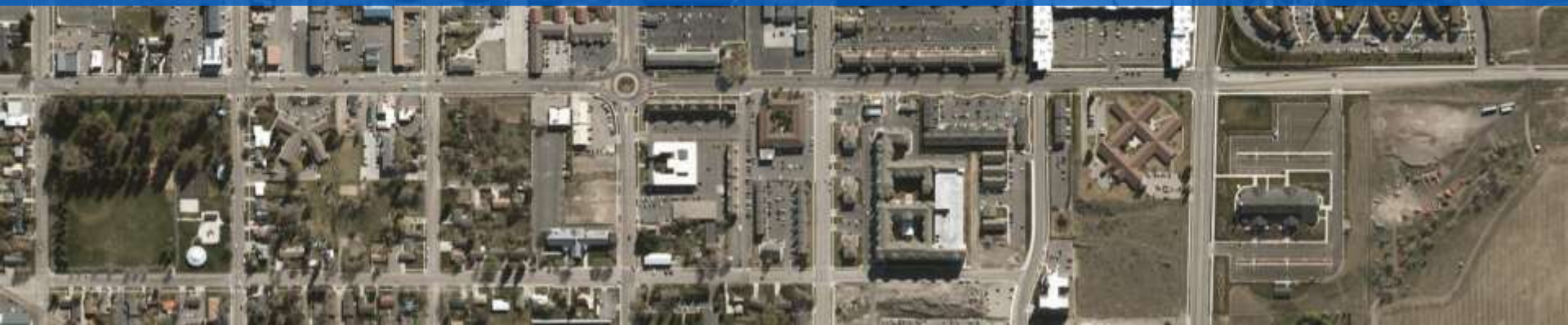
BYU IDAHO | Facilities Management

RMH GROUP

# FROM COGEN TO TRIGEN



# Hello!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FACILITIES MANAGEMENT, HVAC SERVICES SUPERVISOR

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THE RMH GROUP – MECHANICAL ENGINEER

# CASE IN POINT

**BYUI Central Utilities**

4.5 MWe gas combustion turbine

25 MMbtuh heat recovery steam generator (50 MMbtuh with duct burner)

155 MMbtuh steam boiler plant

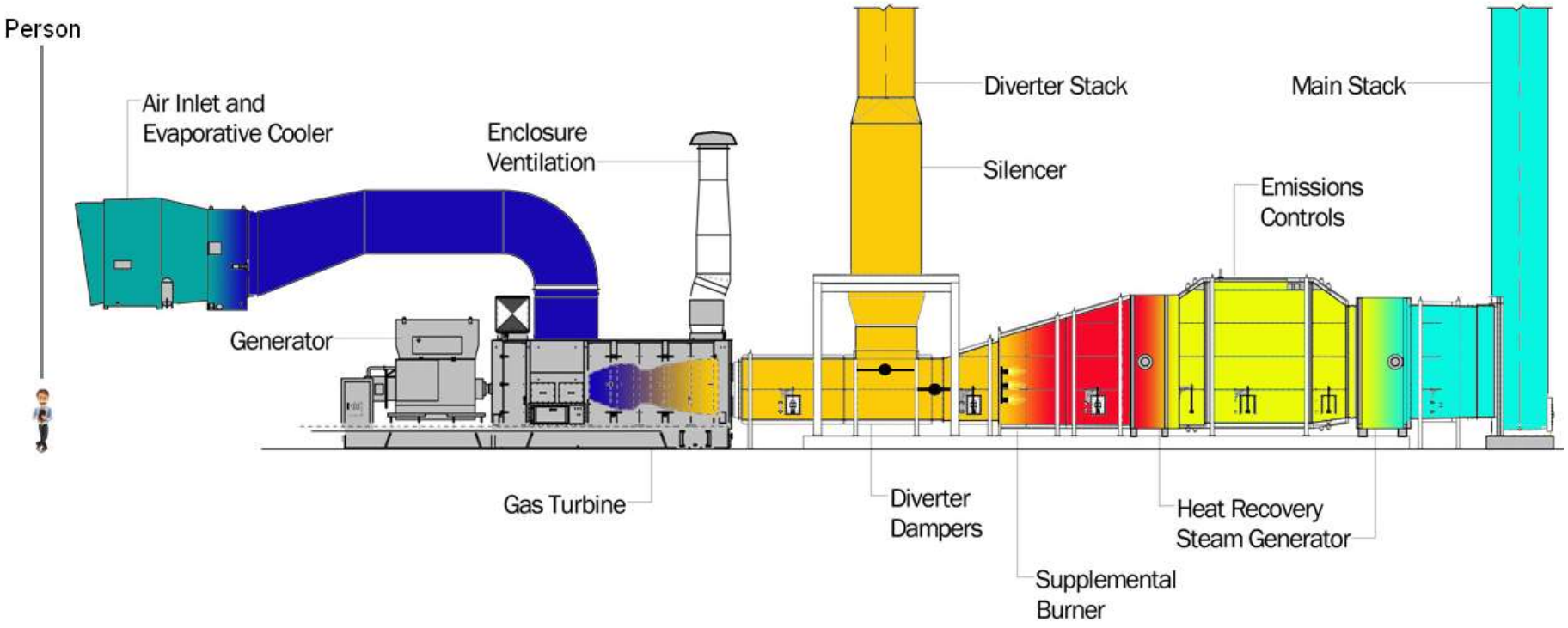
1,800-ton chilled water plant

Up to 45% of turbine exhaust bypassed on hot days

22% of turbine exhaust bypassed in a typical year

More chiller capacity needed by Summer 2020

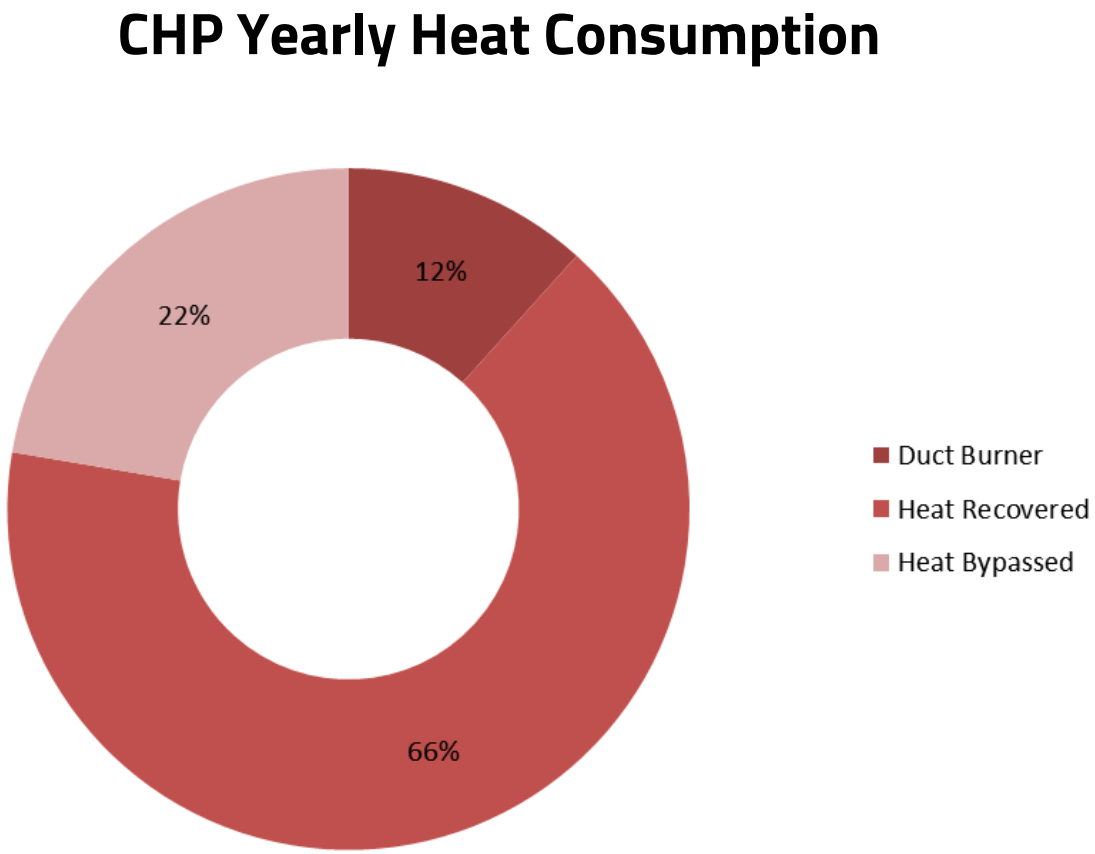
# COGEN
## CHP


Person
Air Inlet and
Evaporative Cooler
Enclosure
Ventilation
Diverter Stack
Silencer
Main Stack
Emissions
Controls
Generator
Gas Turbine
Diverter
Dampers
Heat Recovery
Steam Generator
Supplemental
Burner

## WHAT HAPPENS WHEN
## CHP = TOO MUCH HEAT?

What options do we have?

What is the most efficient way to deal with the heat?



# REJECT IT TO ATMOSPHERE

Rejecting steam to the atmosphere requires infrastructure to automate and regulate the pressure

It also requires additional water, chemical treatment, and heat energy

# TURN IT DOWN?

Turning the turbine down is a less efficient way to operate

AND

The cooling season is when you NEED the power!

# TURN IT OFF?

BYUI is under contract to produce power

The cooling season is when you NEED the power

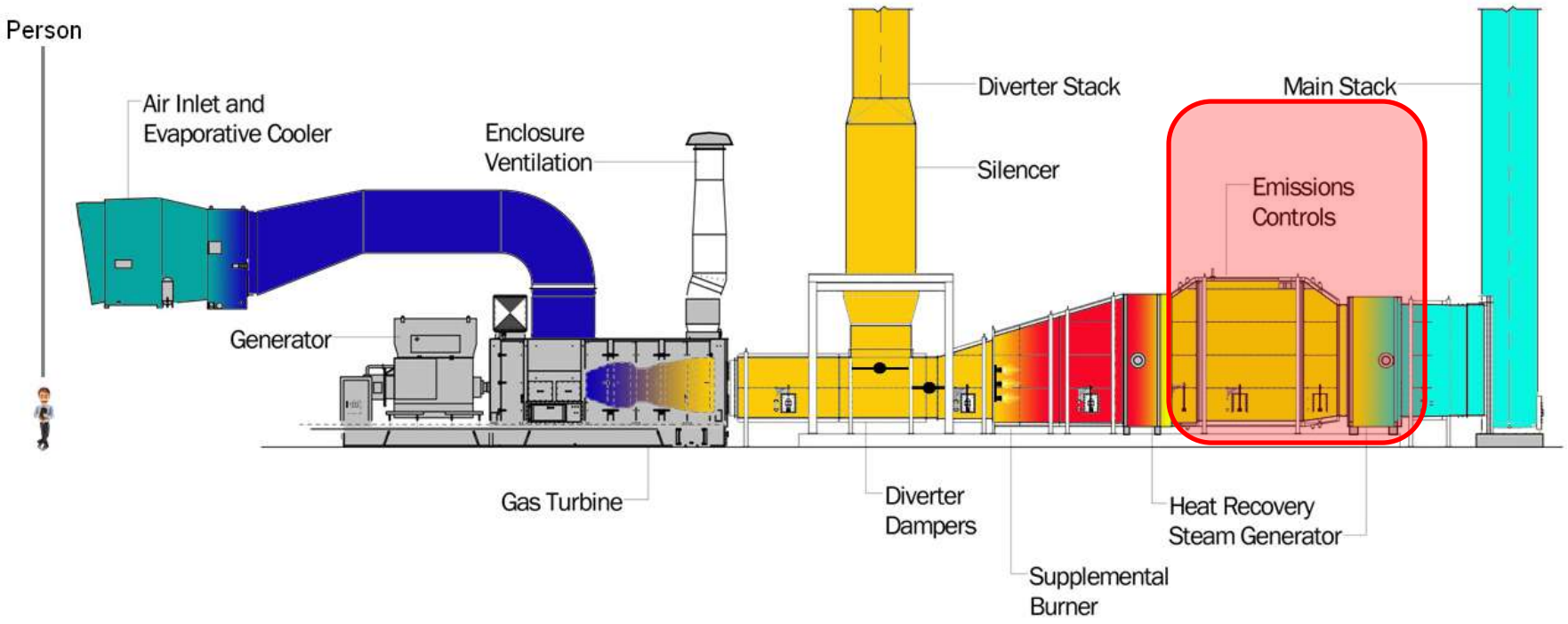
But, if infrastructure is not built-in, turning off the turbine may be the only option

## BYPASS
## THE HEAT RECOVERY

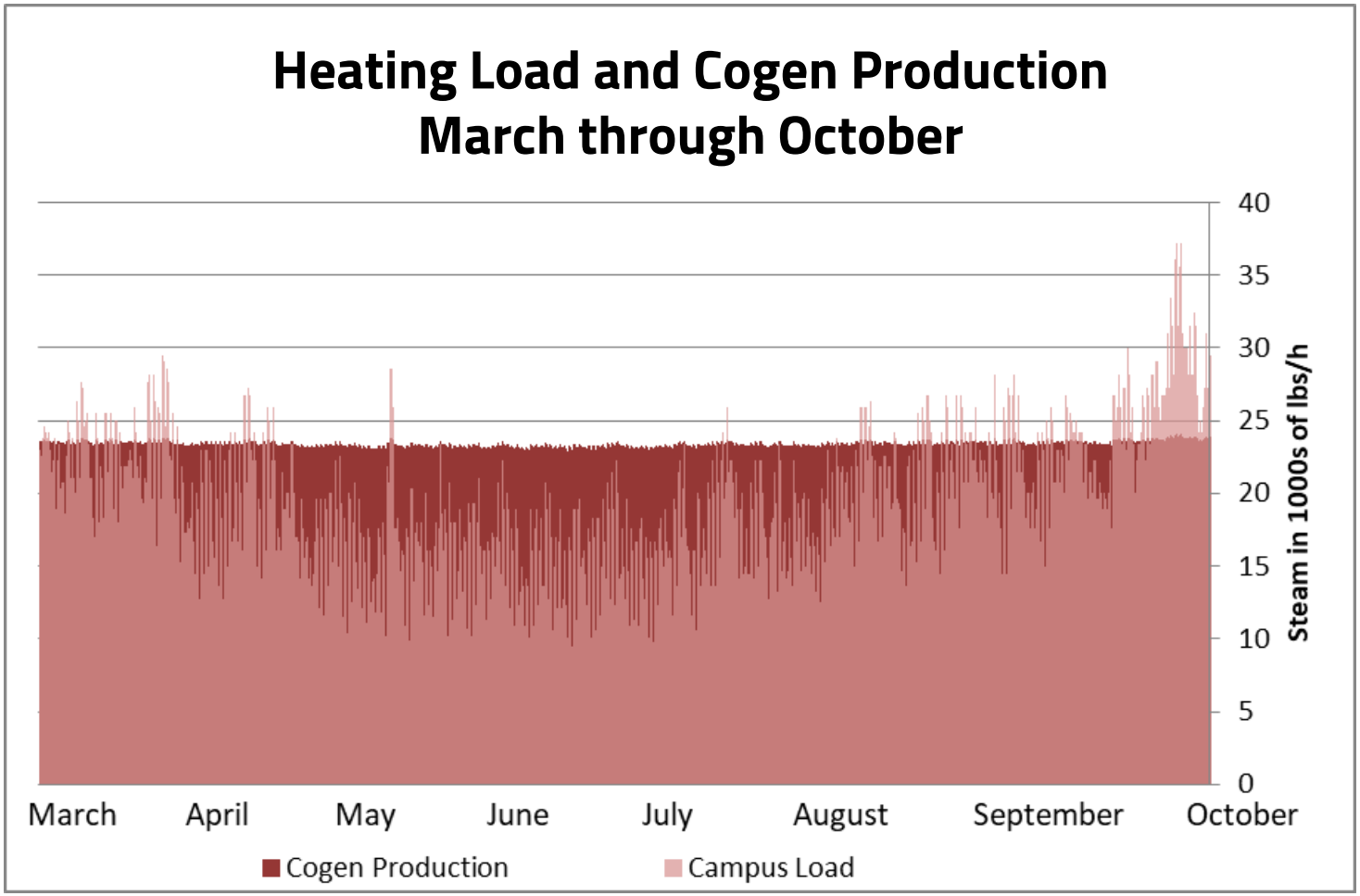
Modulate the extra heat to atmosphere

This is the current practice at BYUI

# STACK
# EMISSIONS



# A PROBLEM OR
# AN OPPORTUNITY?



# STUDY: PROJECT REQUIREMENTS

Use as much “wasted” heat as possible

AND

Meet future campus chilled water demands

AND

Provide a reasonable return on investment

# WHAT CAN EXTRA STEAM DO?

## Process Use

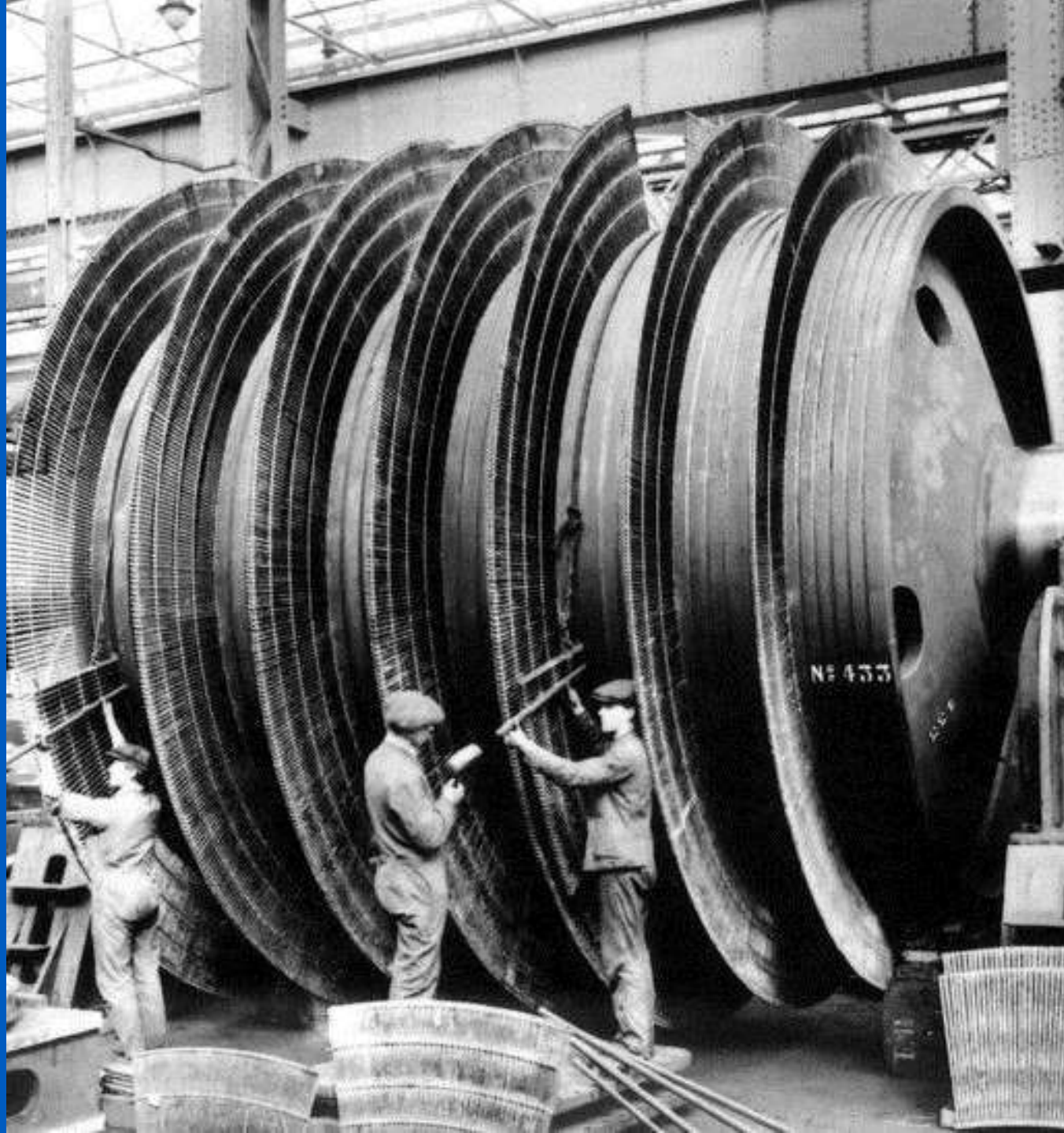
Nothing on campus…

# WHAT CAN EXTRA STEAM DO?

**Make More Power**

Steam turbine

Rankine cycle



# WHAT CAN EXTRA STEAM DO?

## Use Steam to Produce Cooling

Absorption (single, double , and triple effect)

Steam turbine-driven chiller

# STUDY: ADDING A CHILLER

Absorption Chiller

OR

750-ton  Electric Chiller (baseline)

OR

1000-ton Steam Turbine Chiller

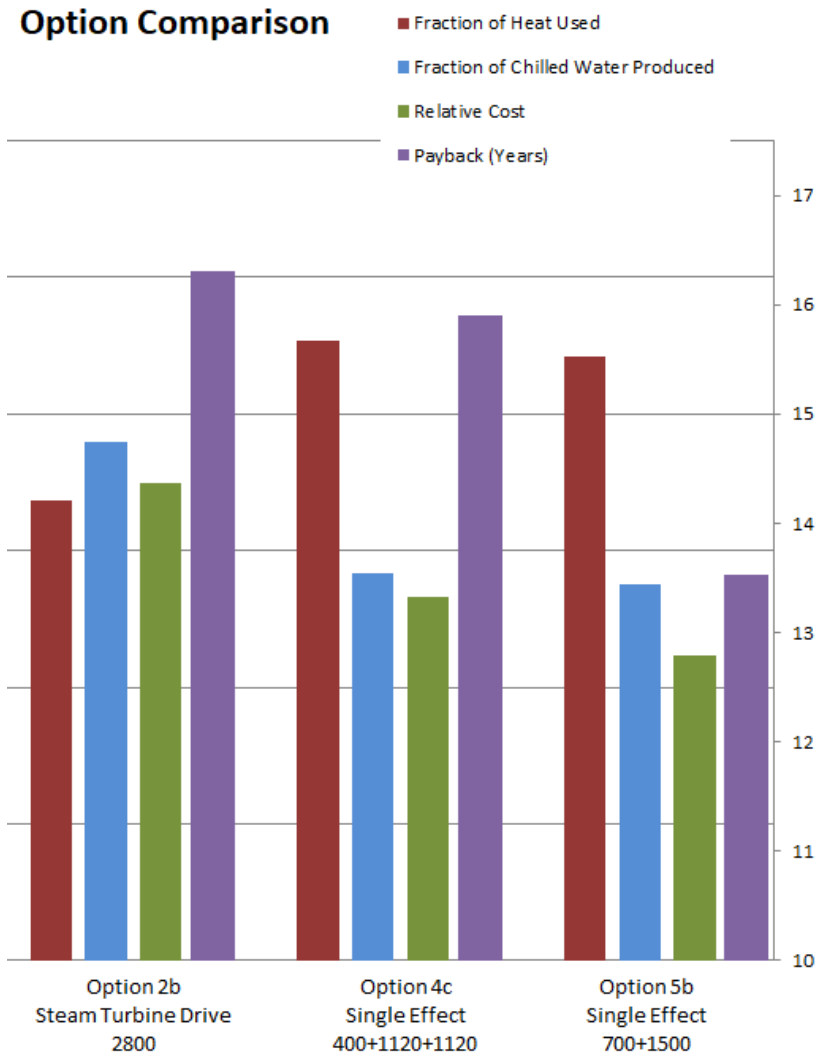
OR

1MWe Steam Turbine Generator + 750-ton Chiller

# WHAT ABOUT
# ABSORPTION CHILLERS

In other studies:

- Absorption is less expensive per ton but uses more heat per ton of cooling produced
- Steam turbine chillers are more compact per ton
- The legacy of older absorption chillers has created a poor reputation

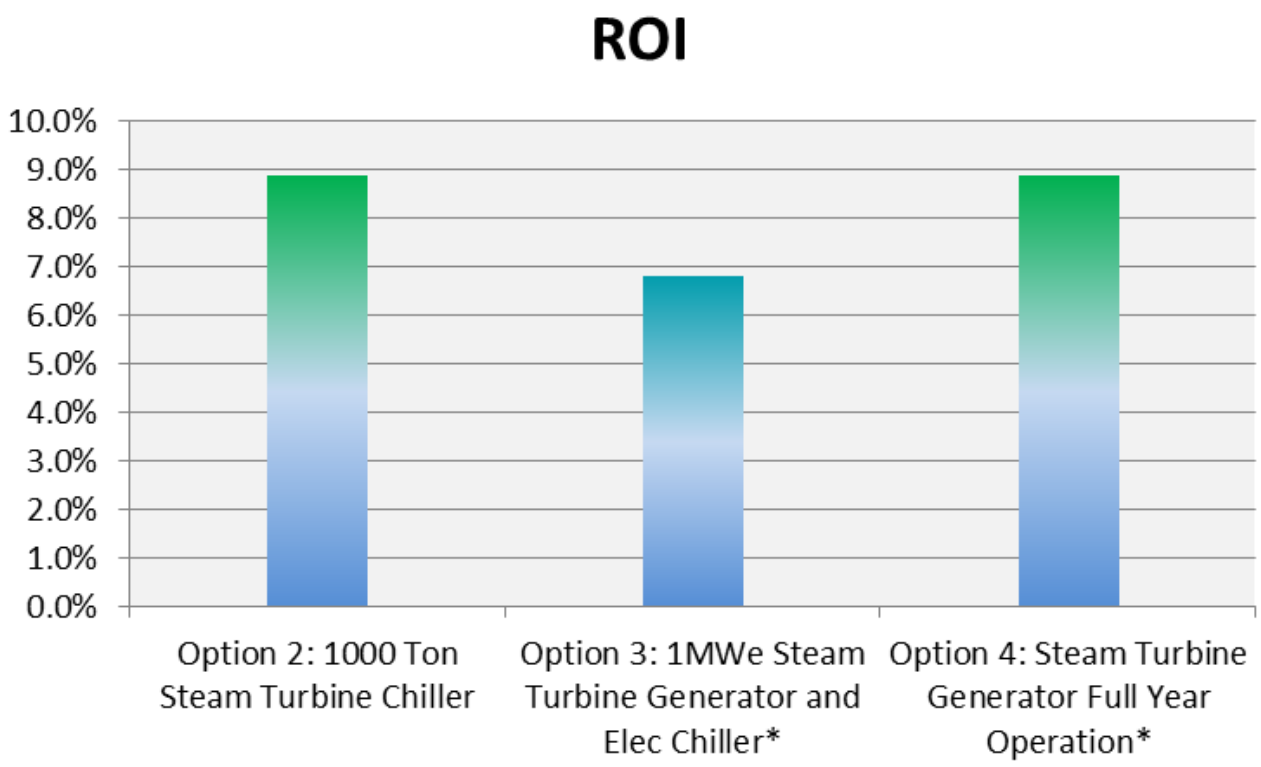


# WHAT ABOUT STEAM-DRIVEN EQUIPMENT?

## Study Results

Return on investment vs. baseline for:

- Steam turbine chiller
- Steam turbine generator and chiller
- Steam turbine generator – always on
- Ignores sunk cost of CHP system



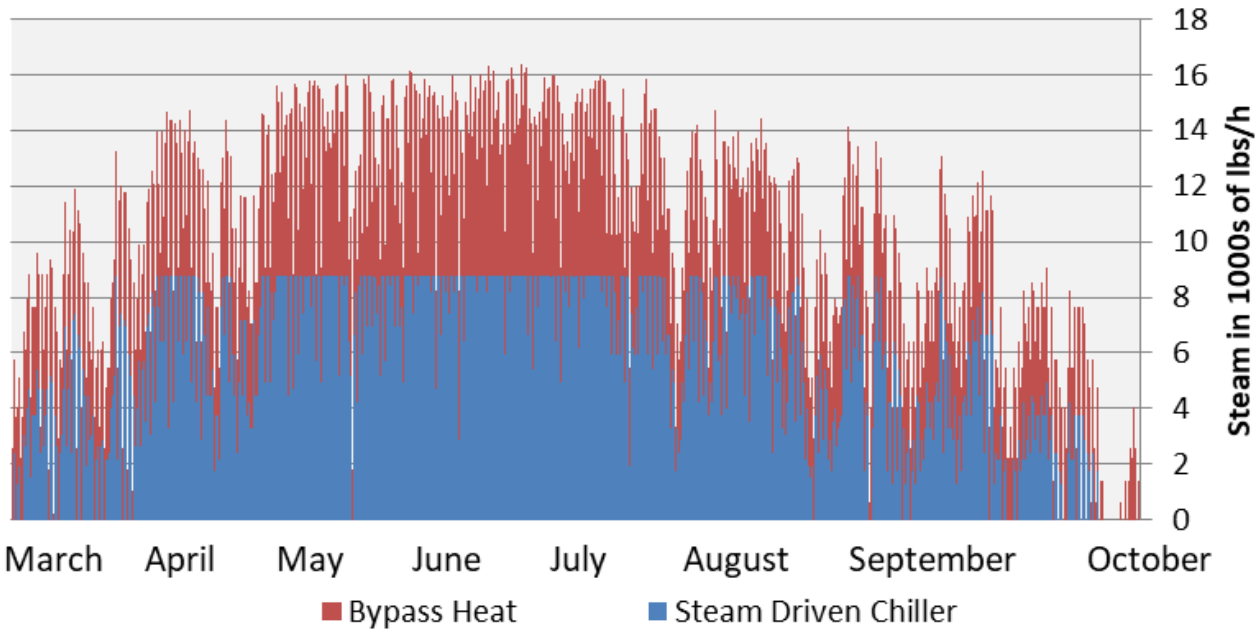
## STEAM STUDY RESULTS: STEAM TURBINE CHILLER

No boiler/duct burner operation needed for chiller

Boilers/duct burner would be needed for steam turbine generator

Short cooling season reduces ROI for all options

### Available Steam
### March through October

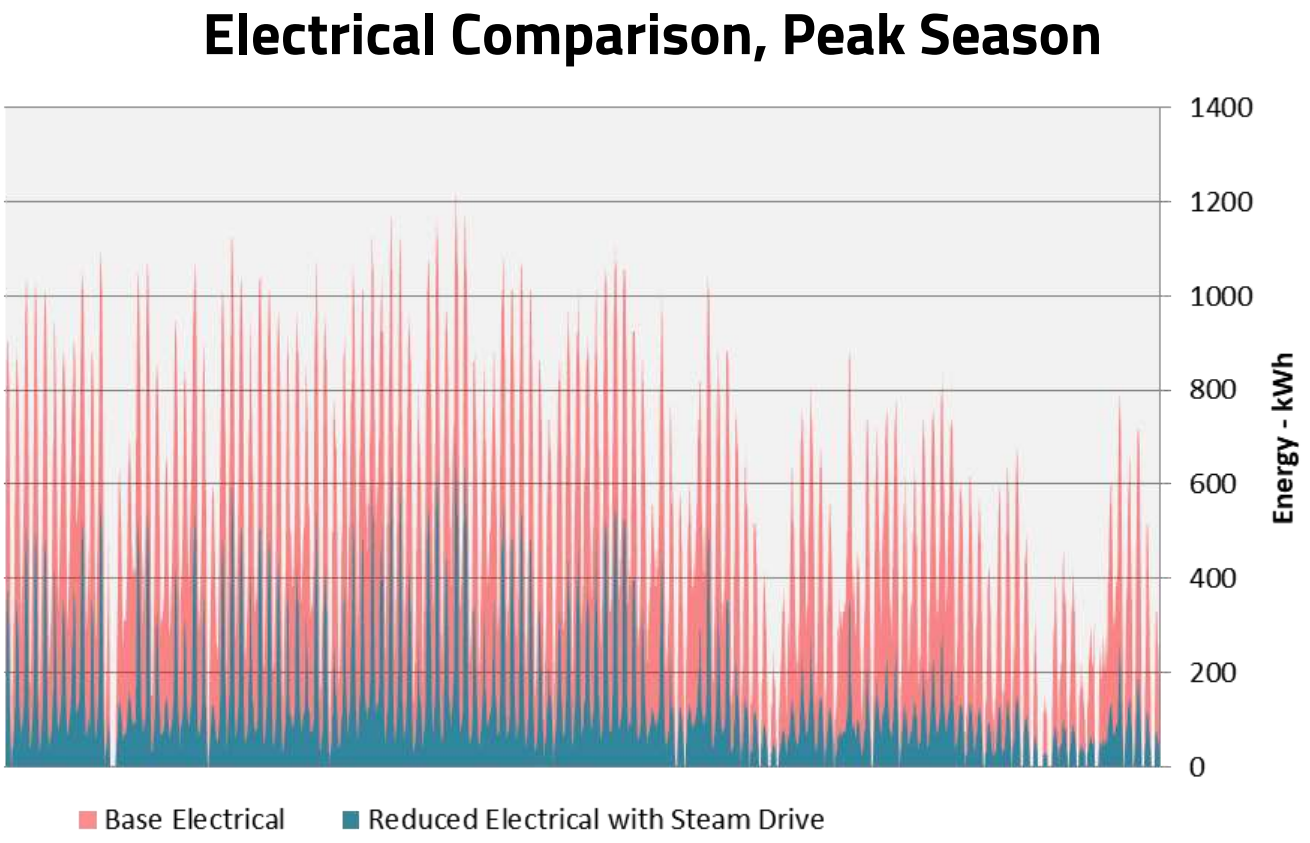


# STEAM STUDY RESULTS: STEAM TURBINE CHILLER

## Electrical Savings

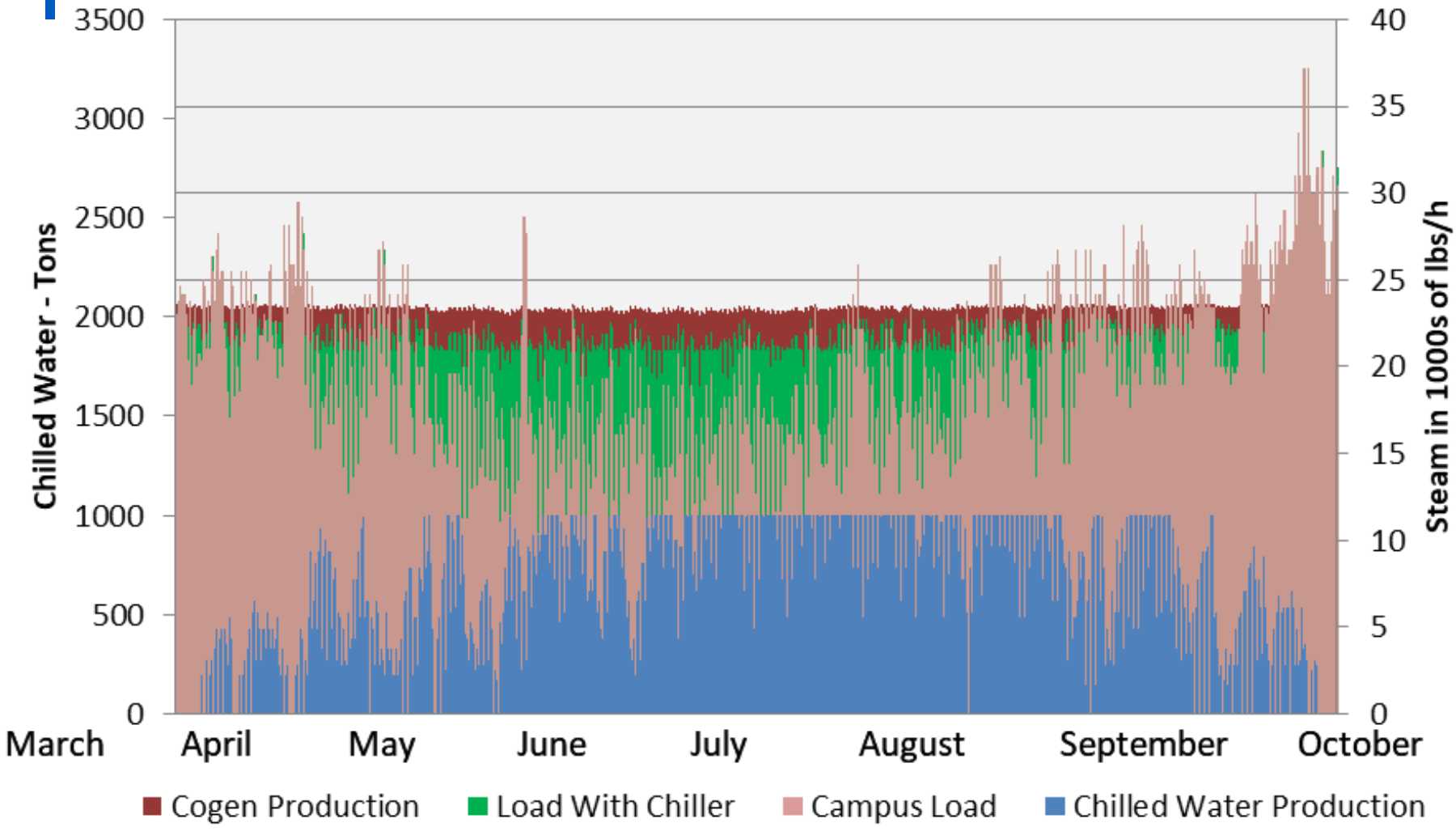
Consumption savings whenever the steam drive is operating

Demand savings because chiller operation coincides with peak campus demand



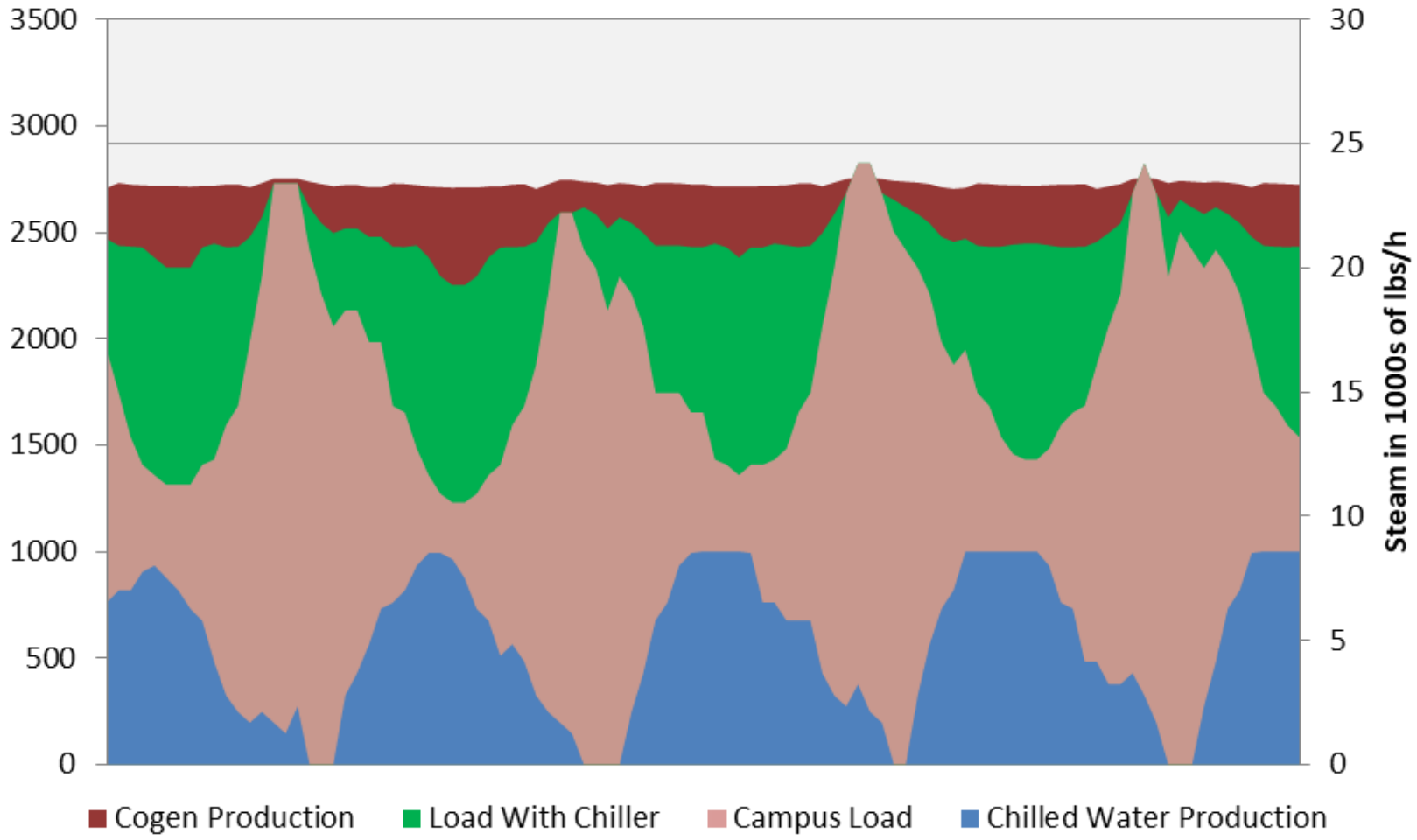
# PREDICTED PERFORMANCE

## Trigeneration Production
### March through October
**-Uses more than half of bypass**



# PREDICTED PERFORMANCE
## A CLOSER LOOK

### Five Representative Days



## FINAL
## DECISION

1,000-ton steam turbine chiller

Project is currently underway!

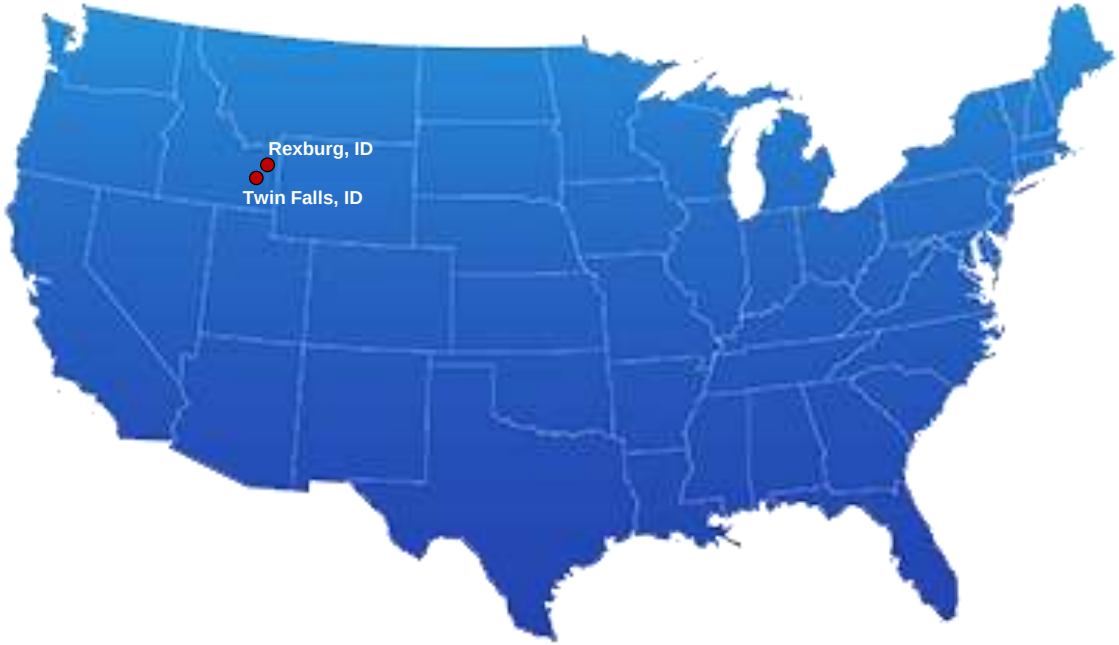
# PROJECT
# COSTS

Initial estimates in the range of $2.5 million

Bids came in over $3.3 million due to material cost increases and construction climate

The following cities experienced the highest construction cost change year-over-year:

- Richmond, VA
- Fargo, ND
- Elizabeth City, NC
- Twin Falls, ID
- Shreveport, LA
- Sioux Falls, ND
- Lynchburg, VA
- Wenatchee, WA
- Augusta, ME



# Thanks!

## Any questions?

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