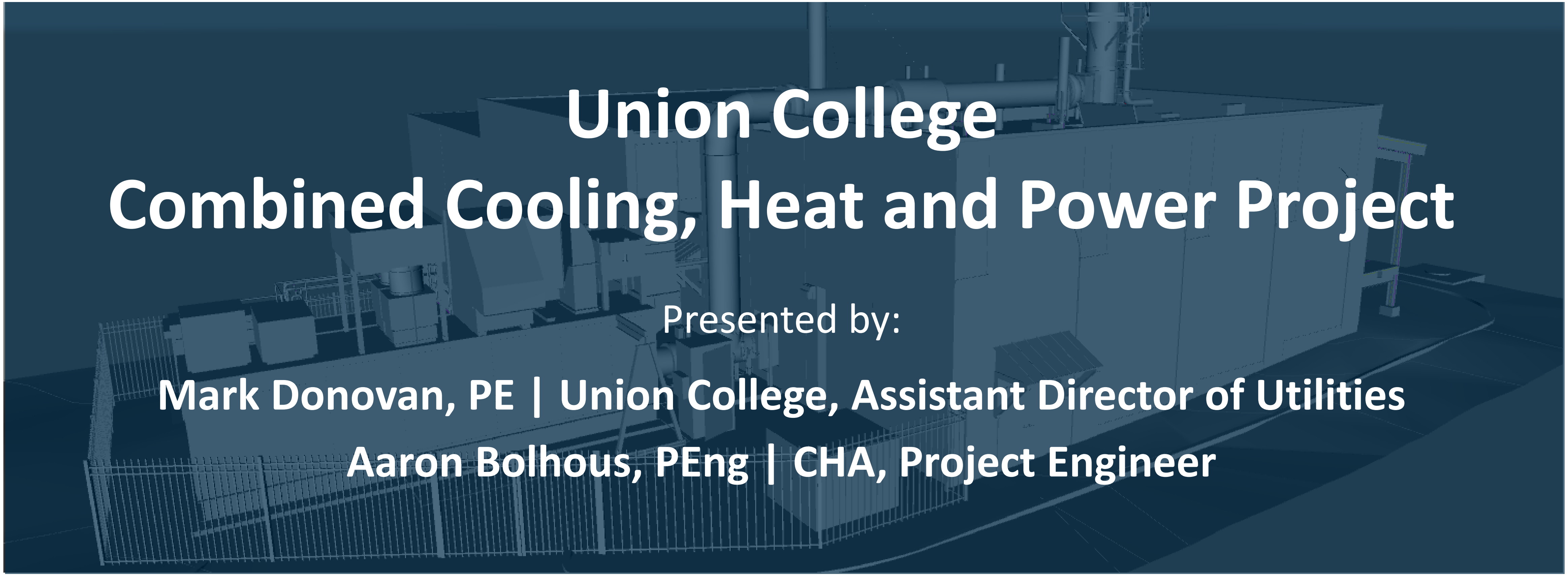

Union College
Combined Cooling, Heat and Power Project

Presented by:

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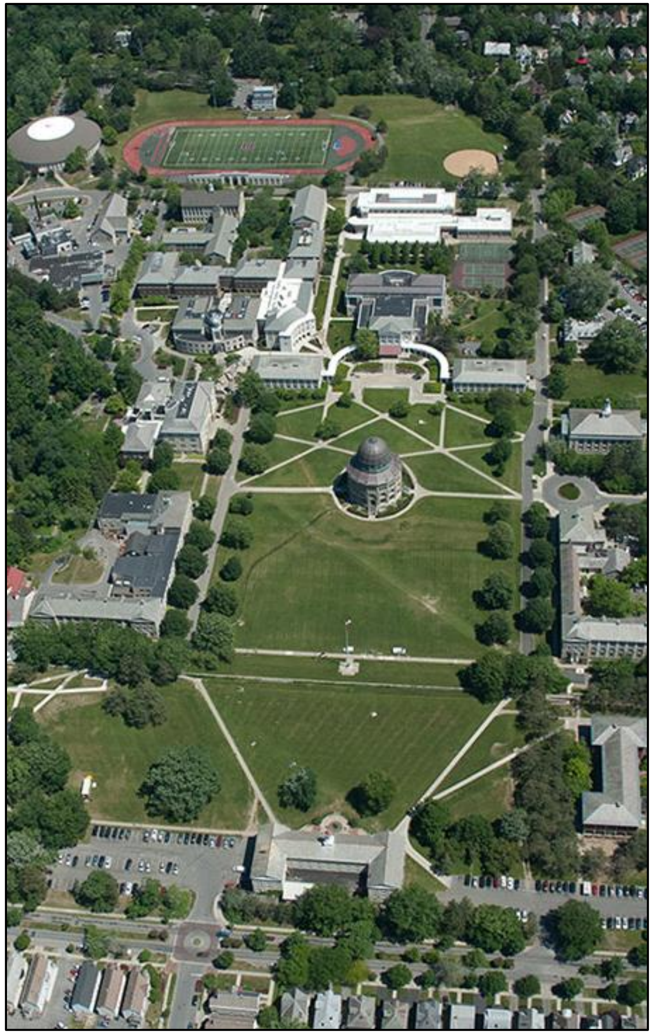
Aaron Bolhous, PEng | CHA, Project Engineer

CampusEnergy2017
February 20-24 | Hyatt Regency Miami | Miami, FL

UNION COLLEGE
FOUNDED 1795

CHA
design/construction solutions

Agenda



- Introduction to Union College
- Utility Usage
- Combined Cooling, Heat and Power Drivers
- Technical Highlights of Design
- Challenges / Lessons Learned
- Key Factors of Success
- Budget & Schedule
- Questions and Answers

Union College

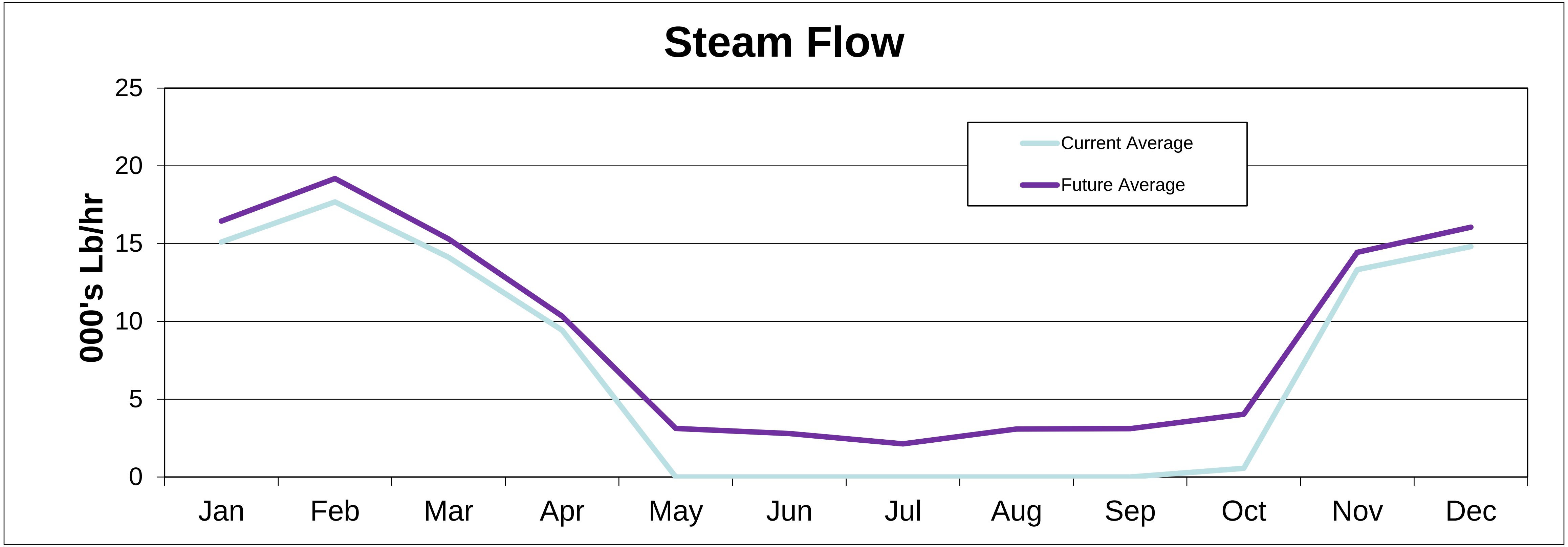
- Founded in 1795; located in Schenectady, NY
- Engineering and Liberal Arts College
- 900 Faculty and Staff
- 2,200 Students
- Central Utility Plant
  - Provides steam and chilled water to 48 buildings
- Power Demand Limited from Utility Provider
- Campus Renovations and Building Plan is aggressive over the next 5-10 years
- 2014 NCAA Division I Ice Hockey Champions

UNION COLLEGE CHA

Central Utility Plant

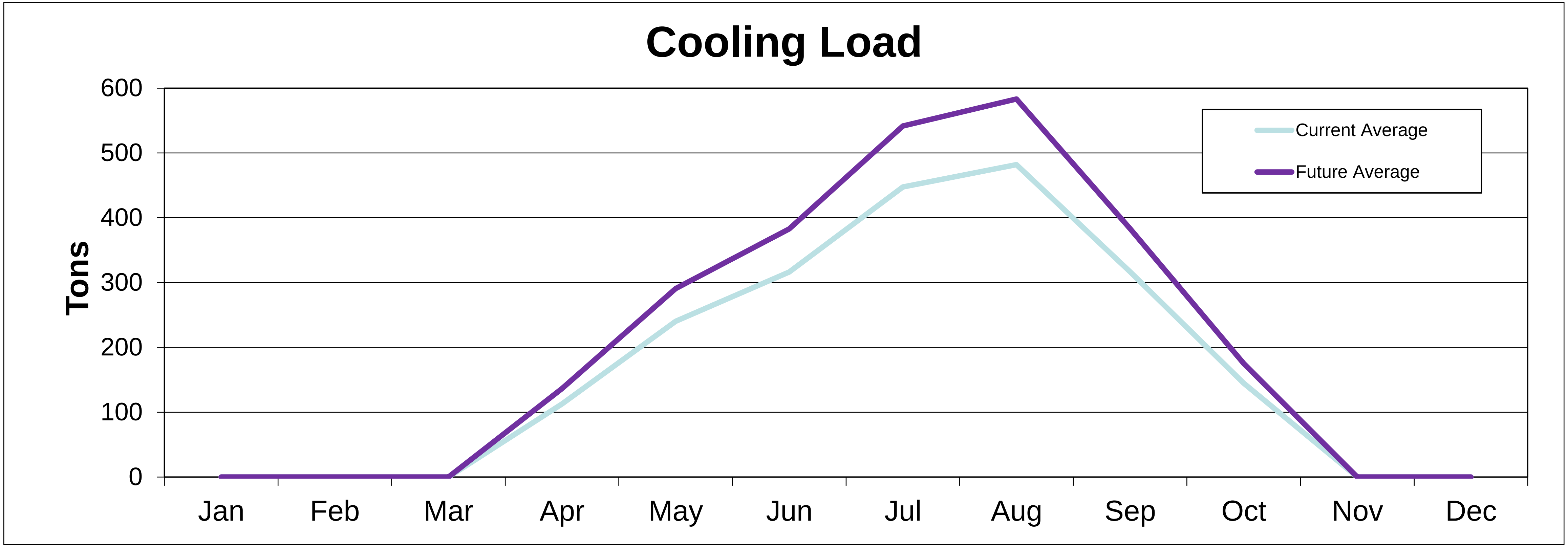
- Two Boilers
  - Natural Gas
  - 30,000 lb/hr each
  - 90 psig, saturated
- Two Chillers
  - Centrifugal
  - 750 Ton Each
  - 42 – 45 °F chilled water temperature
- Three Cooling Towers
  - Only have capacity to support existing chillers

Utility Usage



- Current Peak Steam Load – 44,700 lb/hr
- Expected Future Peak Steam Load – 48,400 lb/hr (8.3%)

Utility Usage



- Current Peak Cooling Load – 1,115 Tons
- Expected Future Peak Cooling Load – 1,350 Tons (21%)

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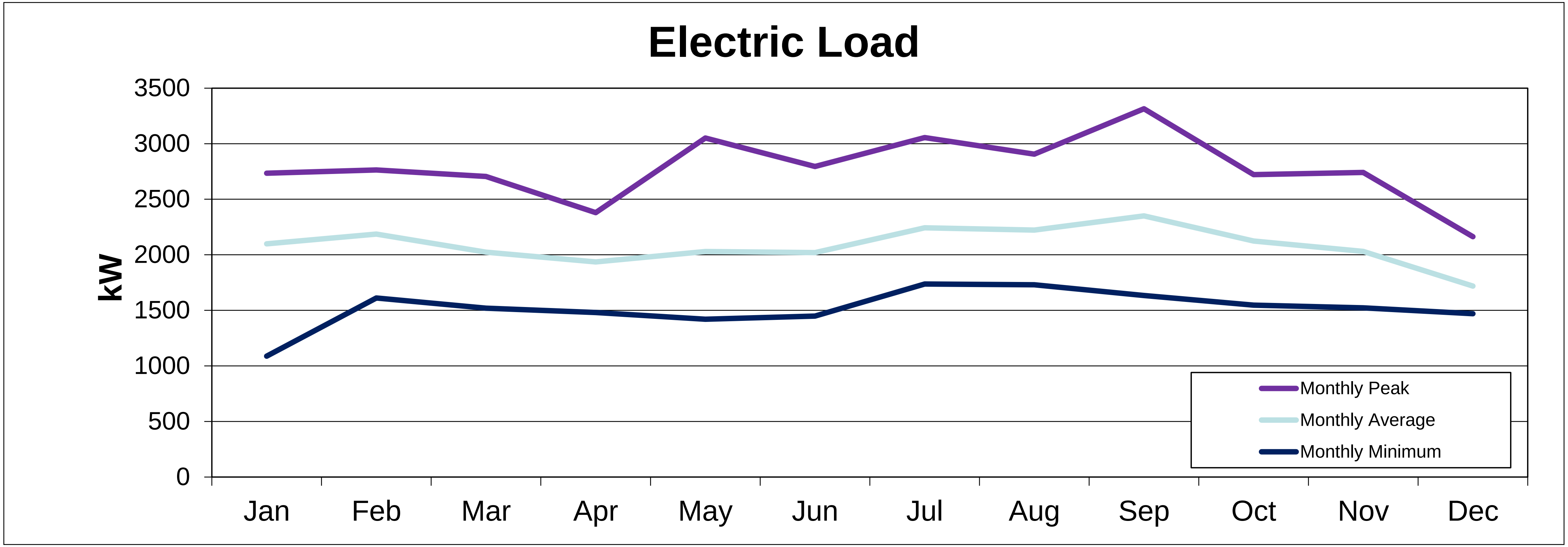
Utility Usage



- Current Peak Electrical Load – 3,314 kW

Combined Cooling, Heat and Power Drivers

- Electrical utility reliability – 10-12 outages per year
- Electrical utility only has capacity to meet current peak demand – significant impact to upgrade
- Planned campus building expansion will exceed this capacity
- Aging existing boilers require rehabilitation
- Reduction in energy supply costs
- Increased utility plant operating flexibility
- Reduction in plant CO_2 emissions
- Design / Build project execution using Cogeneration Power Technologies

UNION COLLEGE CHA

Highlights of CHP Design – Gas Turbine

- Kawasaki model GPB17D
- Typically base-load operation
- 2-stage radial flow compressor w/ 3-stage axial flow turbine
- 13.2 kV synchronous generator
- Complete package with gearbox, control housing, lube oil cooler, inlet air cooling coil, etc. all on a common baseplate
- Guarantee conditions at 40°F
  - Output – 1,820 kW; Heat Rate – 12,540 Btu/kW.hr
  - Nox – 9 ppm (60-100% load); CO – 50 ppm (50-100% load)

UNION COLLEGE CHA

Highlights of CHP Design – HRSG

- Rentech O-type water-wall HRSG
- Economizer, ducting, expansion joints & stack
- Unfired steam – 11,500 lb/hr 90#, saturated
- Low NOx Duct Burner – 45,000 lb/hr
- Diverter damper and bypass ducting allows operation of gas turbine in both simple cycle or cogeneration mode

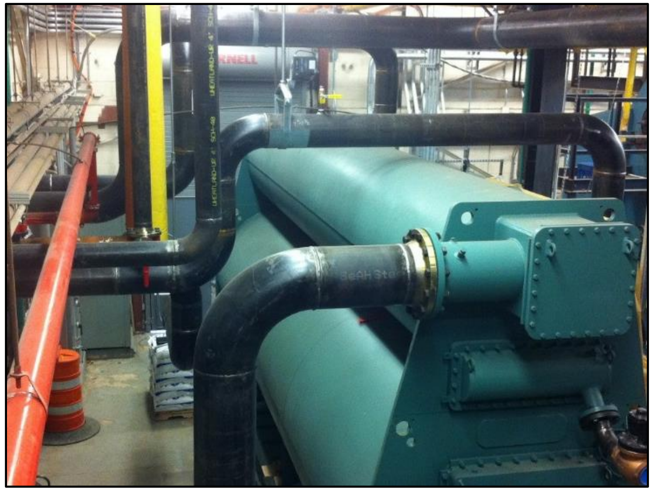
UNION COLLEGE CHA

Highlights of CHP Design – Gas Compressor

- JJ Crewe screw compressor
- 200 HP motor with soft start
- Inlet – 20 psi; Discharge – 230 psi
- Acoustic, weatherproof enclosure
- Air cooler for both compressed gas and lube oil

UNION COLLEGE CHA

Highlights of CHP Design – Absorption Chiller



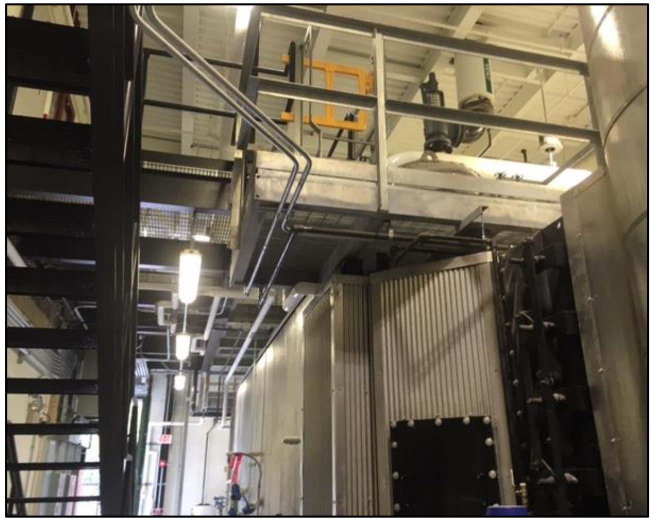
- York YIA single effect, 600 Ton, Lithium Bromide chiller utilizing HRSG steam
- Micro-pile foundation within existing building
- New cooling tower dedicated to new chiller
- JCI control system tied into existing Building Management System to operate in parallel with existing chillers
- GTG inlet air cooling to improve summer performance

UNION COLLEGE CHA

Highlights of Design – Electrical

- Electrical room for 15 kV and 480 V switchgear and batteries
- Multiple MCCs located in new and existing buildings
- Control Room - Plant Control System (Rovisys was used as the system integrator)
- 500 kW Black Start Generator
- GTG and BSG can operate parallel to grid or Islanded
- Load Management System

Highlights of Design – Offices



- New office for Plant Manager
- New restroom for facility
- Learning environment for students and conferences
- Mezzanine observation deck for maintenance and viewing

Challenges / Lessons Learned

- Interfacing with utility provider and relay protection
- Utility engagement on natural gas requirements
- Construction on a space limited project site with unknown underground utilities
- Construction schedule
- Clear understanding of design intent with all vendors

UNION COLLEGE CHA

Key Factors of Success

- Pre-planning and understanding campus loads through metering
- Accurate projections of future loads through modeling
- NYSERDA funding of Flex-Tech studies to understand feasibility with 30% design
- Understanding goals set forth by College and sustainability – selecting the correct option

Overall Budget and Schedule

Budget	
Pre-purchased Equipment	$6.5M
Construction	$6.0M
Engineering, Permitting, & Support	$1.5M
Total Project	**$14M**
NYSERDA Incentive	**$2.0M**

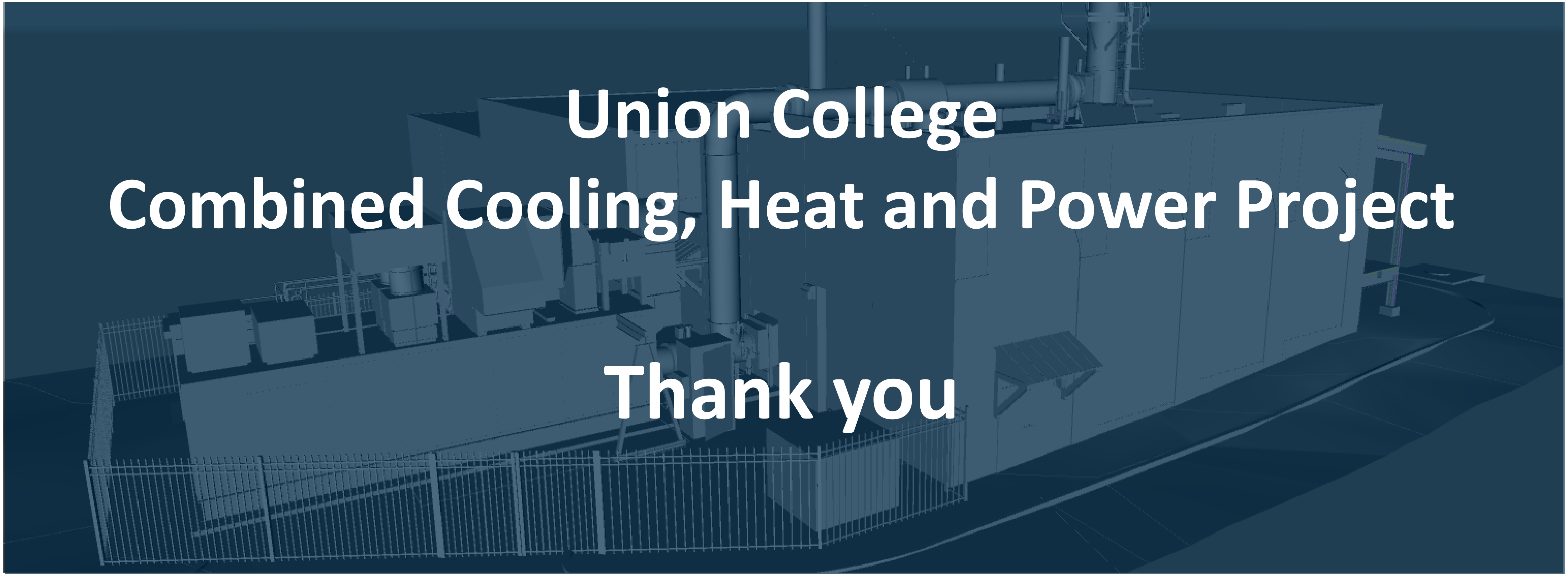
Schedule	
Planning	February 2013 – April 2014
Engineering, Permitting, Interconnection	April 2014 – September 2015
Construction	August 2015 – April 2016
Commercial Operation Date	May 2016

UNION COLLEGE CHA

Combined Cooling, Heat and Power Plant

UNION COLLEGE

CHA



Union College
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Thank you