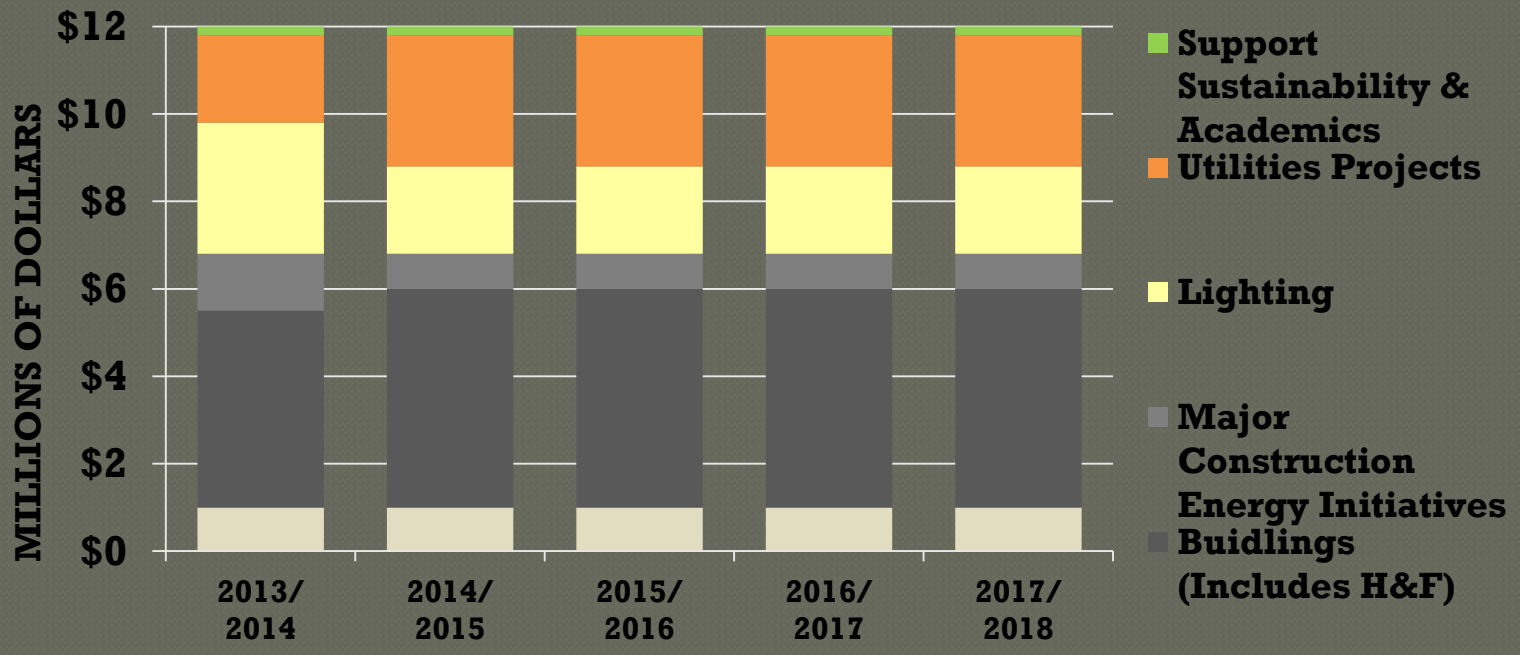
- Recent catastrophies
  - 2003 Cascading NE Grid Collapse
  - 2005 Hurricane Katrina
  - 2009 Kentucky Ice Storms
  - 2011 Tropical Storm Lee
  - 2012 Hurricane Sandy

Energy Funding - Planned

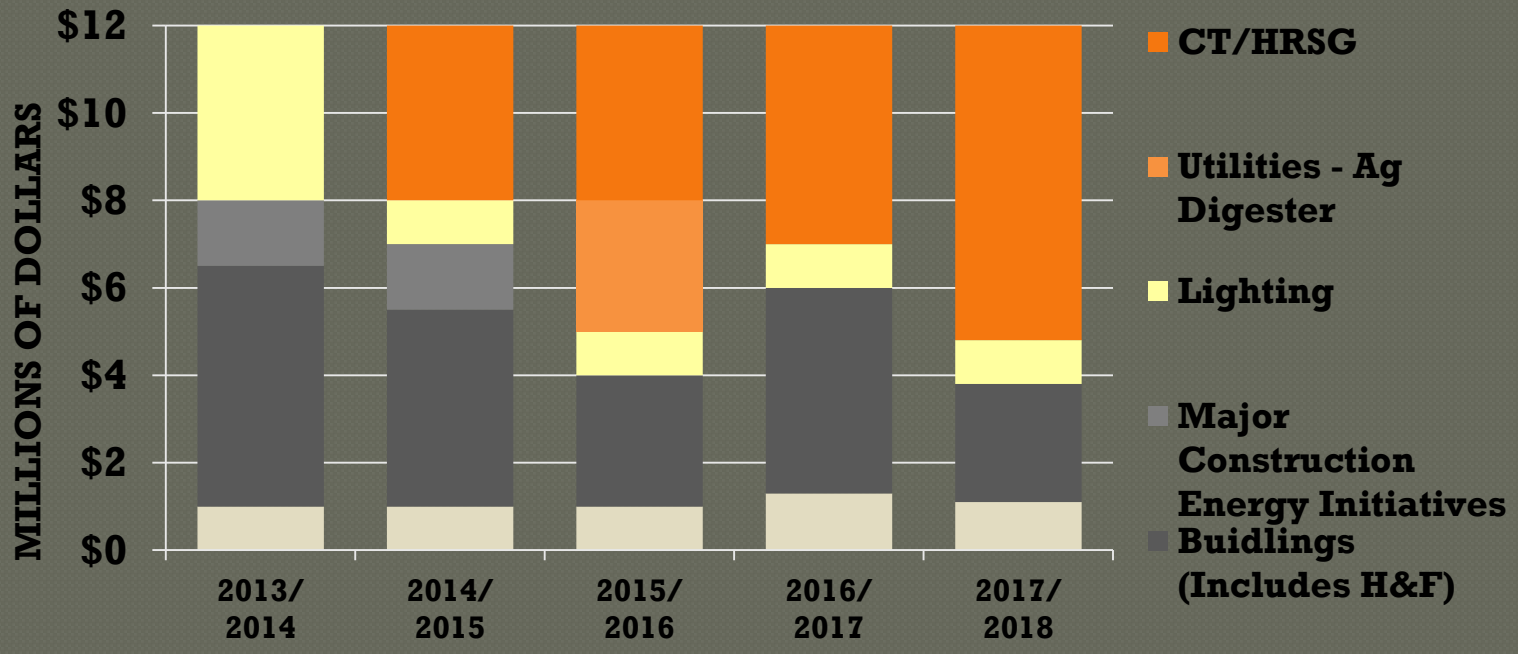
	CT#1	CT#2
Cost	$20M	$20M
Ngas/dth	$13	$5
Elect/kWh	$0.04	$0.08
Coal/ton	$80 ($3.20 per mmBtu)	$125 ($5 per mmBtu)
Funding	Essential Services - Aug 2003 Utilities - Boiler Replacement	Energy Funds At the expense of building improvements

Next Steps

Energy Funding - Planned



Energy Funding – CT/HRSG



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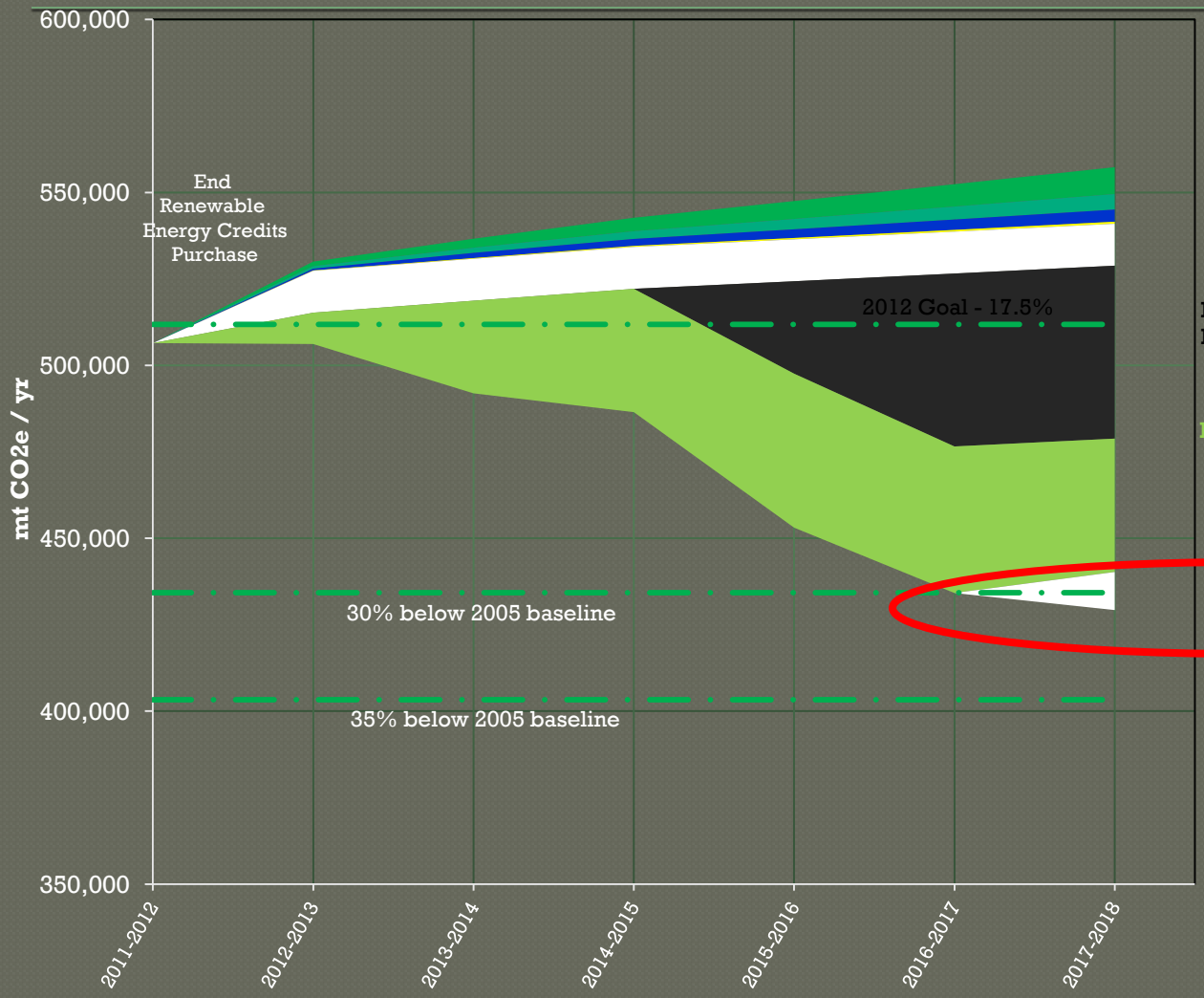

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Thank you

Campus Improvements