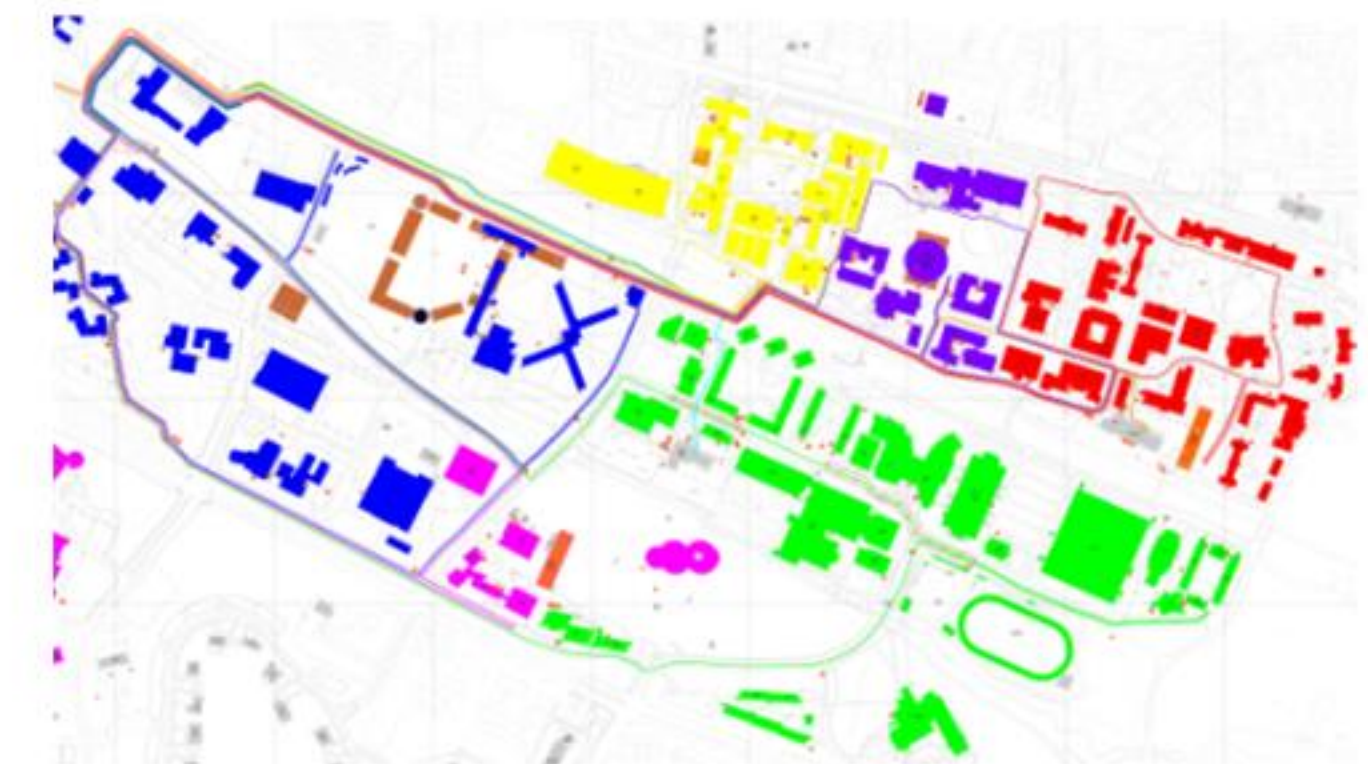
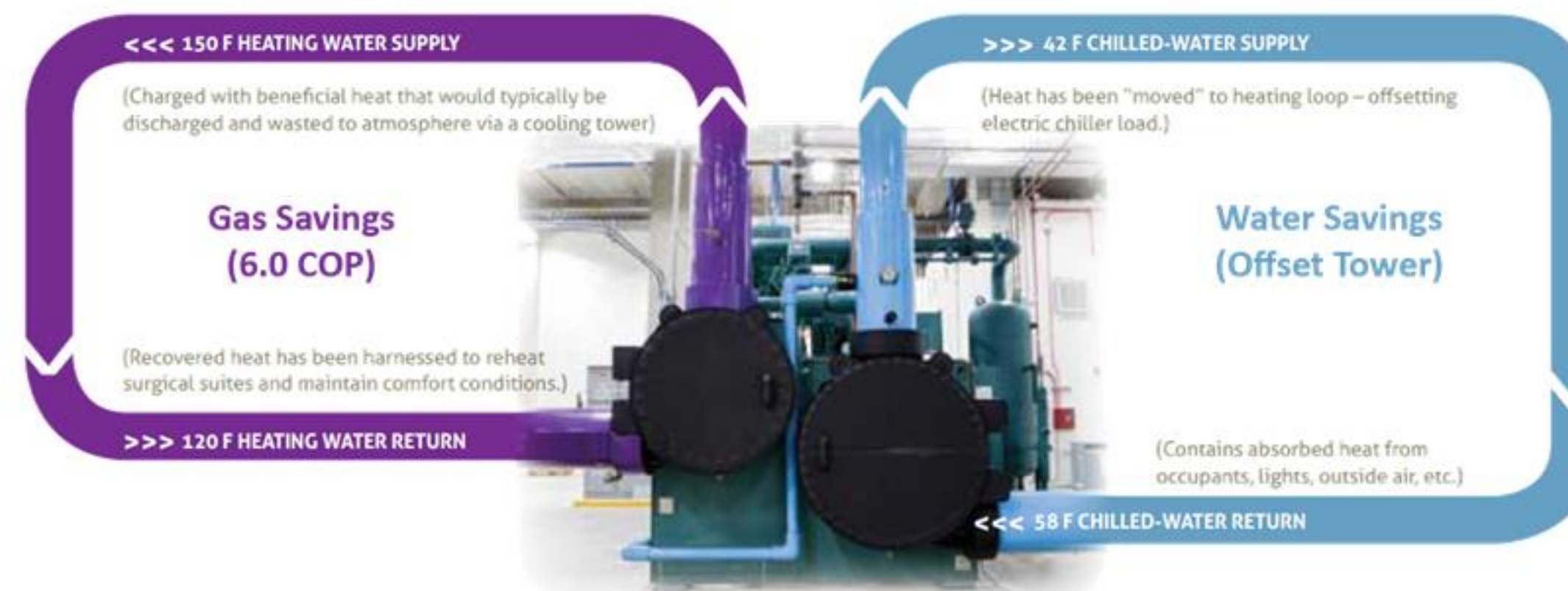
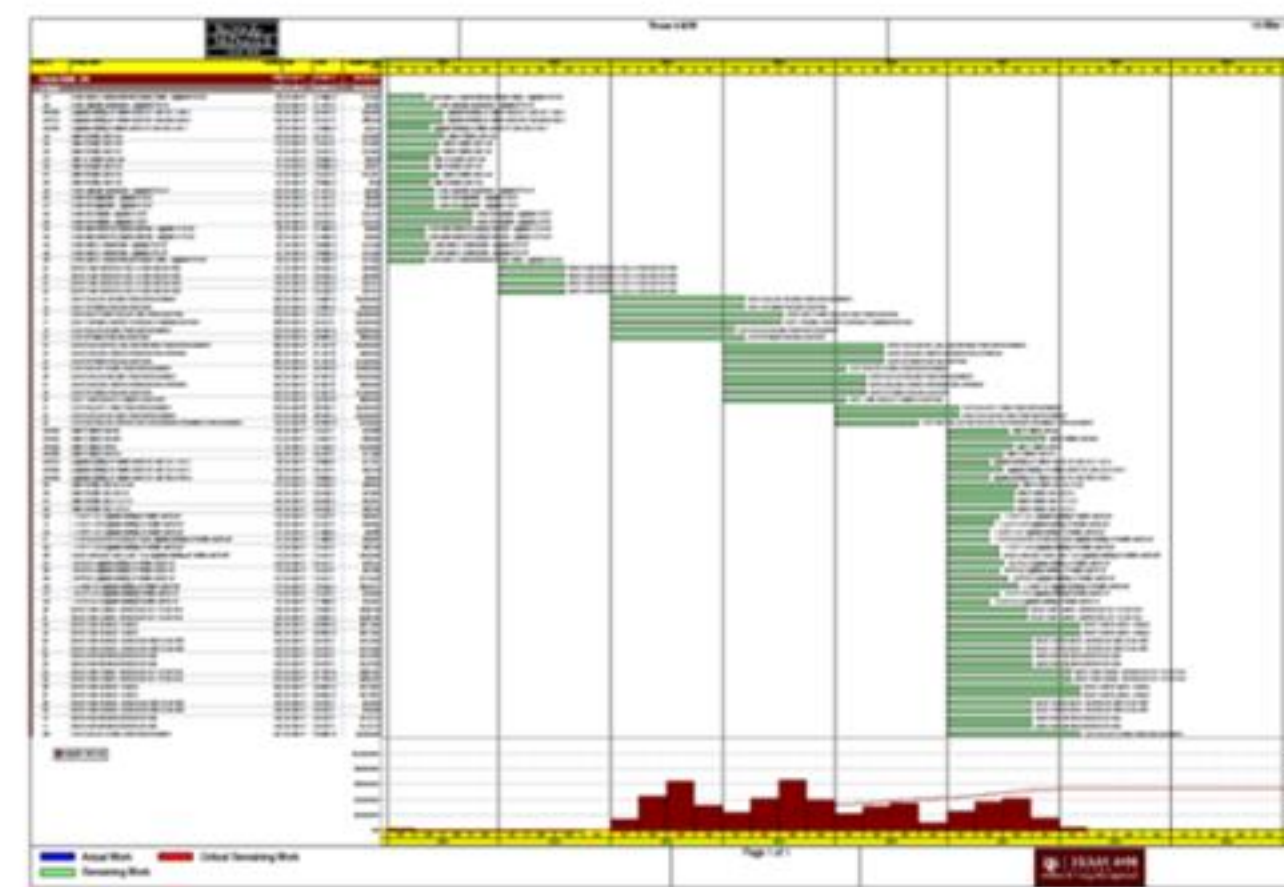




Master Planning Today for Payback Tomorrow

IDEA Webinar Series | 10.01.2014



Welcome to the IDEA Webinar Series

- ❑ The webinar will **start promptly at 2:00pm EDT (Boston time) and is scheduled to last one (1) hour; plus additional time for questions if needed.**
- ❑ Please **mute your phone** during the webinar. All lines are muted.
- ❑ If you are having problems with video or audio, please send a note via the Chat Box function on the right side. Click the Chat box and choose – “**Chat privately to Cheryl Jacques (host)**”. Or call to IDEA at **+1-508-366-9339**.
- ❑ **Questions to Presenters:** Please enter your **Questions** in the **Q&A** box at the lower right of the screen. These questions will be moderated and addressed as time allows. We plan to handle Q&A at the conclusion of the presentation.
- ❑ **Survey:** Please complete the brief on-line survey following the webinar.
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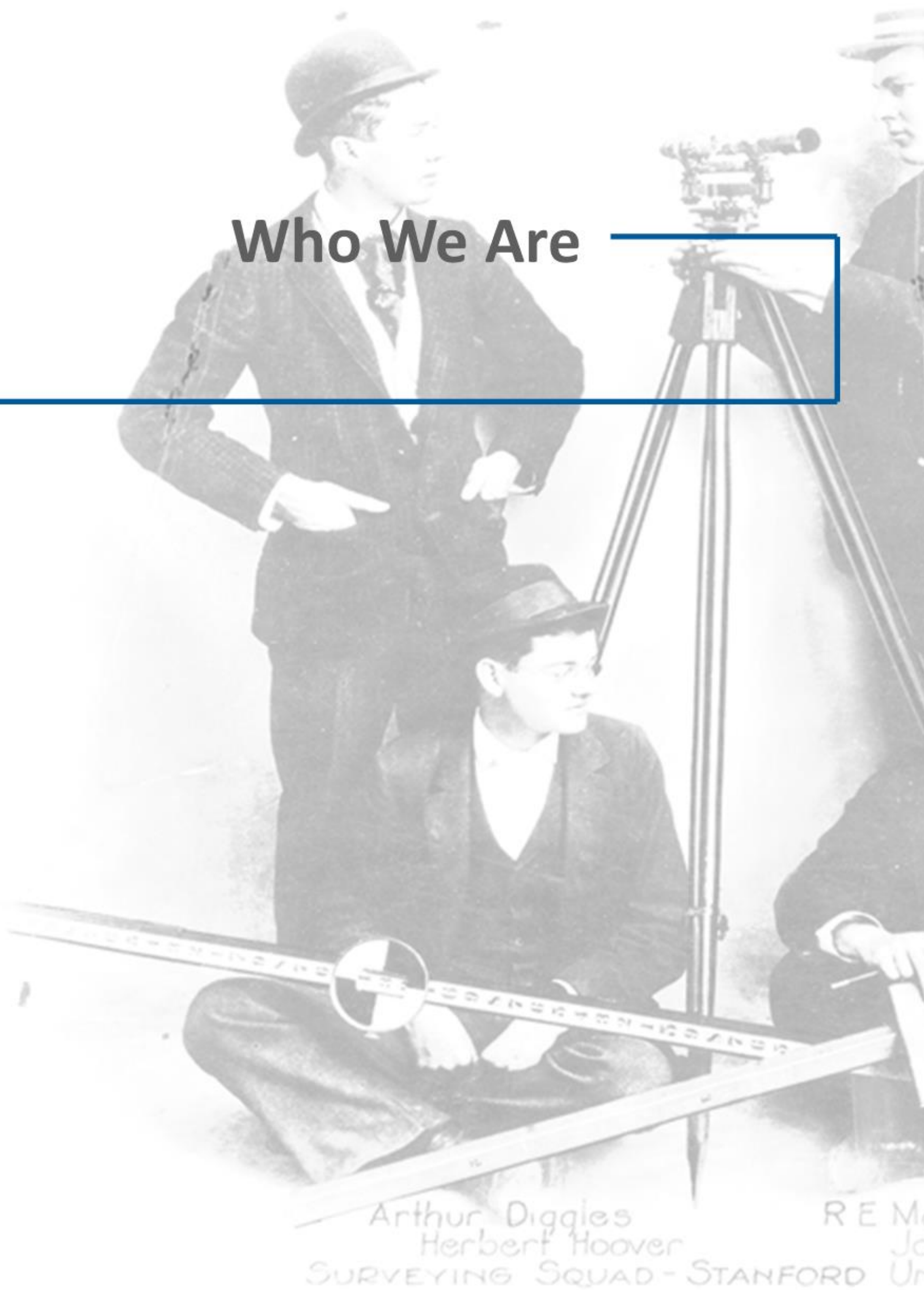
Who We Are

Jon Schwartz, PE, CEM, LEED AP

- Manager, *OnSite* Energy & Power Burns & McDonnell
- IDEA Member since 1997

Blake Ellis, PE, DBIA, LEED AP

- Manager, *OnSite* Energy & Power Burns & McDonnell
- IDEA Member since 2007



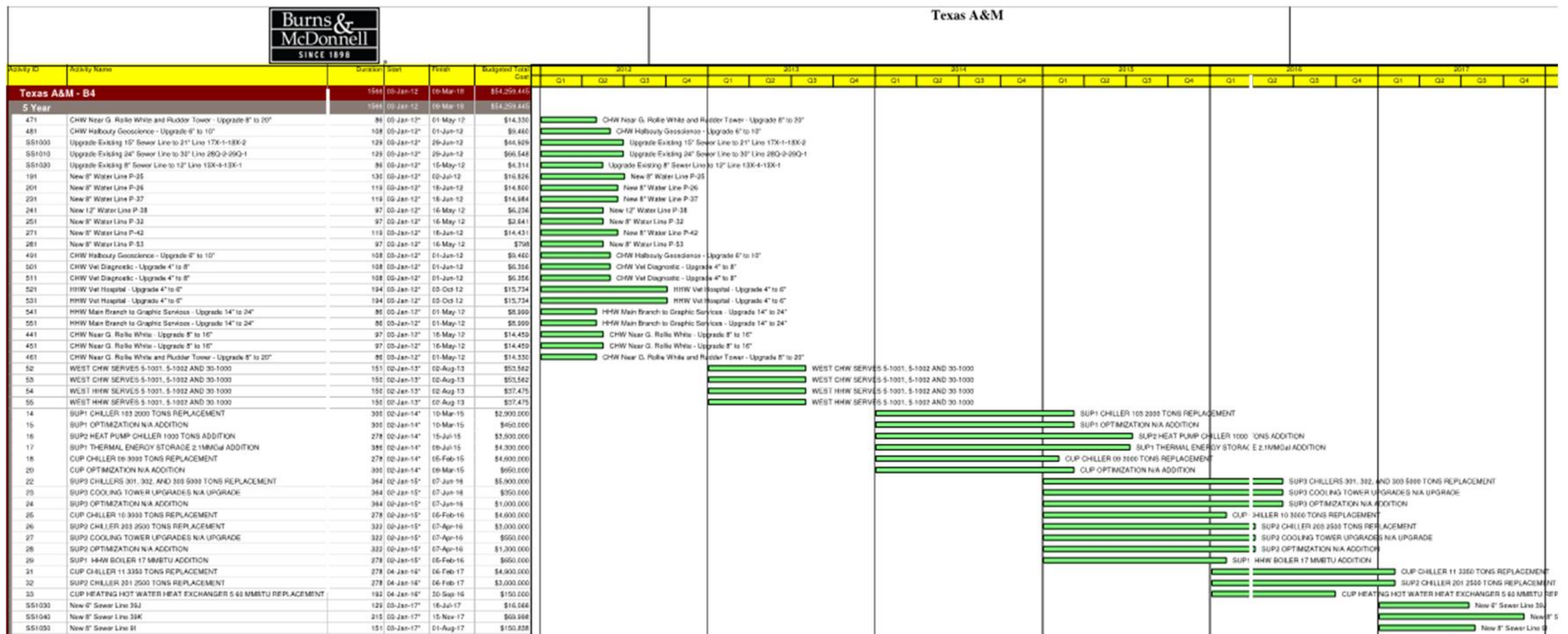
Agenda

- What is a Utility Master Plan
- When to do a UMP
- Initial Planning Items
- Early Steps
- Goals
- Systems
- Data Gathering
- Analysis / Results
- Case Studies
- Q&A



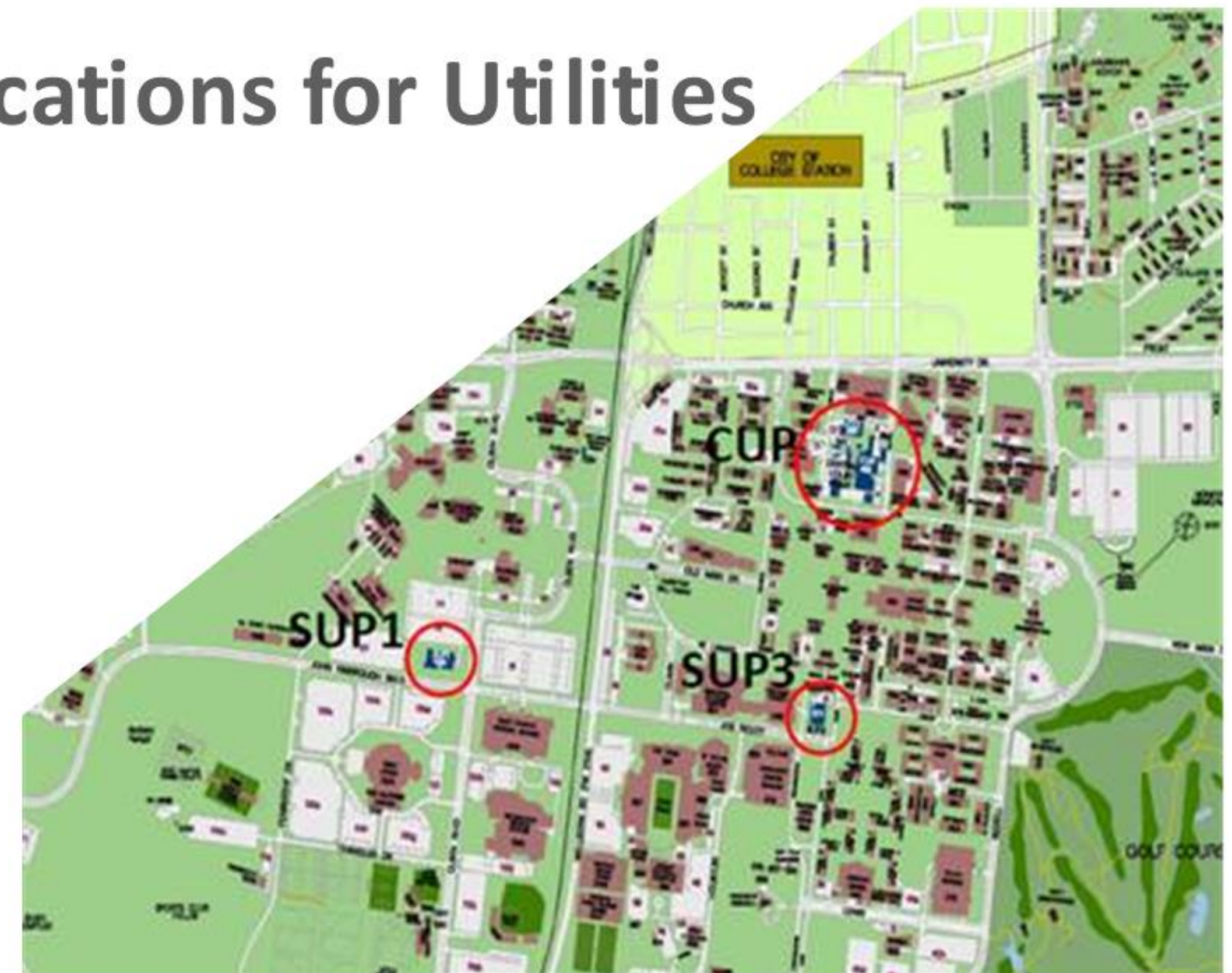
What is a Utility Master Plan

- Document that Bridges from the Current System along a Roadmap to the Future Utility System
- Meets Near Term and Long Term Goals of the Campus
- Unique to Each Utility Infrastructure System



When to Consider a UMP

- Campus is Growing
- Extensive Deferred Maintenance
- Desire Efficiency / Life Cycle Costs Improvements
- Need Redundancy & Reliability Improvements
- Emissions Goals – New or Missed
- Land and Space Planning / Allocations for Utilities
- Budget Planning
- Issues with Current Service
- Reviewing Outsourcing



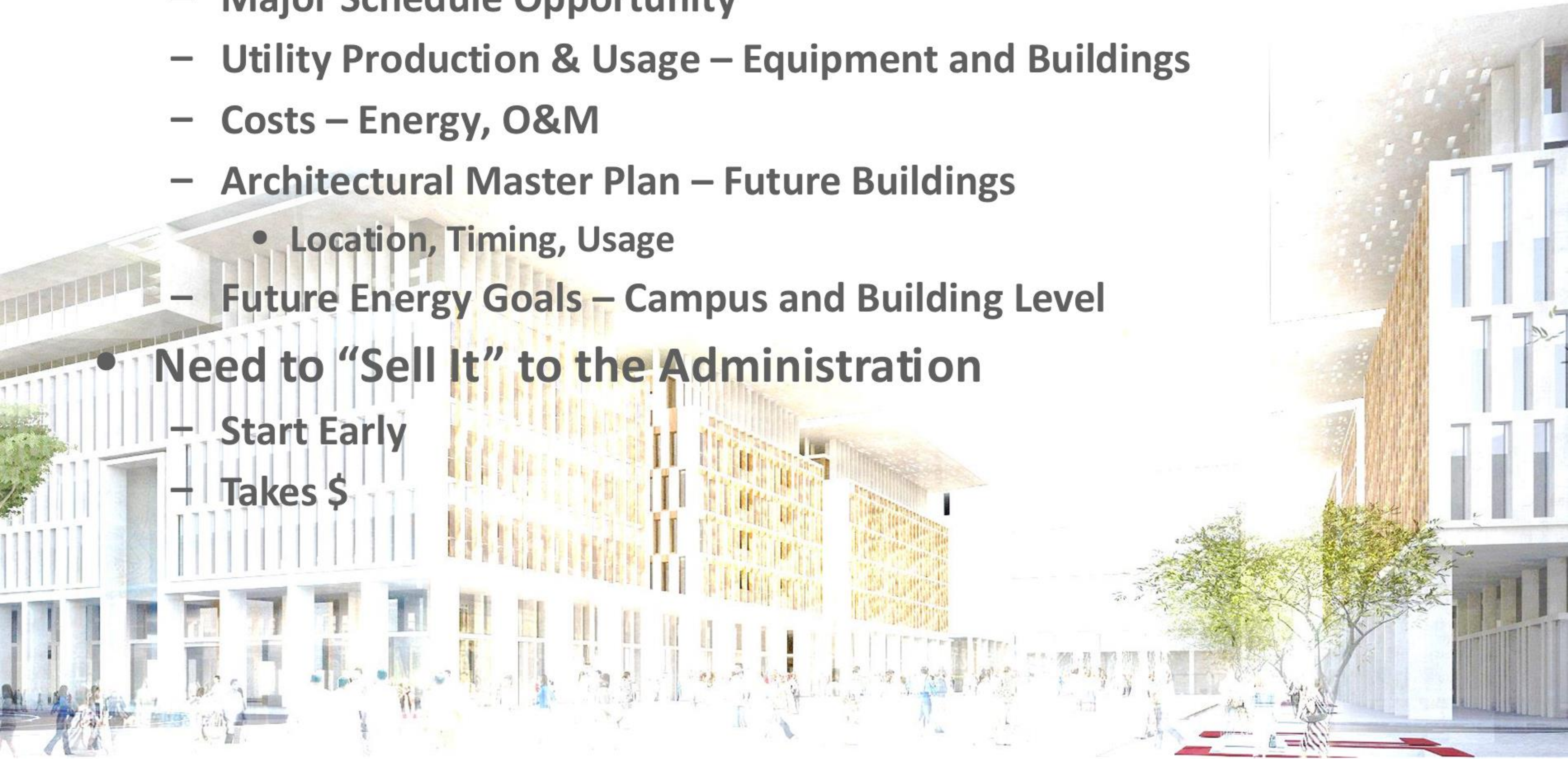
Initial Planning Items

- **How Comprehensive / Honest Self Assessment**
 - Ask “What Do I Need?” and “What am I Ready For?”
 - Capacity and Renewal Focus vs. Long Term Life Cycle Evaluation
- **Which Utilities to Include**
 - Thermal, Electric, Civil
 - Building Side
 - Modeling and Simulations
- **Schedule Needs – Be Realistic**
 - This Can Be a Long Process
 - Alignment Coincident or After Architectural Master Plan
 - Some Overlap is Best



Initial Planning Items

- **Compile Data**
 - Major Schedule Opportunity
 - Utility Production & Usage – Equipment and Buildings
 - Costs – Energy, O&M
 - Architectural Master Plan – Future Buildings
 - Location, Timing, Usage
 - Future Energy Goals – Campus and Building Level
- **Need to “Sell It” to the Administration**
 - Start Early
 - Takes \$



The Team

- **You**
 - Yes, You are on the Team
 - It is Your Project to Lead
- **External**
 - Find the Right Experienced Partner
 - Be Careful of a “Mom & Pop” Company
 - Check References



Define Your Goals

- Capacity
- Reliability
- Efficiency
- Environmental Impact
- Expandability / Flexibility
- Duration of Look Ahead
- Operational, Fuel, & Utility Market
- Technology Opportunities
- Integration – Production, Distribution, & Consumption
- Capital Funding Roadmaps



Goals

- **Capacity**
 - True Existing Capacity
 - Current Equipment Renewal
 - Load Growth
- **Reliability**
 - N+1?
 - By Equipment or Plant?
 - Piping (Looped? Tunnels?)
- **Efficiency**
 - Energy Targets
 - LCC \$



Goals

- **Environmental Impact**
 - GHG (CO₂)
 - NO_x
 - %'s – With or Without SF Growth
 - Timeframe
- **Expandability / Flexibility**
 - Plants – walls, future slots
 - Fuel Flexibility
- **Duration of Look Ahead**
- **Operational, Fuel, & Utility Market**
 - Staff Changes
 - Fuel Goals (get off coal?)
 - How Do You Want to Engage Market
 - Single Rates, Layered Rates, Dynamic Rates

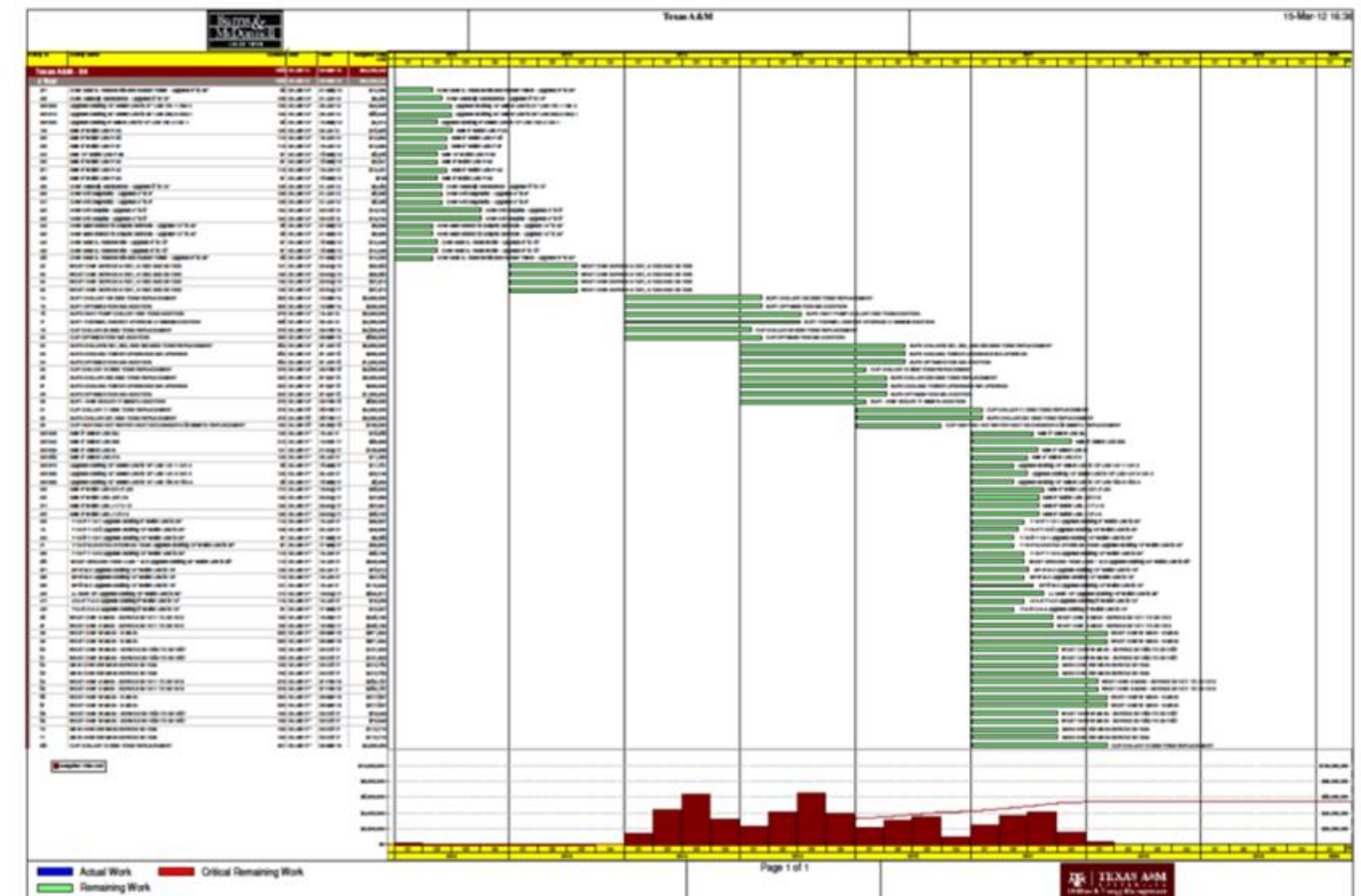


“Yesterday is not ours to recover, but tomorrow is ours to win or lose.”

- Lyndon B. Johnson

Goals

- Technology Opportunities
 - Proven – Currently Available
 - Future Innovation
 - Staffing Know-How
- Integration Production, Distribution, & Consumption
 - Cover it All?
 - Separate Buildings' Effort?
- Capital Funding Roadmaps



Determine the Scope



- **Thermal Utilities**

- Chilled Water
- Heating Water
- Steam / Condensate

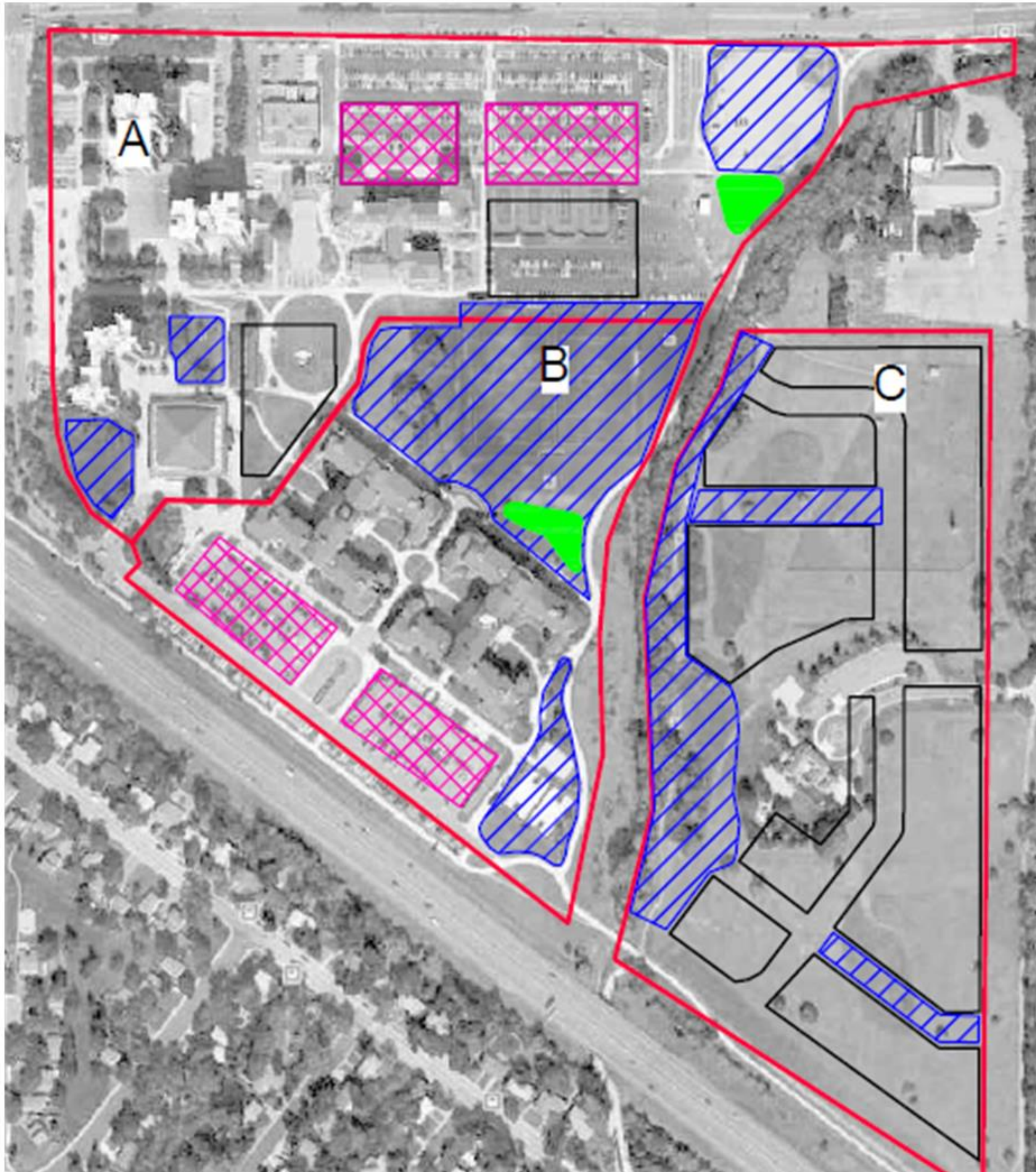
- **Electrical**

- **Where do I Focus...the Big 3:**

- Production?
- Distribution?
- Building Demand?



Determine the Scope



- **Civil Utilities**

- Sanitary Sewer
- Storm Sewer
- Domestic Water
- Non-Potable Water
- Natural Gas

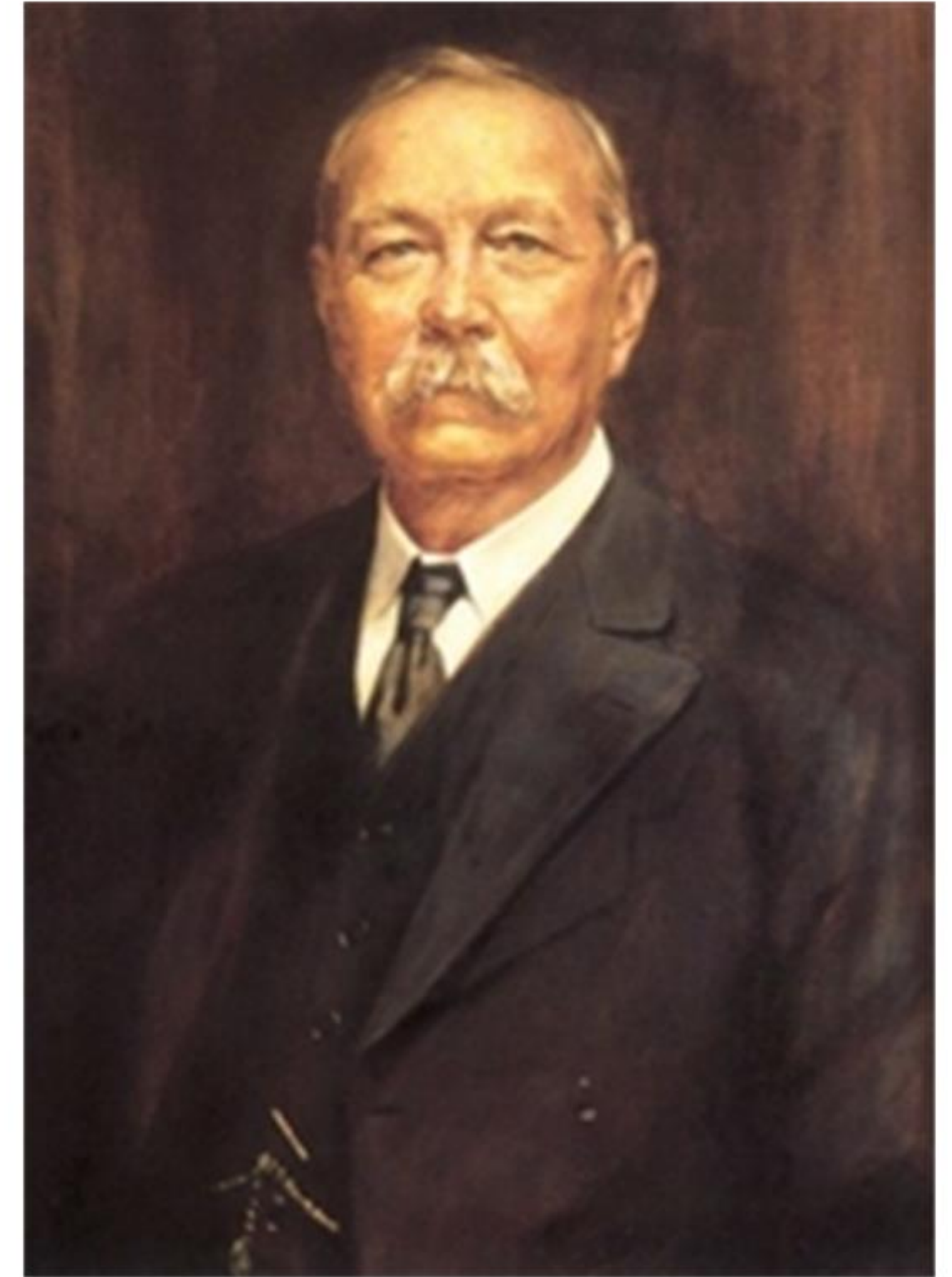
- **Other Utilities**

- Domestic Hot Water
- Compressed Air



“It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts.”

— Arthur Conan Doyle, Sherlock Holmes



[illegible]

-
- data
- results insight action learn performance
- effectiveness planning real time job board predictions workforce timely direction
- unbiased benchmark branding forecasting tools velocity planning on demand storage collection exploit candidate understanding talent summarize calibration cQuest linear automation capitalize direction
- relationships streamlining leadership decisiveness connect informatics search testing research aligned predict distribution humanize
- management change database identify efficient progression business metrics accuracy enterprise analyze
- streamline

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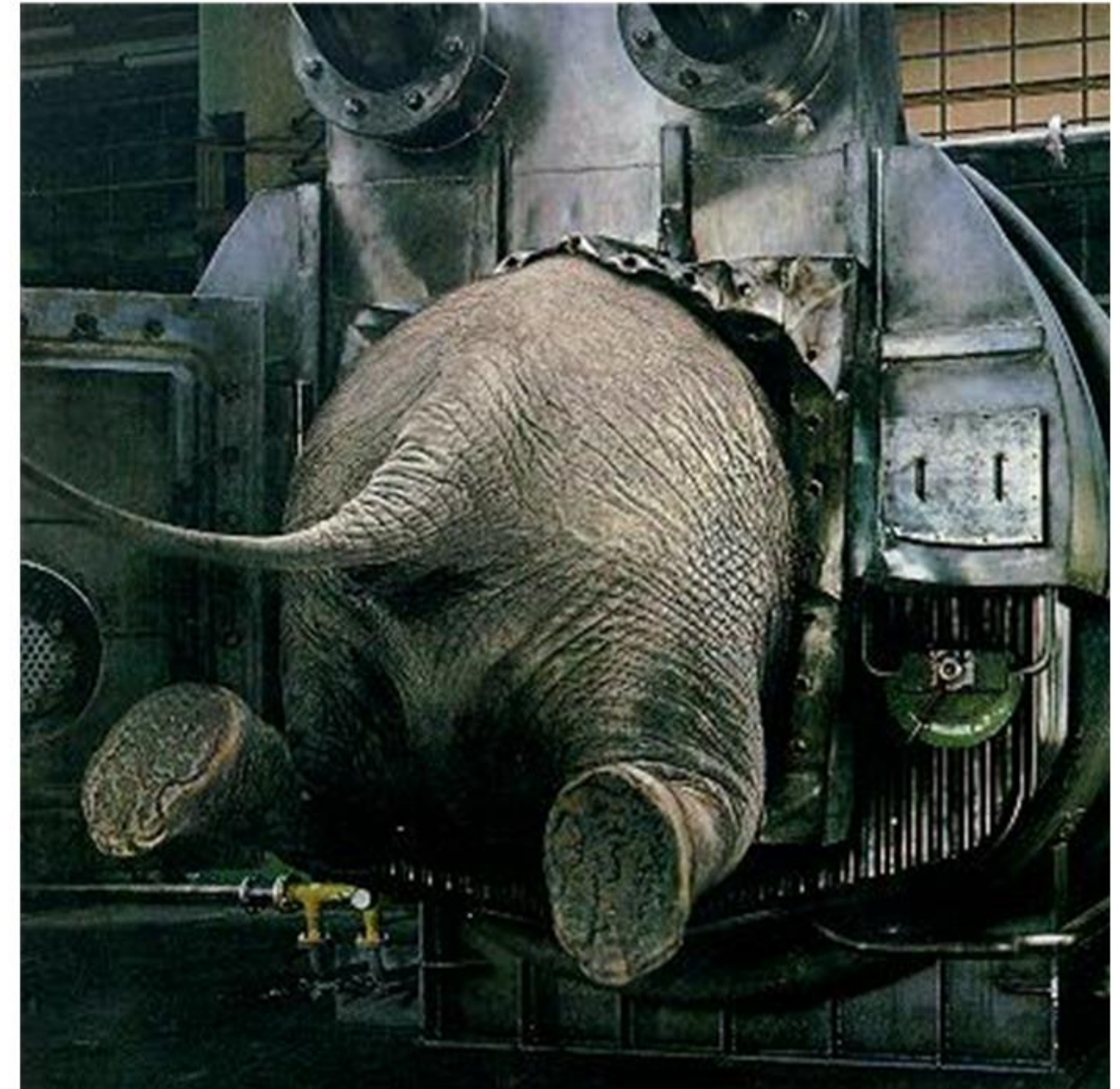
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Information Gathering

- **Condition Assessments**
 - What is the goal?
 - Level of detail can vary widely
 - Equipment capacity
 - Remaining life
 - General condition
 - Deferred maintenance list
 - Maintenance history (work and \$)
 - Schedule for repairs
 - Nondestructive examinations
 - magnetic particle
 - ultrasonic wall thickness
 - videoborescopic
 - support system surveys
 - pipe stress analysis, etc.
 - Destructive examinations
 - metallurgical
 - chemical evaluations



Information Gathering

- **Stakeholder / Administrative Engagement**

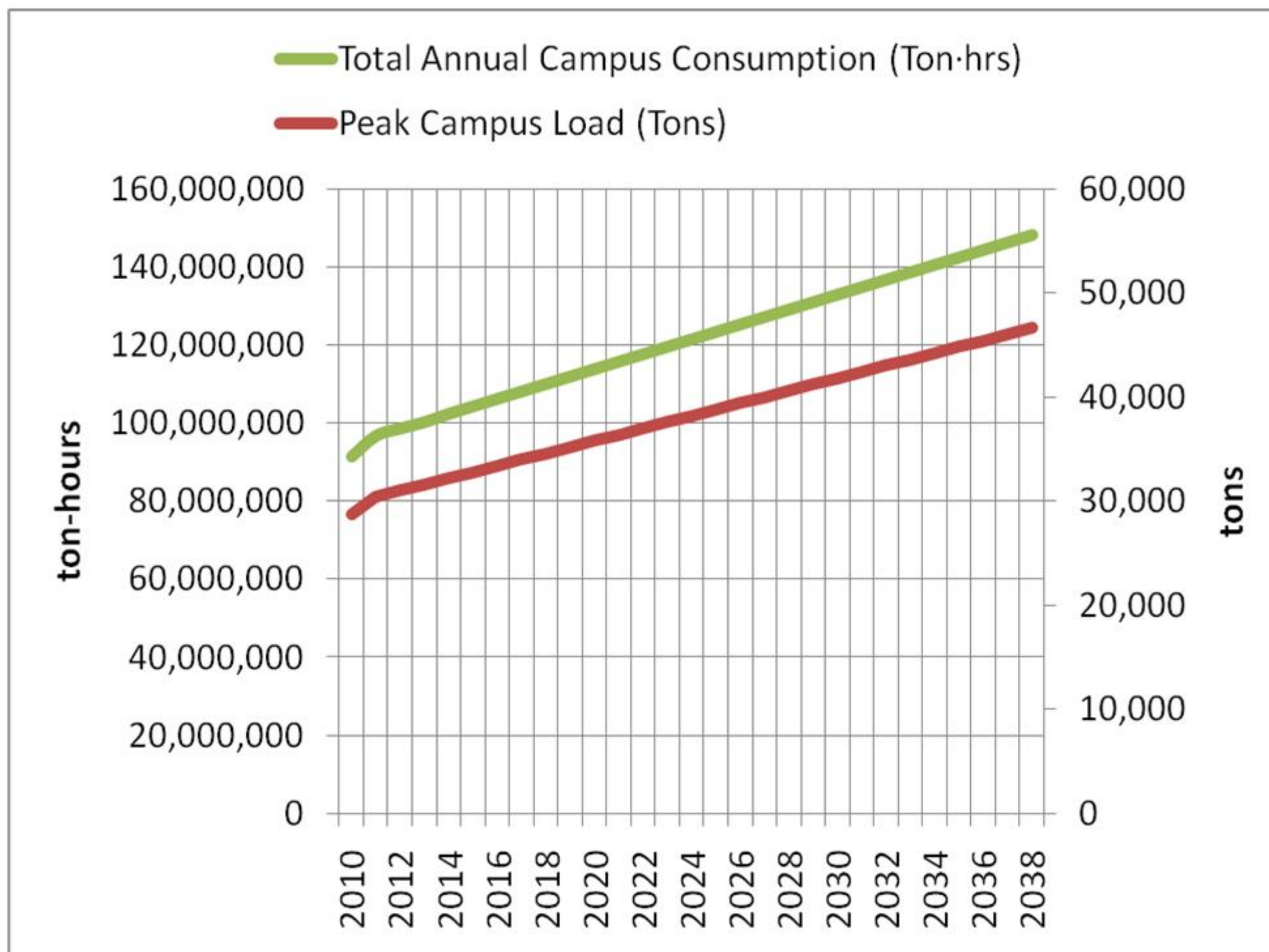
- Helps align the UMP
- Increases knowledge of the stakeholders
- Unique insight
- Builds trust
- Increases transparency
- Allows groups to be a part of the solution

Stakeholder
Involvement



Load Development

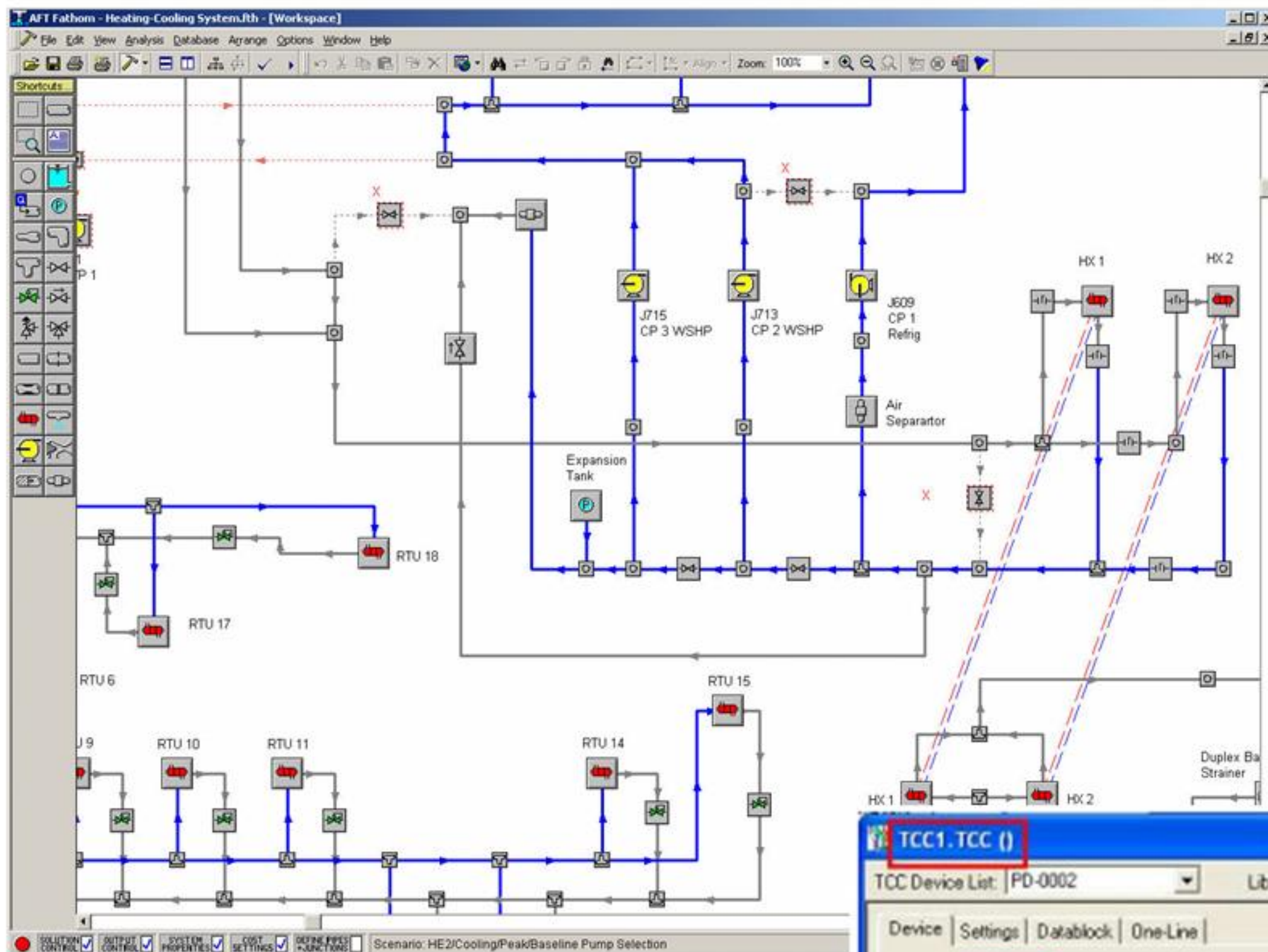
- For entire planning period
 - Near term - Specific
 - Long term - Densification? Sprawl?



- Considerations
 - Architectural Master Plan
 - “Non-connected” buildings
 - Will they be connected?
 - What is the difficulty?
 - Energy standards
 - Energy improvements

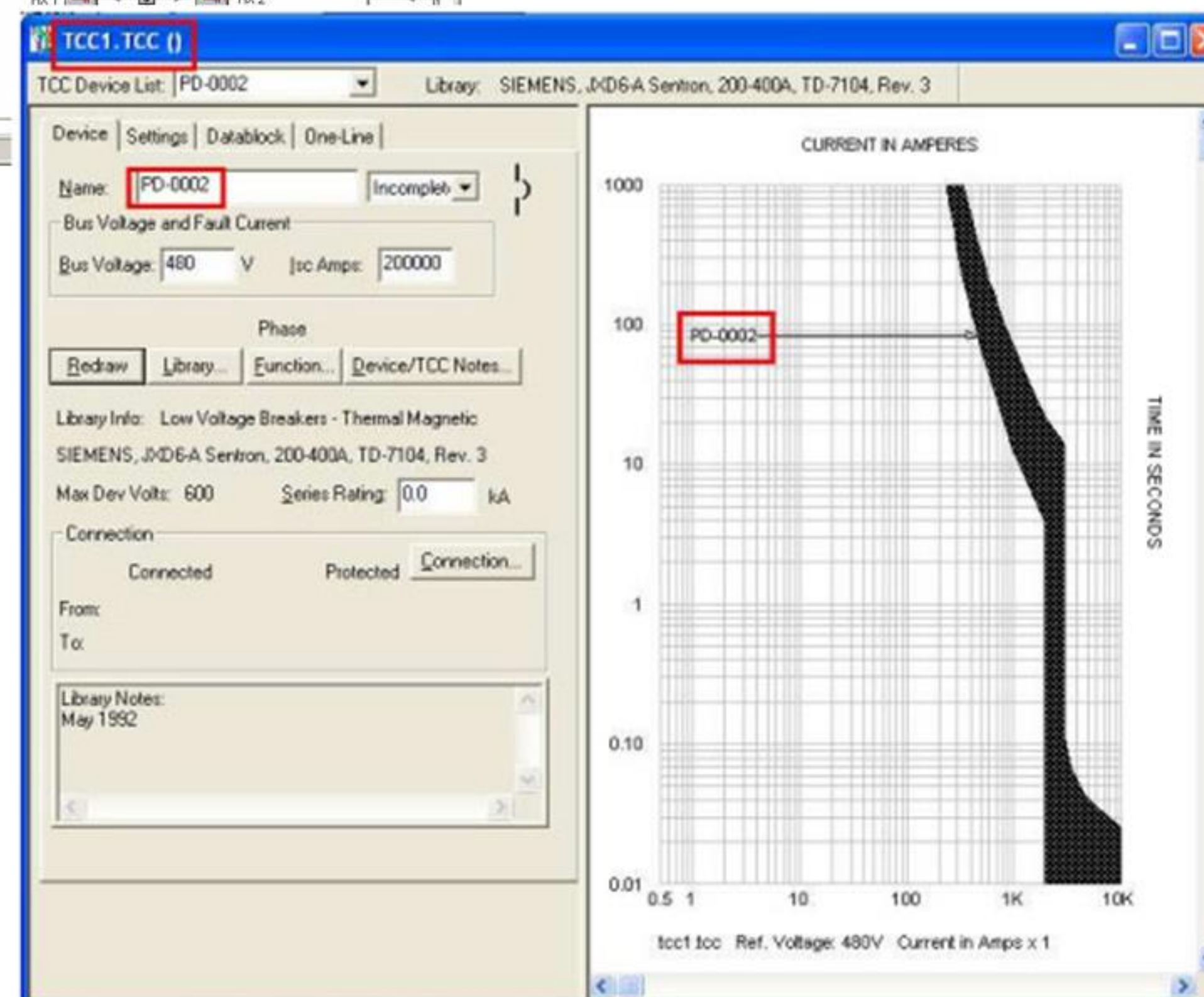


Analysis



Simulations:

- Entire system performance
- Includes plant and distribution
- Identifies the bottlenecks
- Provides “what if” analysis
- Can be updated going forward
- Available for several utilities:



- » Chilled Water
- » Steam
- » Electrical
- » Domestic Water
- » Storm Sewer
- » Sanitary Sewer

Performance Modeling

- **Balance of Loads & Resources**

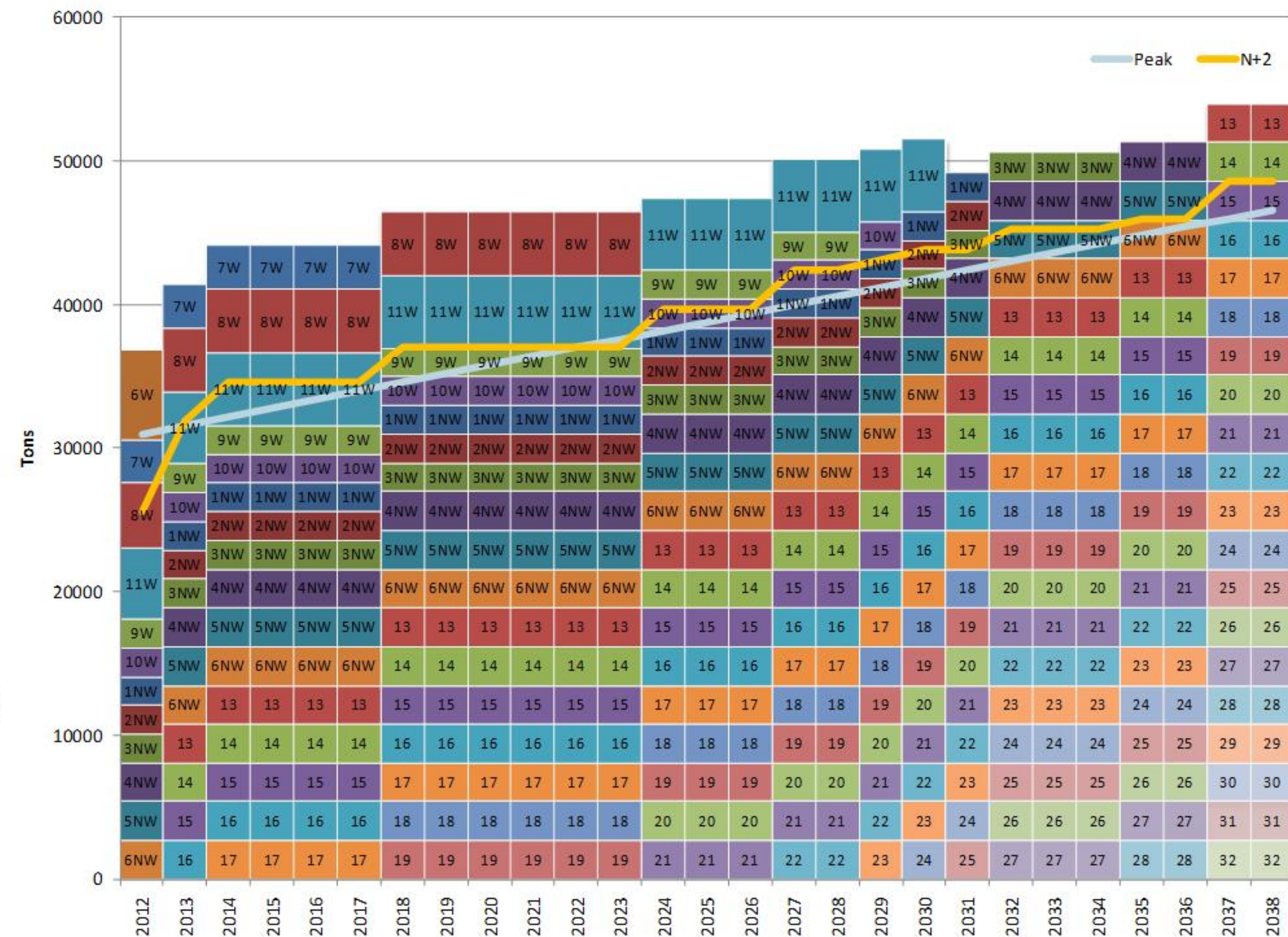
- Hourly analysis
- Includes more than energy

- **Interdependence**

- Outside air temperature
- Combined Heat & Power (CHP)
- Thermal Energy Storage (TES)
- Water considerations
- Building impacts to plant impacts

- **Base Case establishment**

- Capacity offset considerations
- Includes service life and replacement timing
- Major equipment and support equipment (pumps, towers, etc)



Analysis



Siting New Utility Plants:

- Aesthetics
- Available space
- Architectural Master Plan
- “Reservations” for Plants & Utilities

Seinfeld

- Piping system constraints

- » Location of mains
- » Radial feeds
- » Condensate gravity return



Analysis

• Future Energy Costs

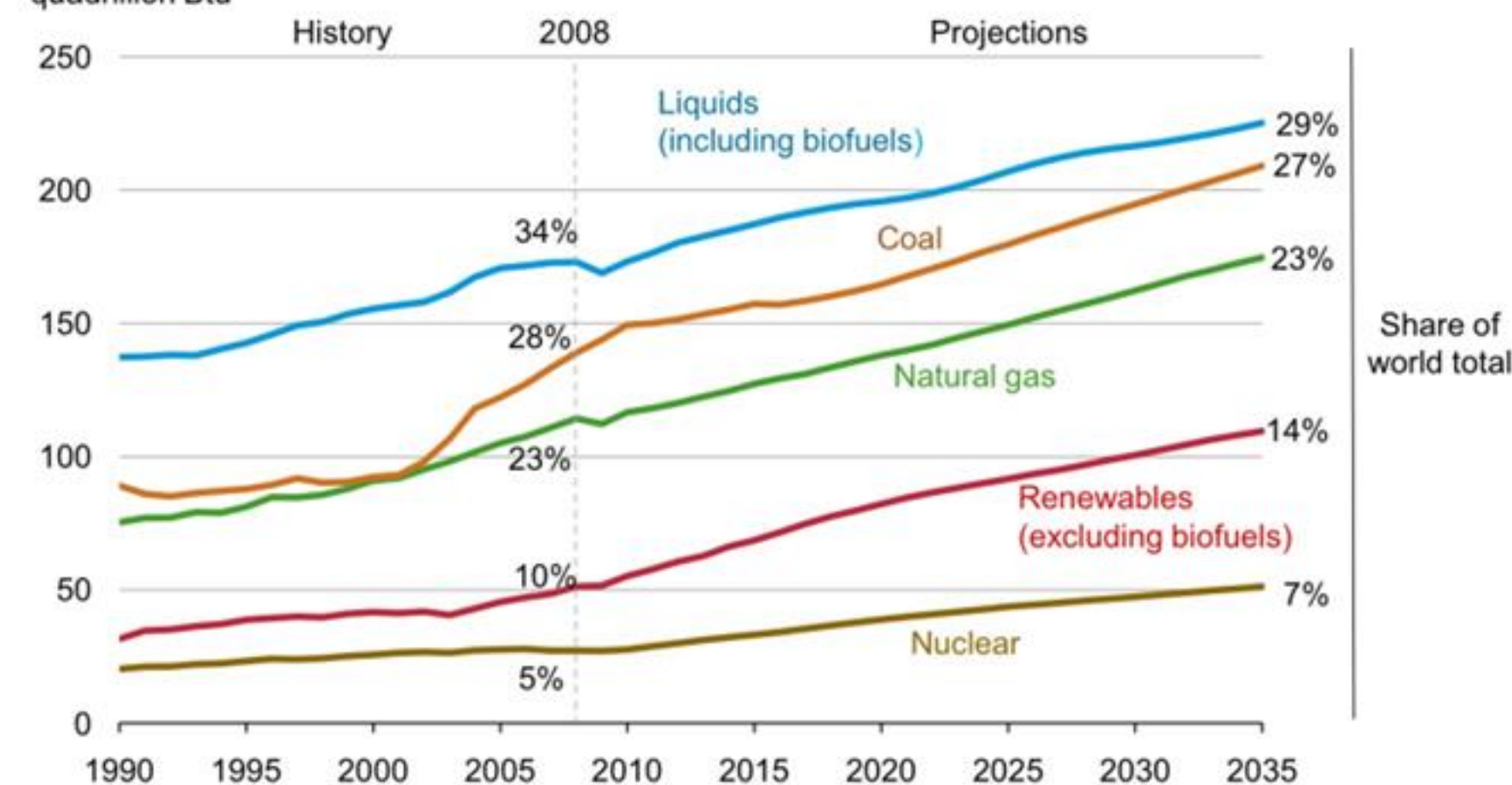
- Can be a “research” project
- US Energy Information Association (EIA)
- Interdependence is important
- Monte Carlo Analysis can mitigate

• Emissions

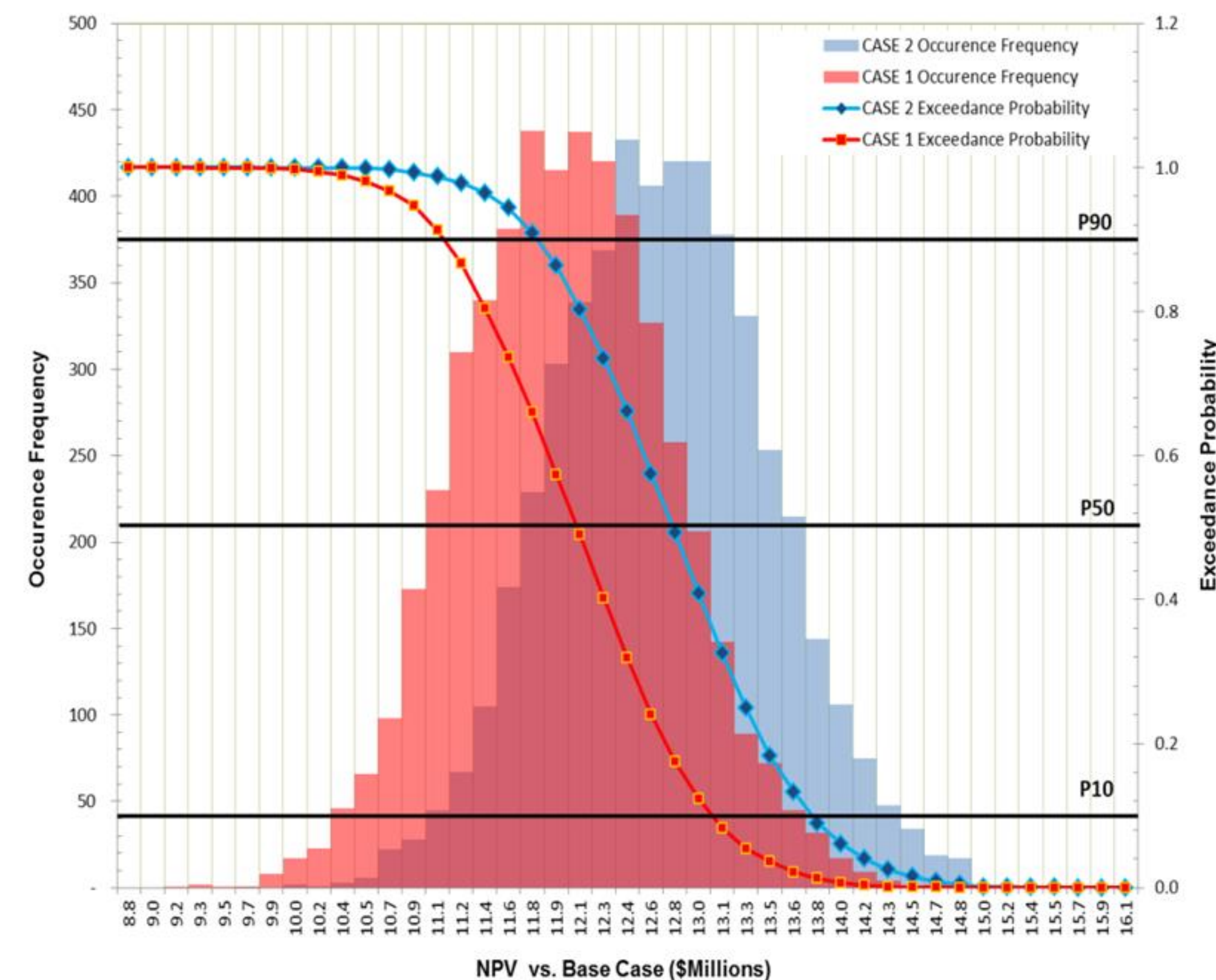
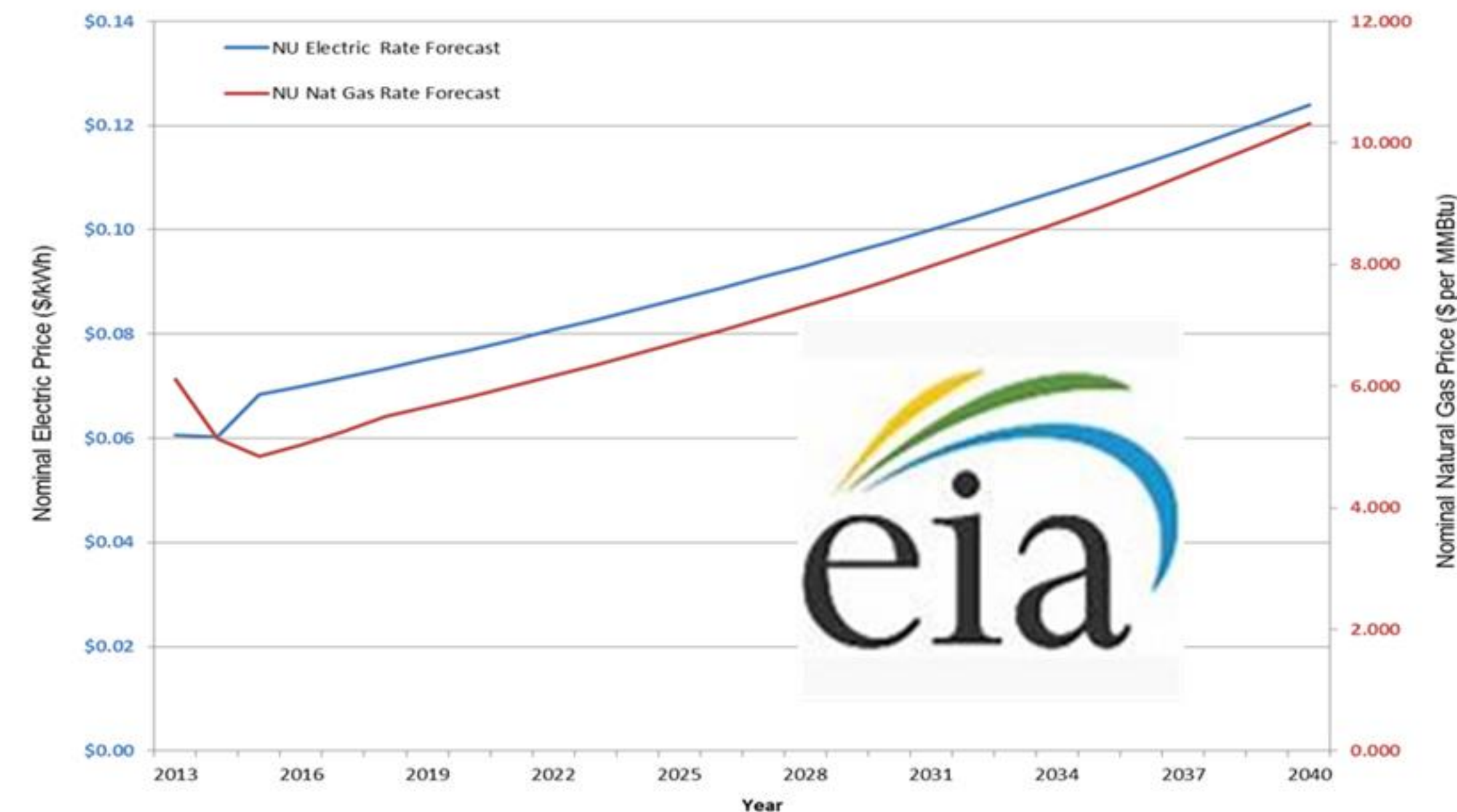
- High level analysis provides insight on project timing
- Provides reality to master plan

Renewables are the fastest growing source of energy consumption

world energy consumption by fuel quadrillion Btu



Source: EIA, International Energy Outlook 2011



Analysis

• Screening of Options

- Campus preferences
- Political items to be reviewed
- Desire for renewables
- Options to avoid (absorbers?)

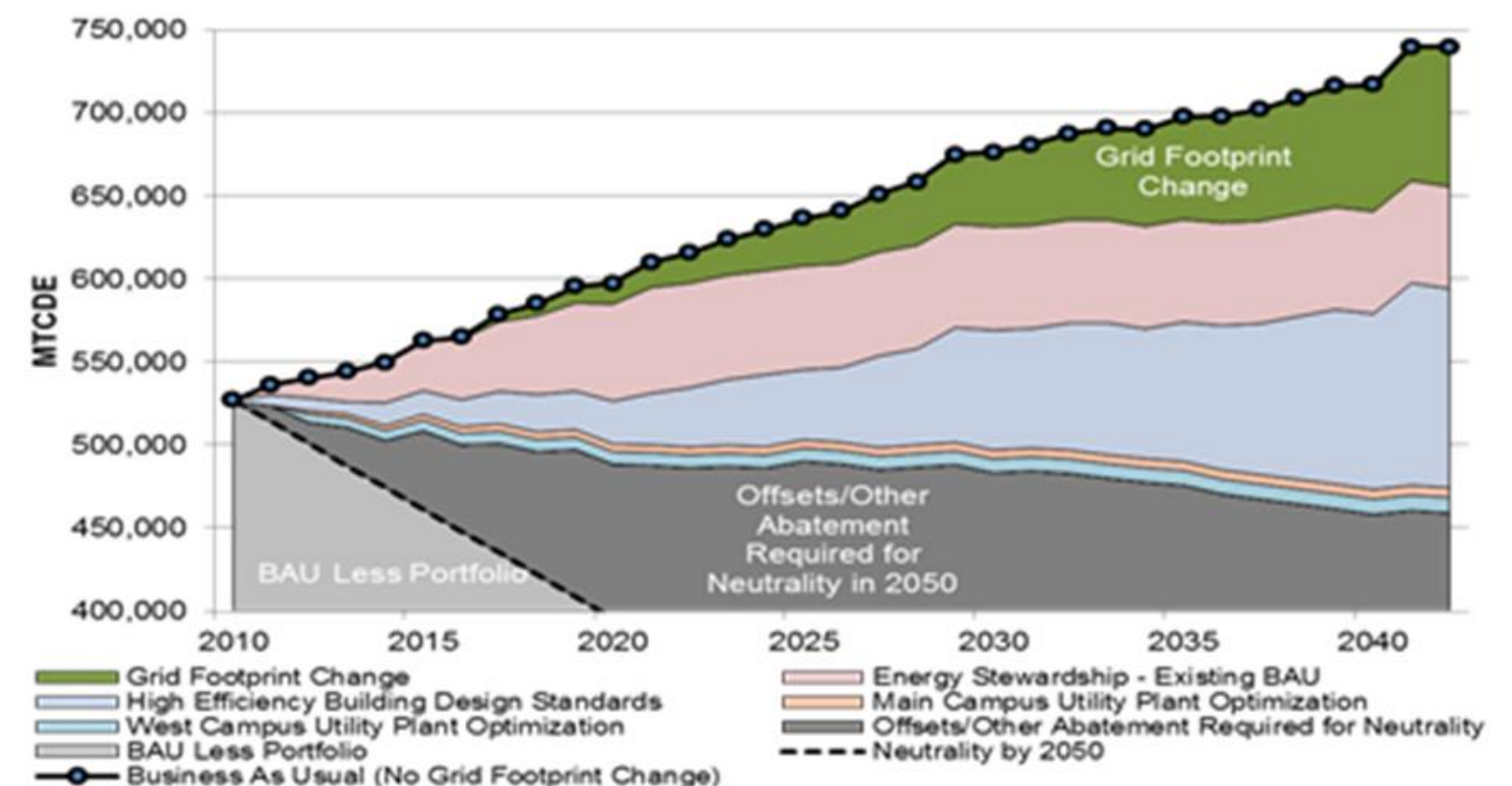
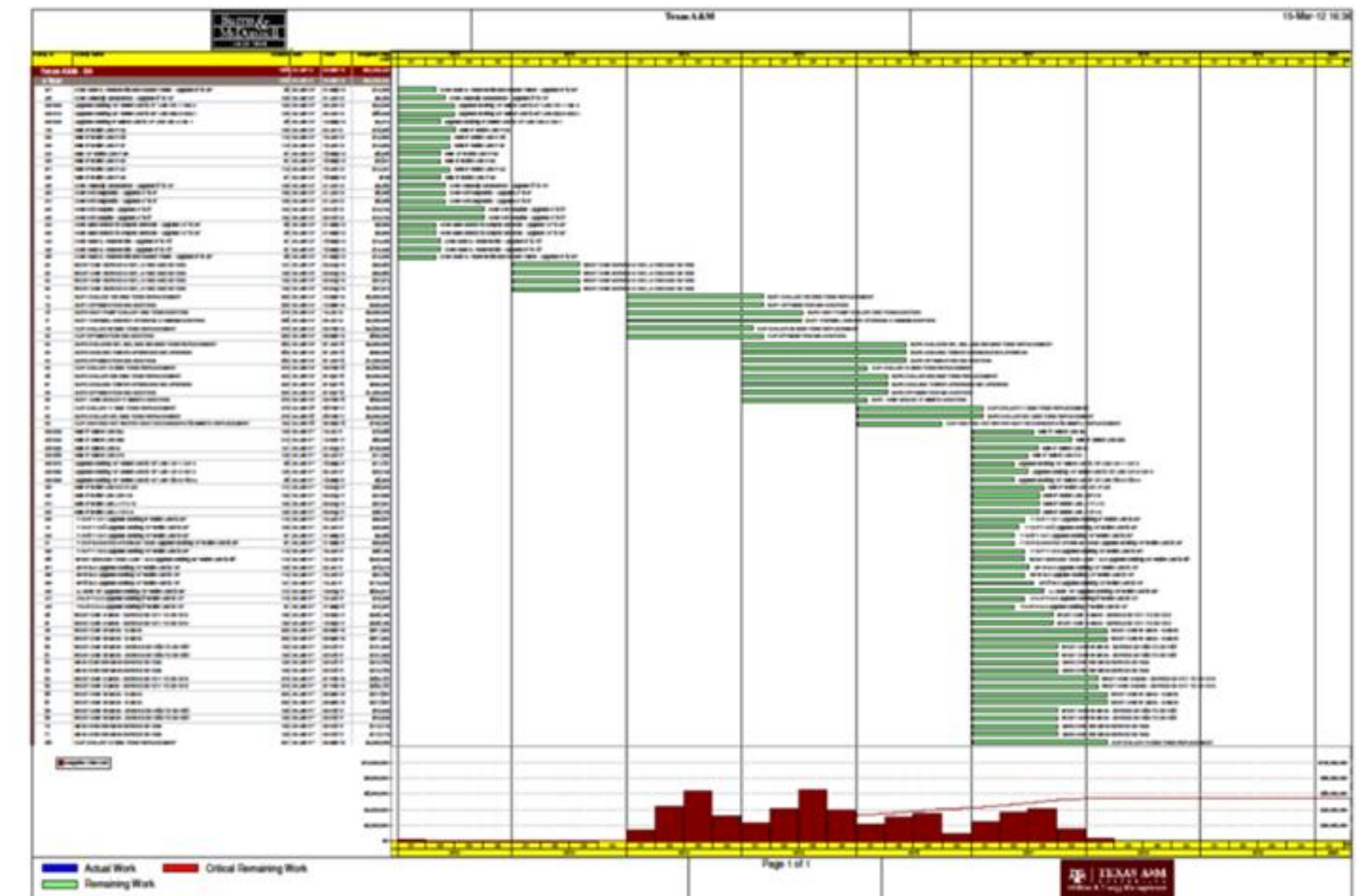
• Challenges with UMPs

- The “answer” isn’t known until the end
- 30% and 60% packages don’t provide 30% and 60% of the answer
- Large gaps in between review meetings

#	Description	Capital Cost	Improve LCC	Increase Redundancy	Improve Performance
Base	CUP Expansion	\$\$\$	N	N	N
1	CHP	\$\$\$\$	N	Y	Y
2	TES	\$\$	Y	Y	Y
3	CUP Heat Rejection Modification	\$\$	Y	Y	Y
4	ICE Chiller Production	\$	N	Y	N
5	ICE Chiller Cooling Tower	\$	Y	Y	Y
6	Satellite South Utility Plant	\$\$\$	-	Y	Y
7	EVMS Decoupled from CUP	\$\$\$	N	Y/N	N

Results to Recommendations

- Results Work Session
 - Results not equal to Recommendations
- Narrative Report
- Roadmap
- Green House Gas (GHG) Wedges
- “Selling It” to Management
 - PowerPoint
 - Other Deliverables

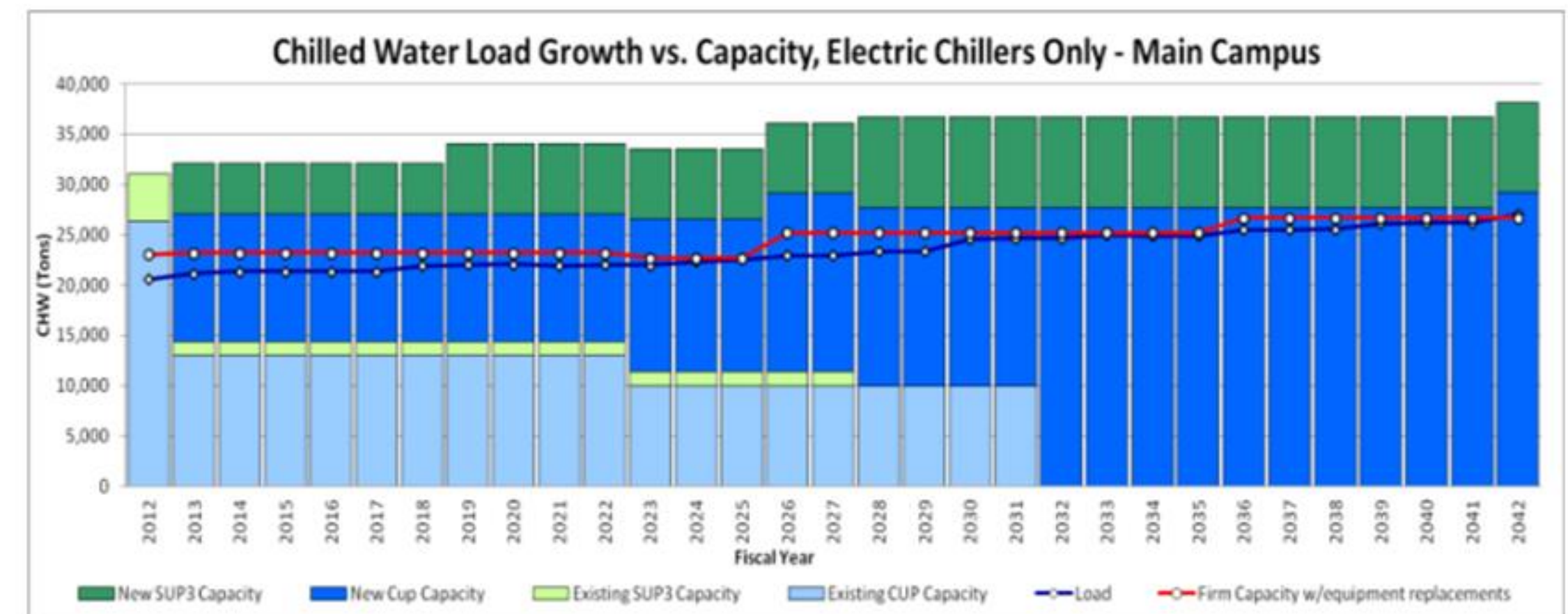


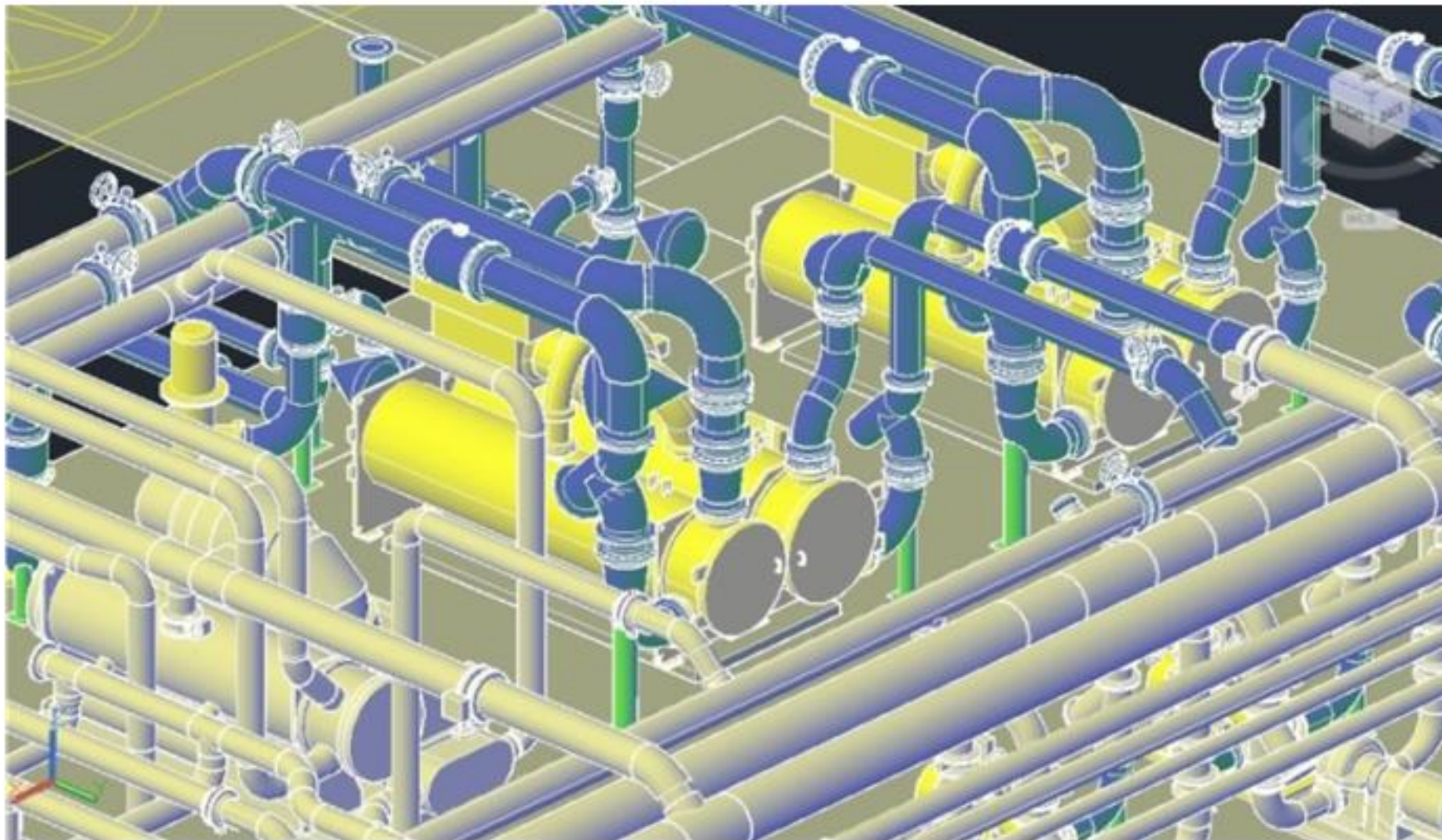
Case Studies

- Texas A&M University
- Northwestern University
- Confidential Healthcare Client

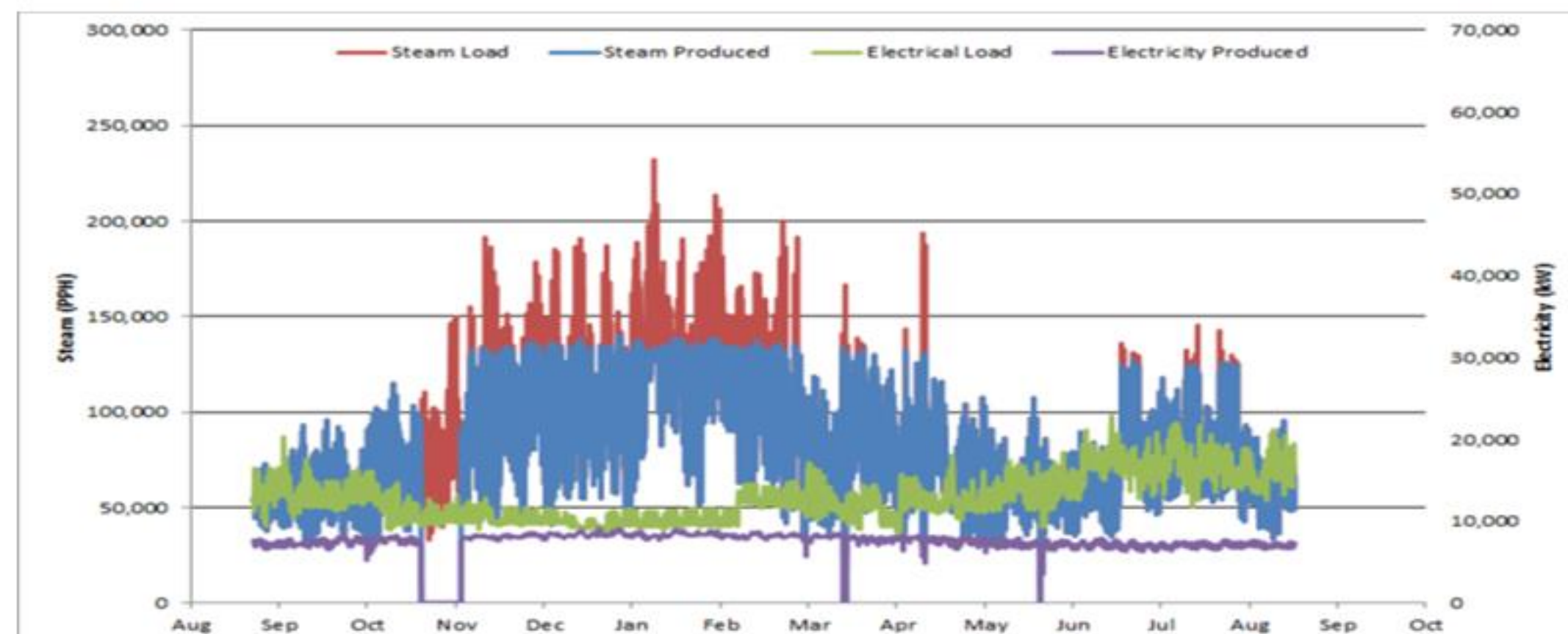
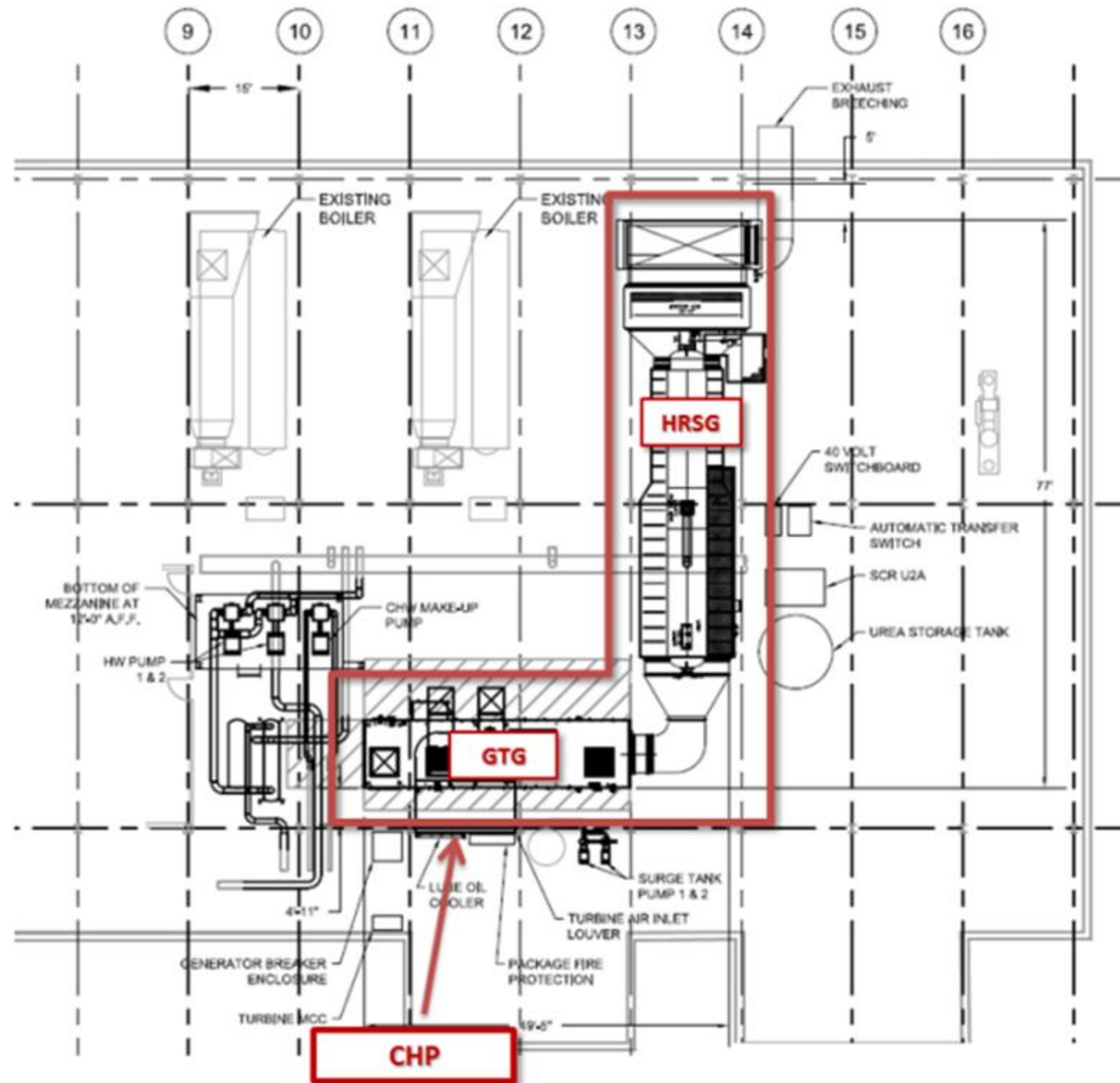


- 2005 and 2011
- Expansion 56% - over 30 years
- Thermal, Electric, and Civil Utilities Investigation
- Recommendations
 - Thermal Energy Storage
 - Heat Pump Chillers
 - CHP
 - Plant Optimization
 - New Plant Locations
 - Equipment & Distribution Replacements
- Life Cycle Savings - \$33 Million
 - \$170MM in capital projects
 - \$10MM grant for CHP





- **Discrete Project Recommendations**
 - Direct to Capital Plan
- **6 New/Replacement Chillers – 16,500 tons**
- **1 Heat Pump Chiller – 1,200 tons**
- **24,000 ton-hr (3MM Gallons) TES**
- **1000 BHP HHW Capacity**
- **Upgrades:**
 - Towers
 - Pumping
 - Electrical Systems

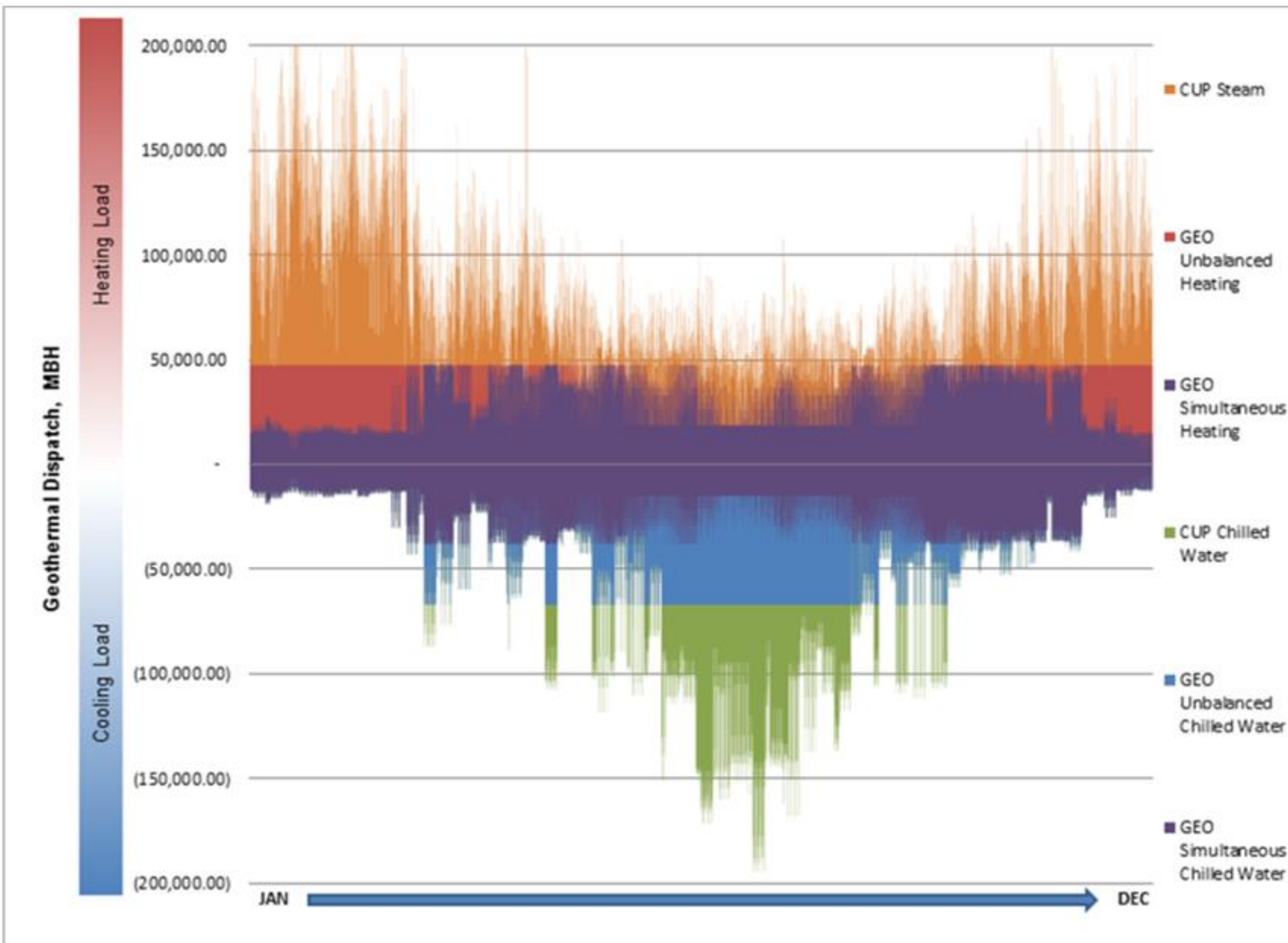


CHP and Alternative Energy Study

- **Issues:**
 - Reduced boiler capacity due to derate
 - Meet expanding campus demands
 - Economic responsibility
 - Environmental responsibility
- **Evaluated CHP and Renewable Energy Alternatives**
 - Combined heat and power 4-13 MW
 - Ground Source Geothermal Heat Pump Chillers (3 options)
 - Market assessment of PPA for wind power

Three Geothermal Options

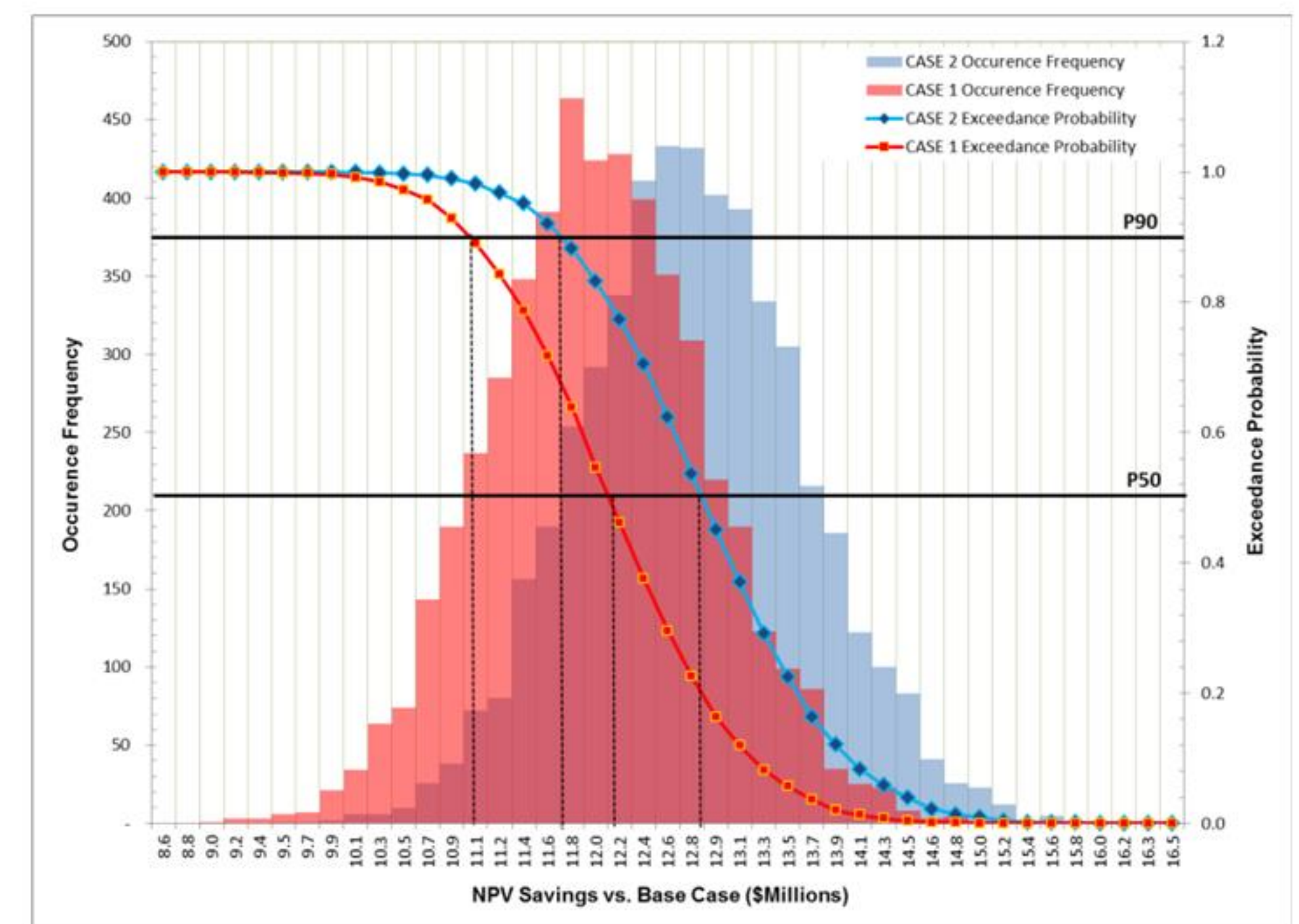
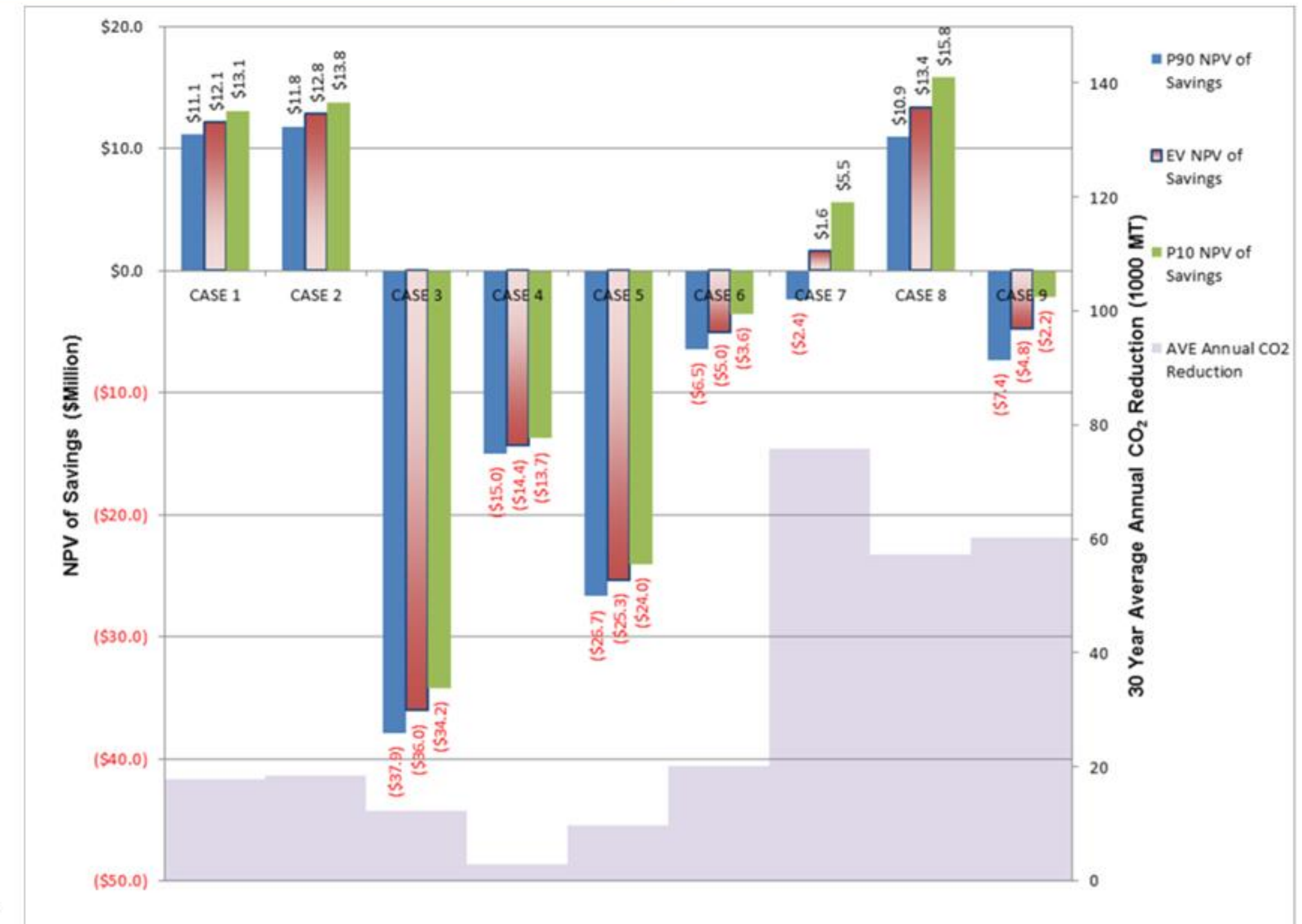
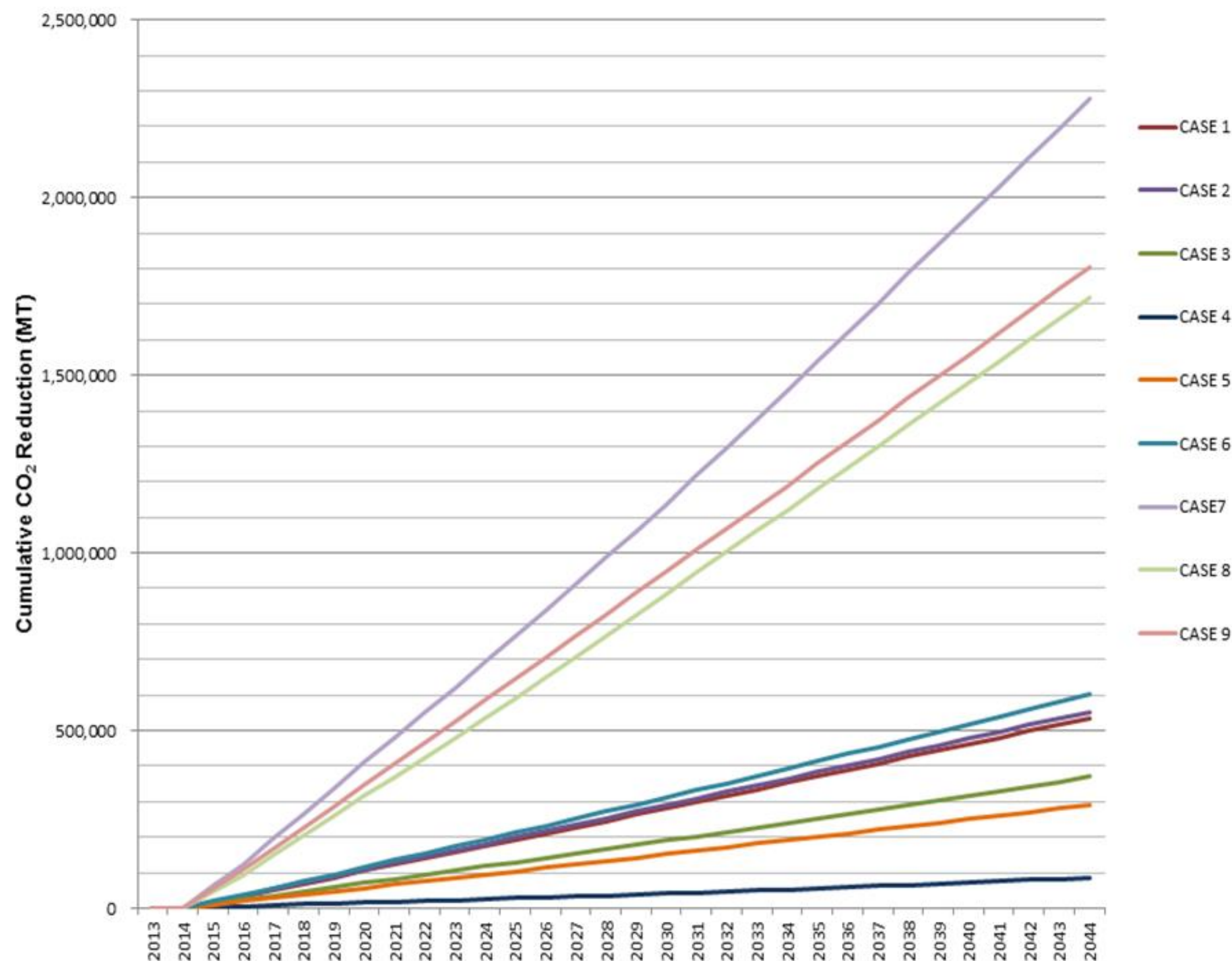
- Well field locations
- Extent of building modifications
- Simultaneous heating & cooling
- Seasonal balance between heating & cooling



Northwestern University

Analysis

- Monte Carlo Analysis
- P10, P50, P90
- Net Present Value
- CO2 Reduction



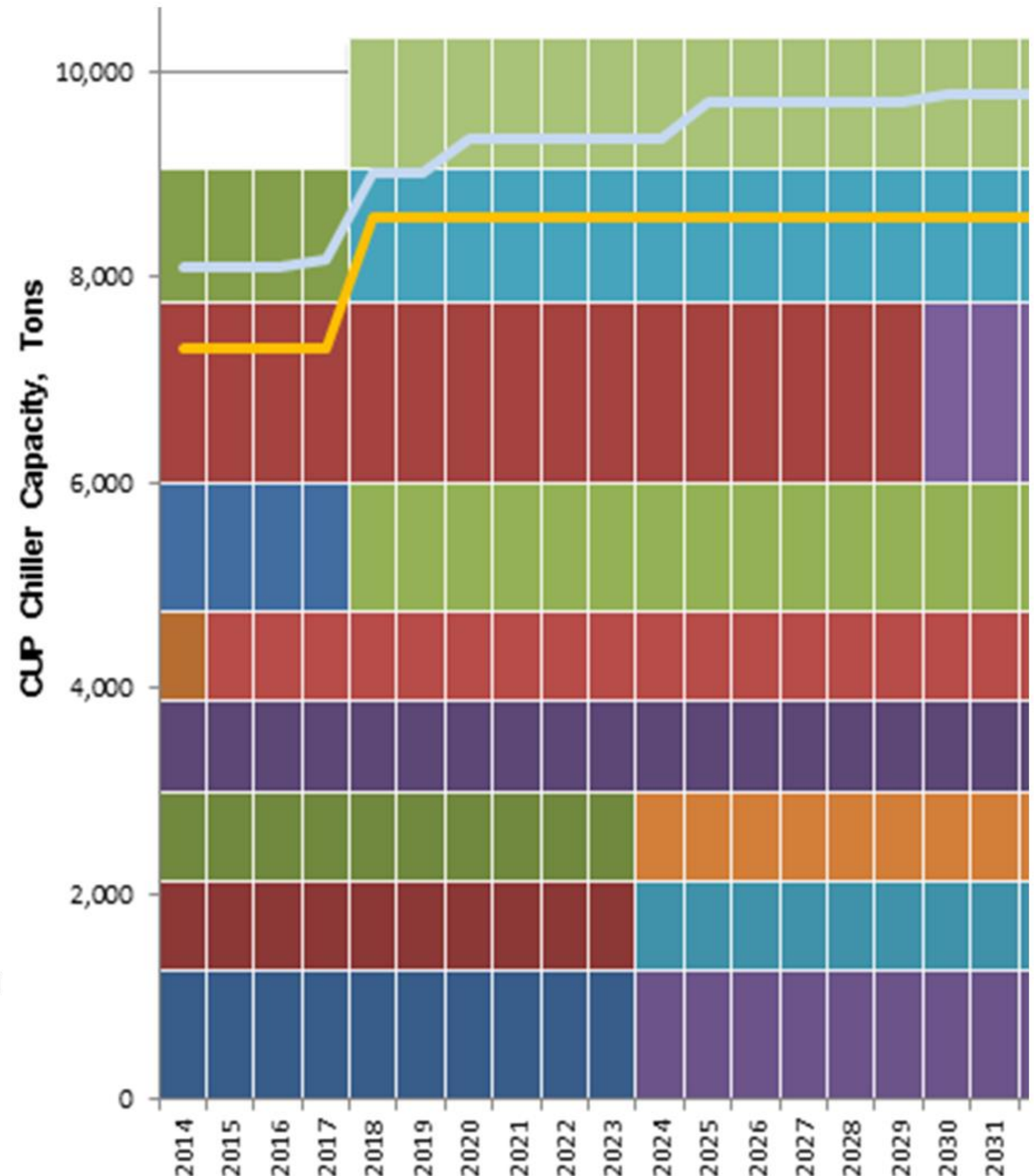
Confidential Hospital

Current Situation

- Existing Central Utility Plant
 - 10,500 tons of chilled water
 - 12,000 pph of steam
- Serves 2.5 million square feet
- Level I trauma center
- Existing small ice storage
- No N+1 on cooling (desired)

Challenges

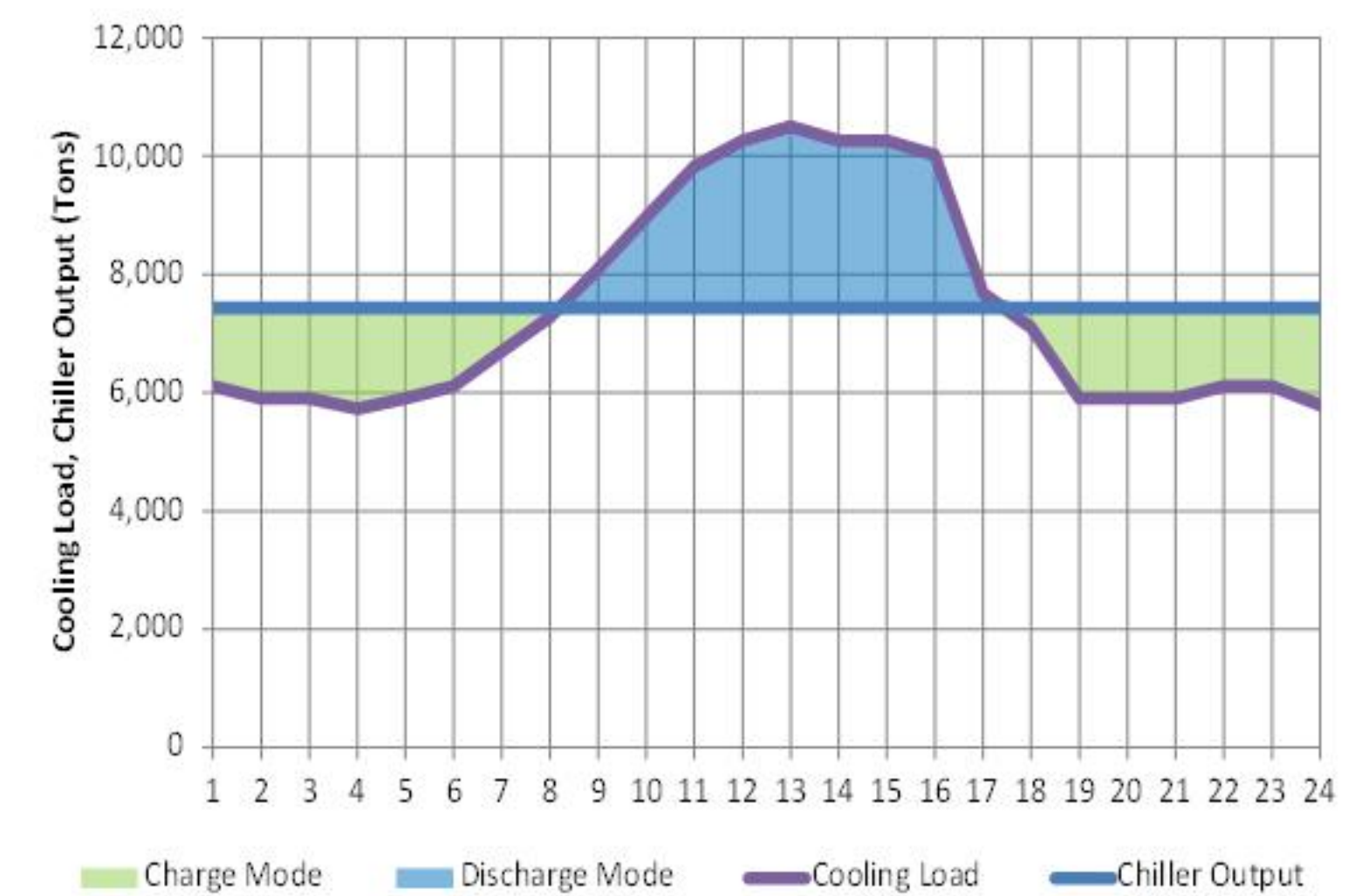
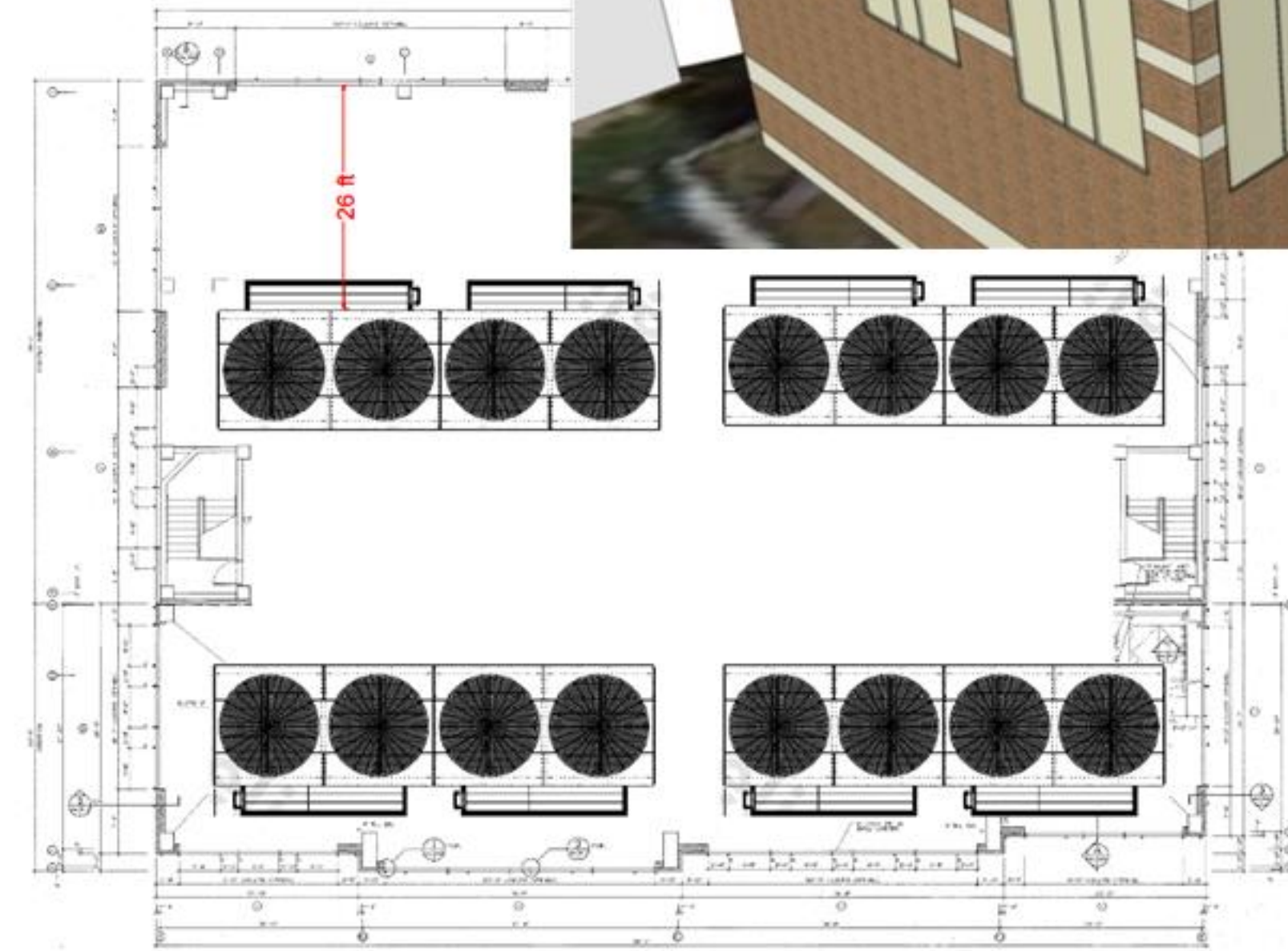
- Insufficient production capacity
 - Plant struggled to meet 8,100 ton peak
 - Peak capacity de-rated to 9,000 tons
- Short term (2-3 year) demand increase
 - Increase to 9,000 tons
- Looking for the sound financial decision
- High on-peak demand rates
- Can't expand existing plant
- Looking to build a new plant



Confidential Hospital

- Options

- Variety of plant modifications
- Thermal Energy Storage (TES)
- New cooling towers
- Chiller plant expansion
- Satellite chiller plant



Questions & Answers



Jon Schwartz, PE, CEM, LEED AP
Manager, *OnSite* Energy & Power
Burns & McDonnell
Direct: 817.840.1234
Email: jschwartz@burnsmcd.com



Blake Ellis, PE, DBIA, LEED AP
Manager, *OnSite* Energy & Power
Burns & McDonnell
Direct: 816.822.3332
Email: bellis@burnsmcd.com

Thank You