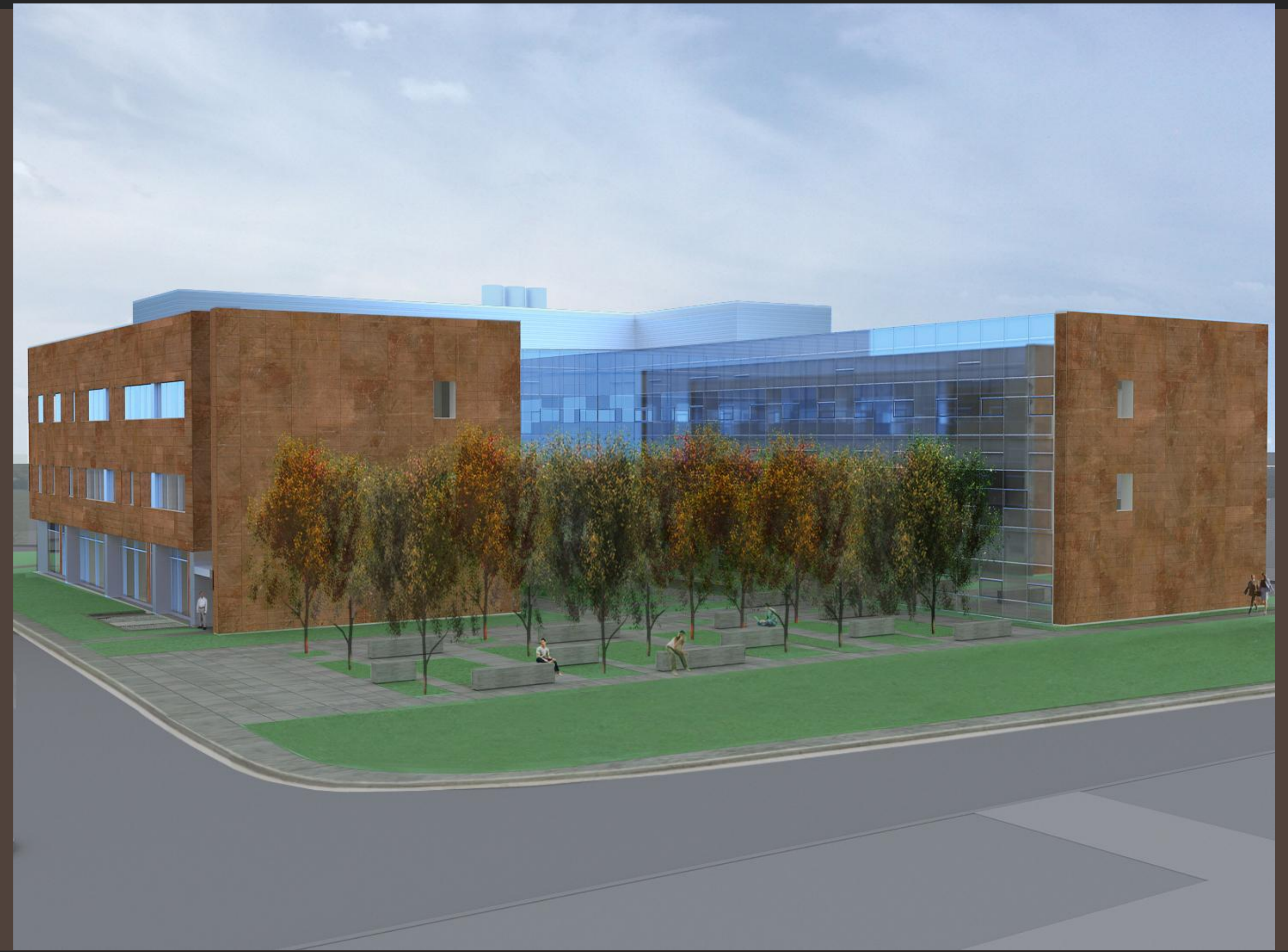
Nassau Community College Life Sciences Building

Garden City, NY



Michael Reilly, Jr. – Mechanical Option
Advisor – James Freihaut, PhD & Dustin Eplee
The Pennsylvania State University

Presentation Outline

- **Introduction**
  - **Summary**
  - Life Sciences Building
  - Mechanical System
- Depth 1: Decentralized Air System
- Depth 2: Chiller Plant Design
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

Decentralized System Findings

- 20% decrease in first cost with chilled beam & dedicated outdoor air system
- 50% reduction in supply air
- 18% increase in chilled water flow
- 26% decrease in energy*

Chiller Plant Findings

- $26,000 lower first cost with variable primary flow
- $1,500 annual energy savings with variable primary flow

Presentation Outline

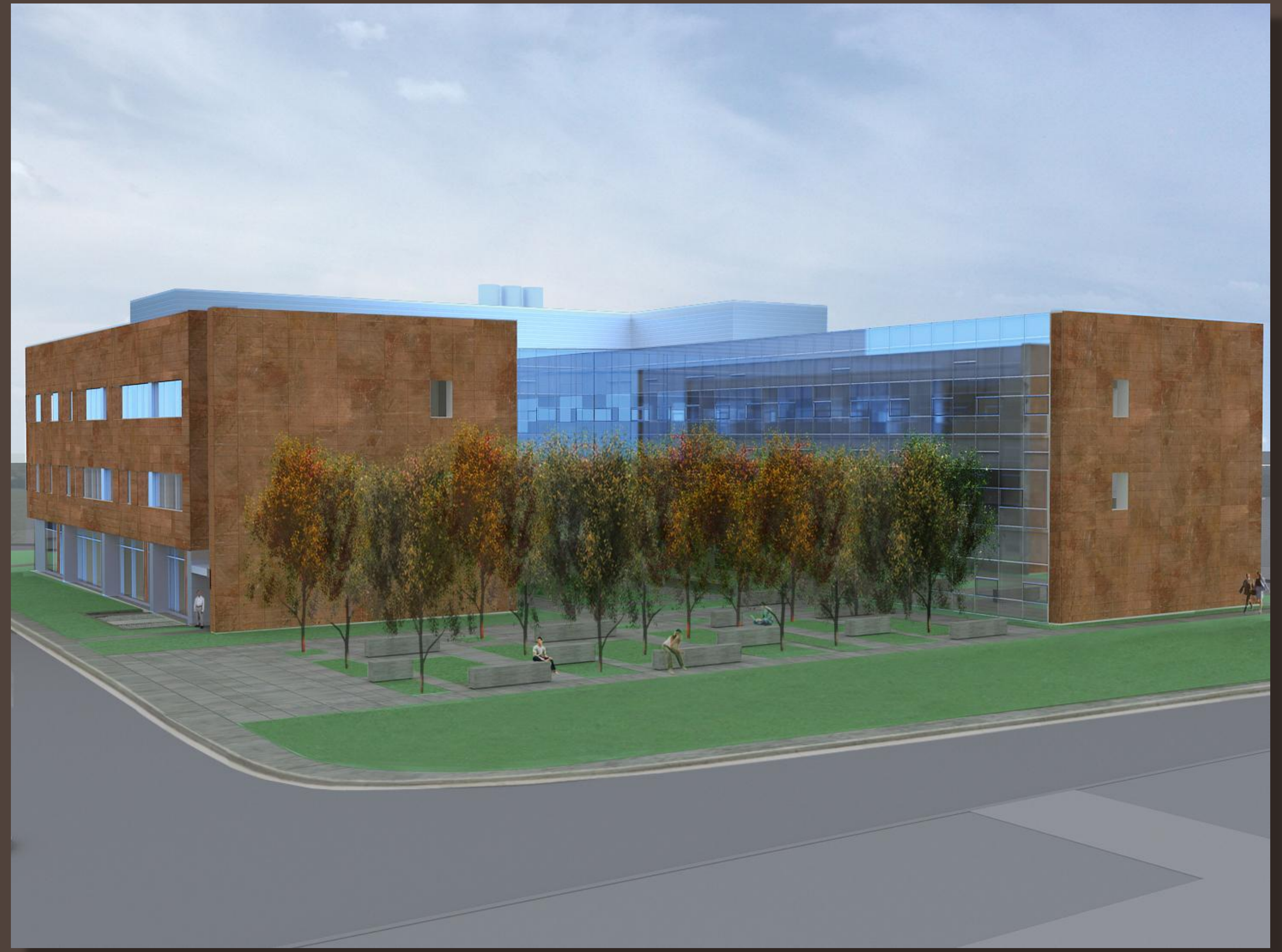
- **Introduction**
  - Summary
  - **Life Sciences Building**
  - Mechanical System
- Depth 1: Decentralized Air System
- Depth 2: Chiller Plant Design
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

Building Information

Size	72,400 Square Feet
Occupancy:	Classrooms/Laboratories/Offices
Levels:	3/Penthouse/Basement
Cost:	$30 Million
Construction Dates:	March 2010 – January 2012

Team

Architect:	Cannon Design
Structural:	Cannon Design
M/E/P/FP:	Cannon Design
CM:	Jacobs Project Management Co.



Presentation Outline

- **Introduction**
  - Summary
  - Life Sciences Building
  - **Mechanical System**
- Depth 1: Decentralized Air System
- Depth 2: Chiller Plant Design
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

Waterside

- Campus High Temperature Hot Water – 270°F
  - Heat Exchangers – 180°F
  - Direct to Air Handling Units
- Campus Chilled Water - 42°F
  - Booster Pumps
  - Direct to all coils

Airside

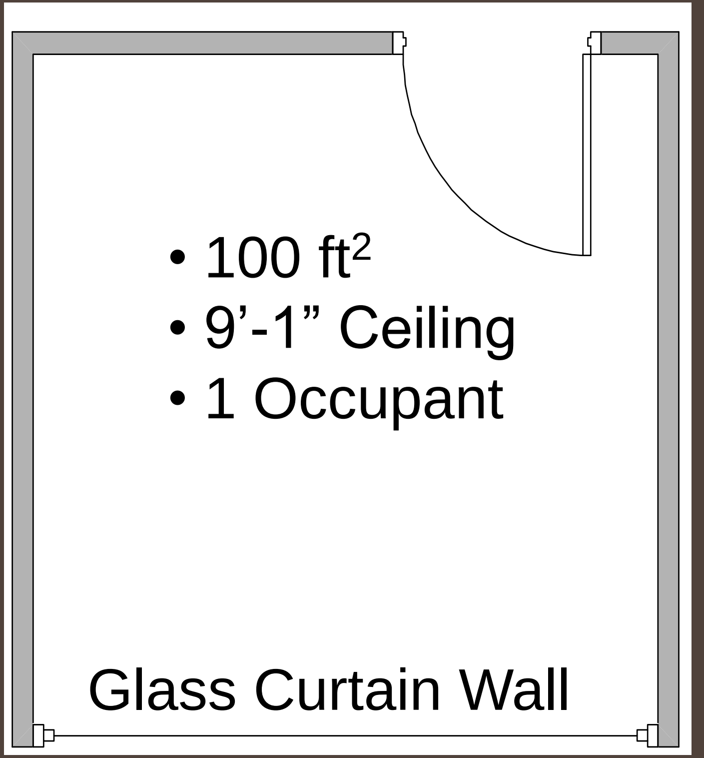
- Classrooms/Offices
  - 25,550 CFM VAV with Terminal Reheat
- Laboratories
  - VAV with Supply Valves and Reheat
  - Fume Hoods
  - Glycol Heat Recovery Run-Around Loop
- Laboratory Exhaust
  - 3 Fans with a minimum discharge of 4,000 FPM
  - Heat Recovery

Presentation Outline

- Introduction
- **Depth 1: Decentralized Air System**
  - **Design**
  - Energy/First Cost
  - Life Cycle
- Depth 2: Chiller Plant Design
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

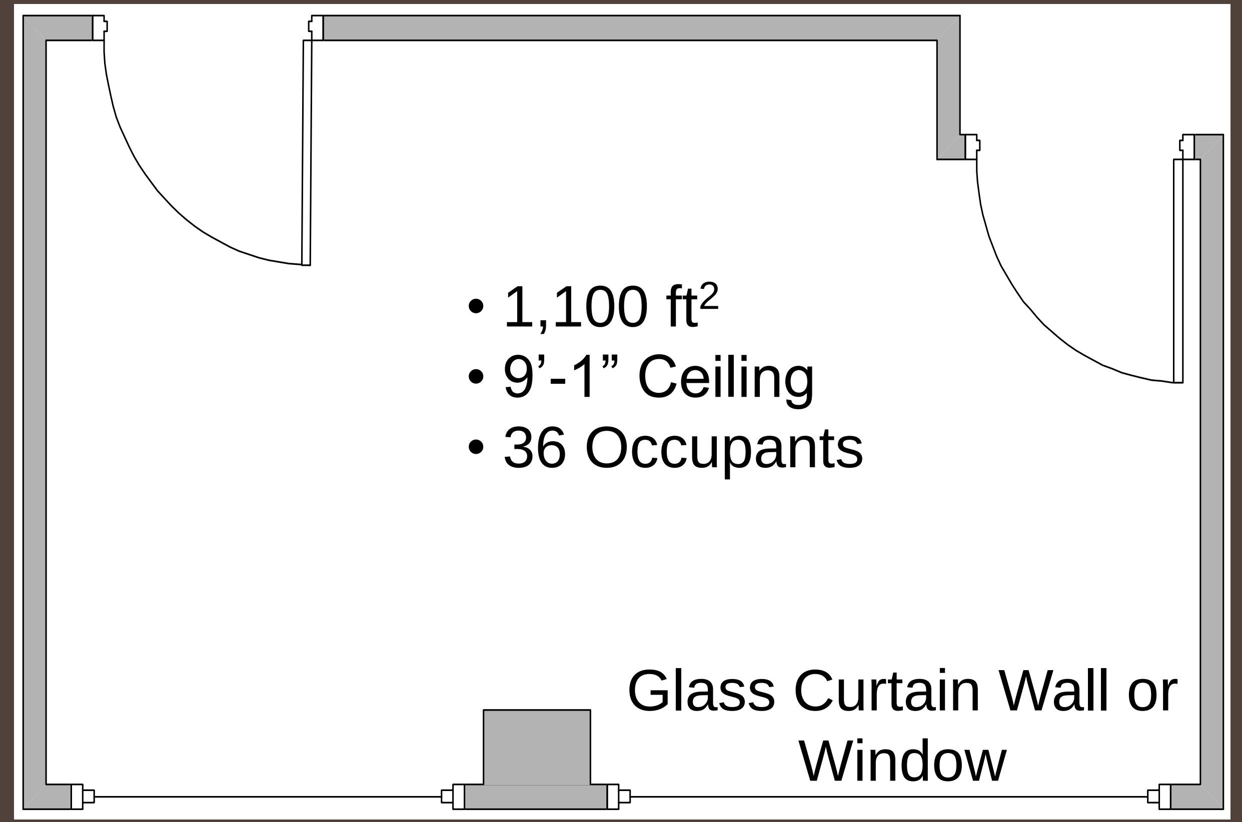
Chilled Beam

- Offices



Chilled Beam

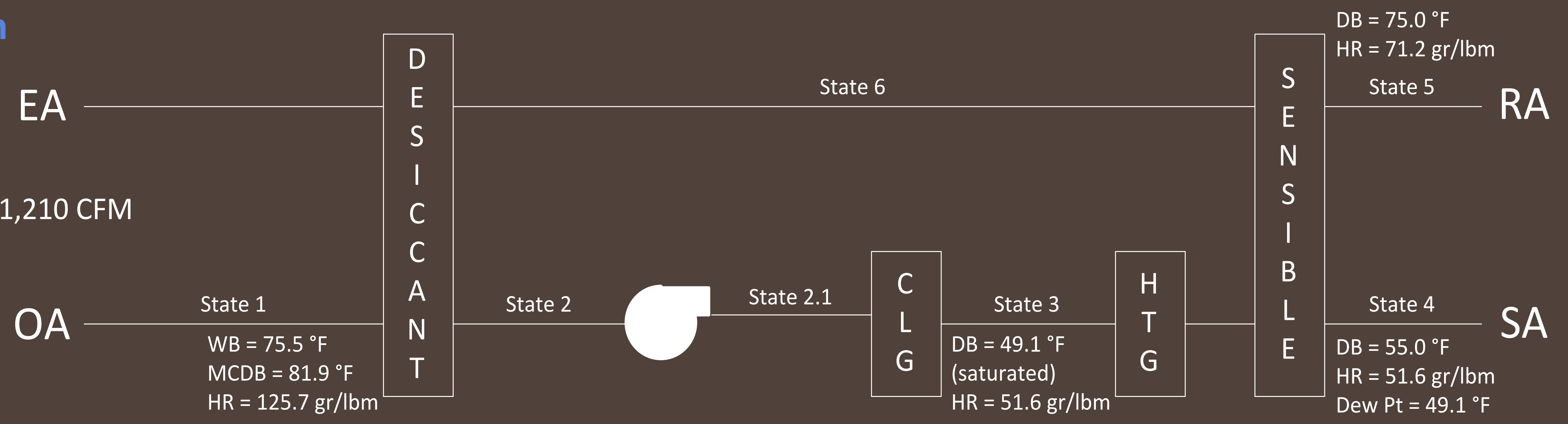
- Classrooms



Presentation Outline

Dedicated Outdoor Air Unit

- •Introduction
- **•Depth 1: Decentralized Air System**
  - **•Design**
  - •Energy/First Cost
  - •Life Cycle
- •Depth 2: Chiller Plant Design
- •Breadth 1: Daylighting
- •Conclusion
- •Acknowledgements
- •Questions

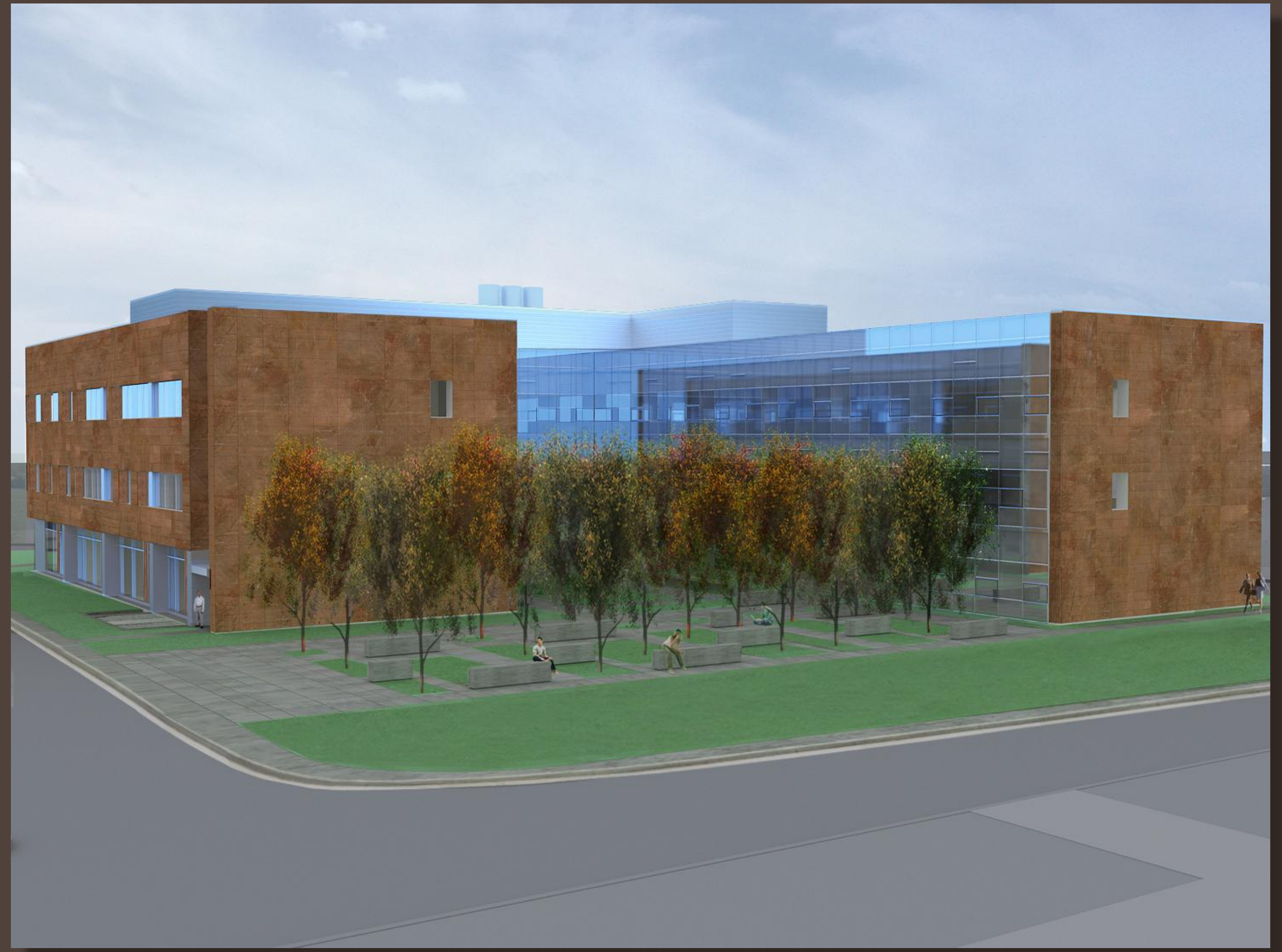


Presentation Outline

- Introduction
- **Depth 1: Decentralized Air System**
  - Design
  - **Energy/First Cost**
  - Life Cycle
- Depth 2: Chiller Plant Design
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

Energy Analysis Procedure

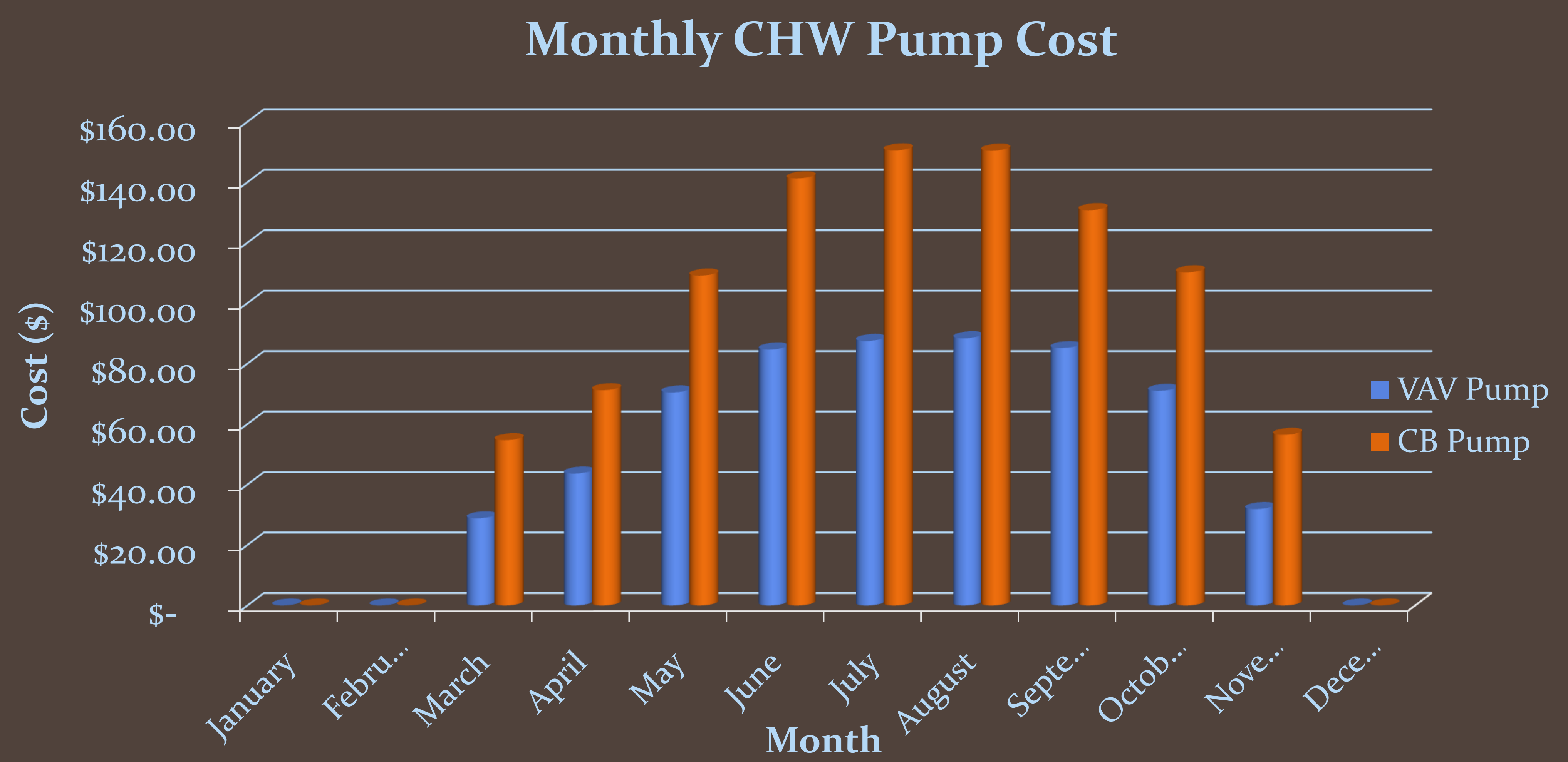
- Obtain design hourly cooling load predictions
- Select Similar Pump/Fan model
- Create regressions illustrating equipment
  - Curve Model
- Use regressions to determine power
- Apply utility rate structure



Presentation Outline

- Introduction
- **Depth 1: Decentralized Air System**
  - Design
  - **Energy/First Cost**
  - Life Cycle
- Depth 2: Chiller Plant Design
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

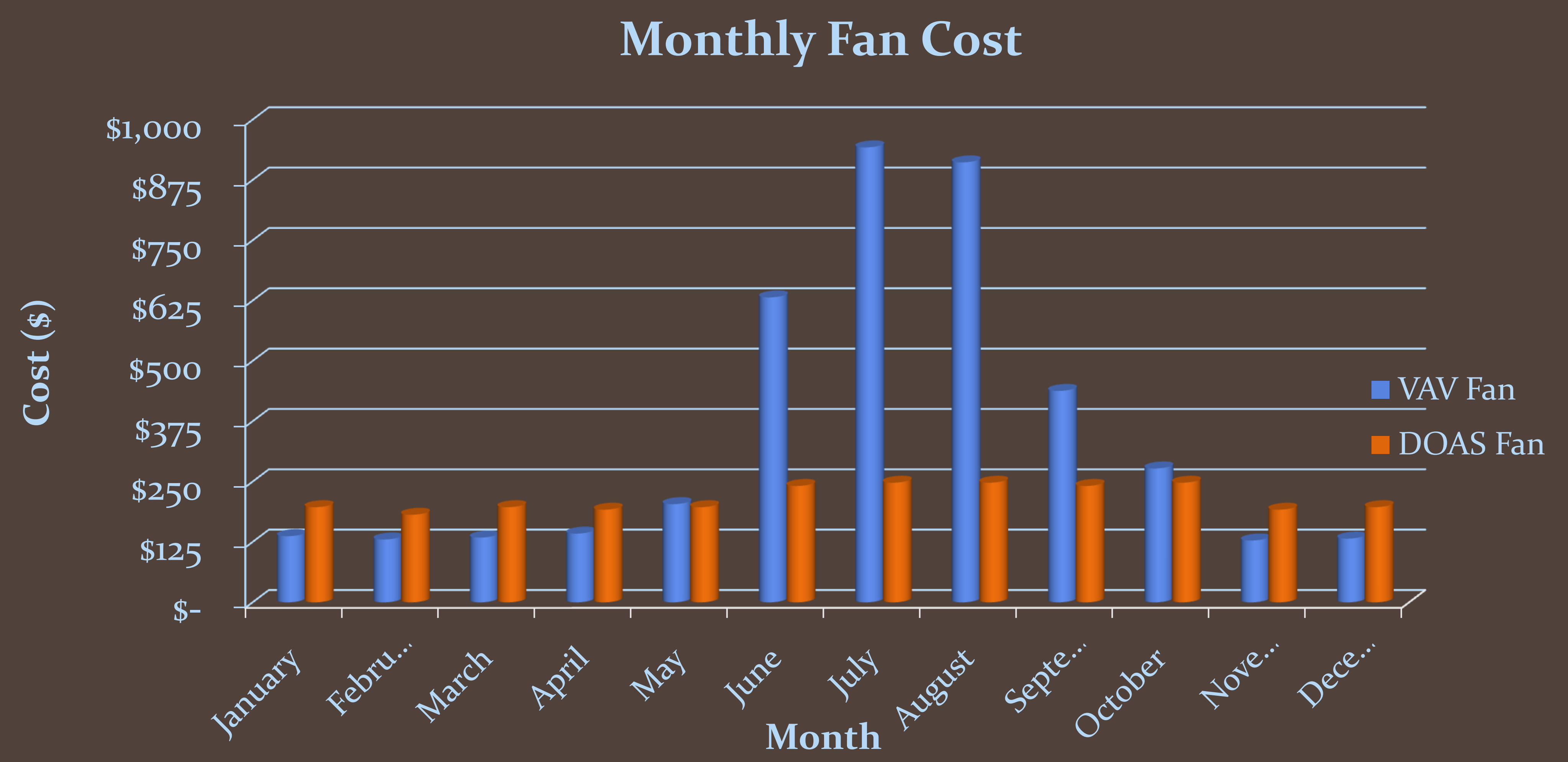
Pump Energy



Presentation Outline

- Introduction
- **Depth 1: Decentralized Air System**
  - Design
  - **Energy/First Cost**
  - Life Cycle
- Depth 2: Chiller Plant Design
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

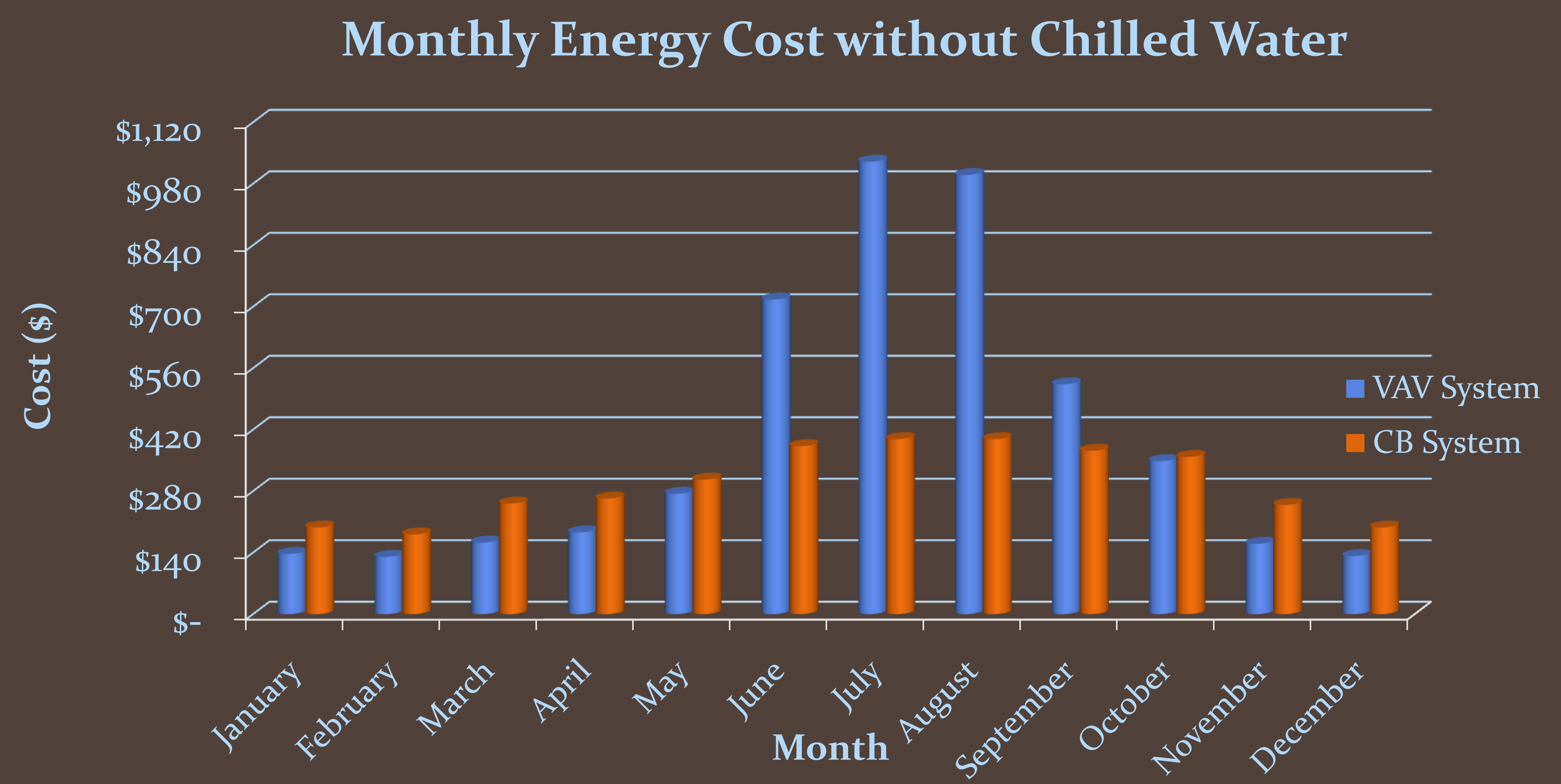
Fan Energy



Presentation Outline

- Introduction
- **Depth 1: Decentralized Air System**
  - Design
  - **Energy/First Cost**
  - Life Cycle
- Depth 2: Chiller Plant Design
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

Total Energy

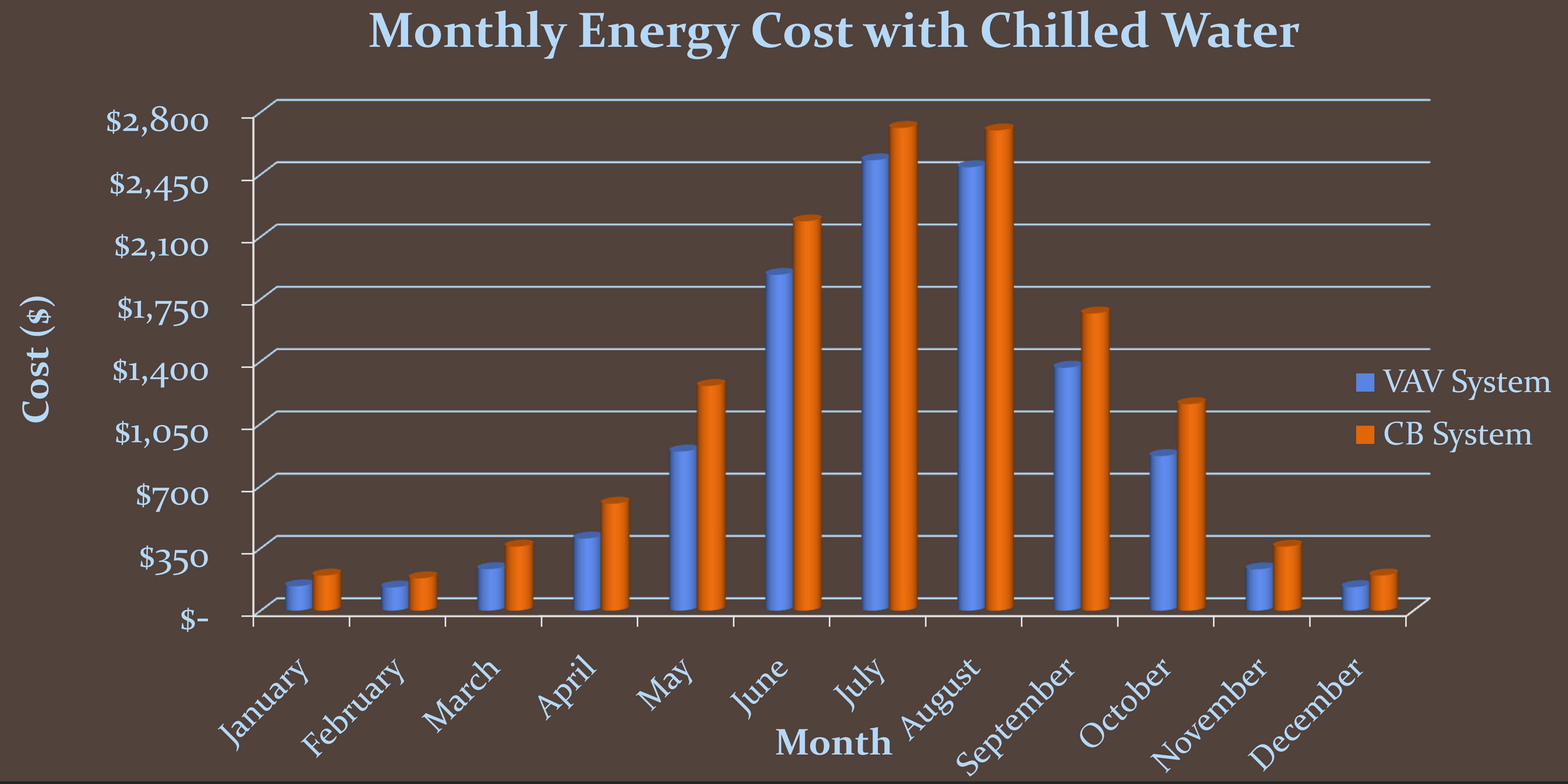


Michael Reilly, Jr. | Nassau Community College Life Sciences Building | Mechanical Option

Presentation Outline

- Introduction
- **Depth 1: Decentralized Air System**
  - Design
  - **Energy/First Cost**
  - Life Cycle
- Depth 2: Chiller Plant Design
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

Total Energy



Presentation Outline

- Introduction
- **Depth 1: Decentralized Air System**
  - Design
  - **Energy/First Cost**
  - Life Cycle
- Depth 2: Chiller Plant Design
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

First Cost

- New Chilled Beam/DOAS - $1,000,000
  - Smaller Air Handling Unit
  - Less VAV Boxes
  - Less Ductwork
  - No Finned Tube Radiation
  - Extra Piping
  - Add Desiccant/Sensible Wheels
  - Add Pump
- 20% Less First Cost

First Cost

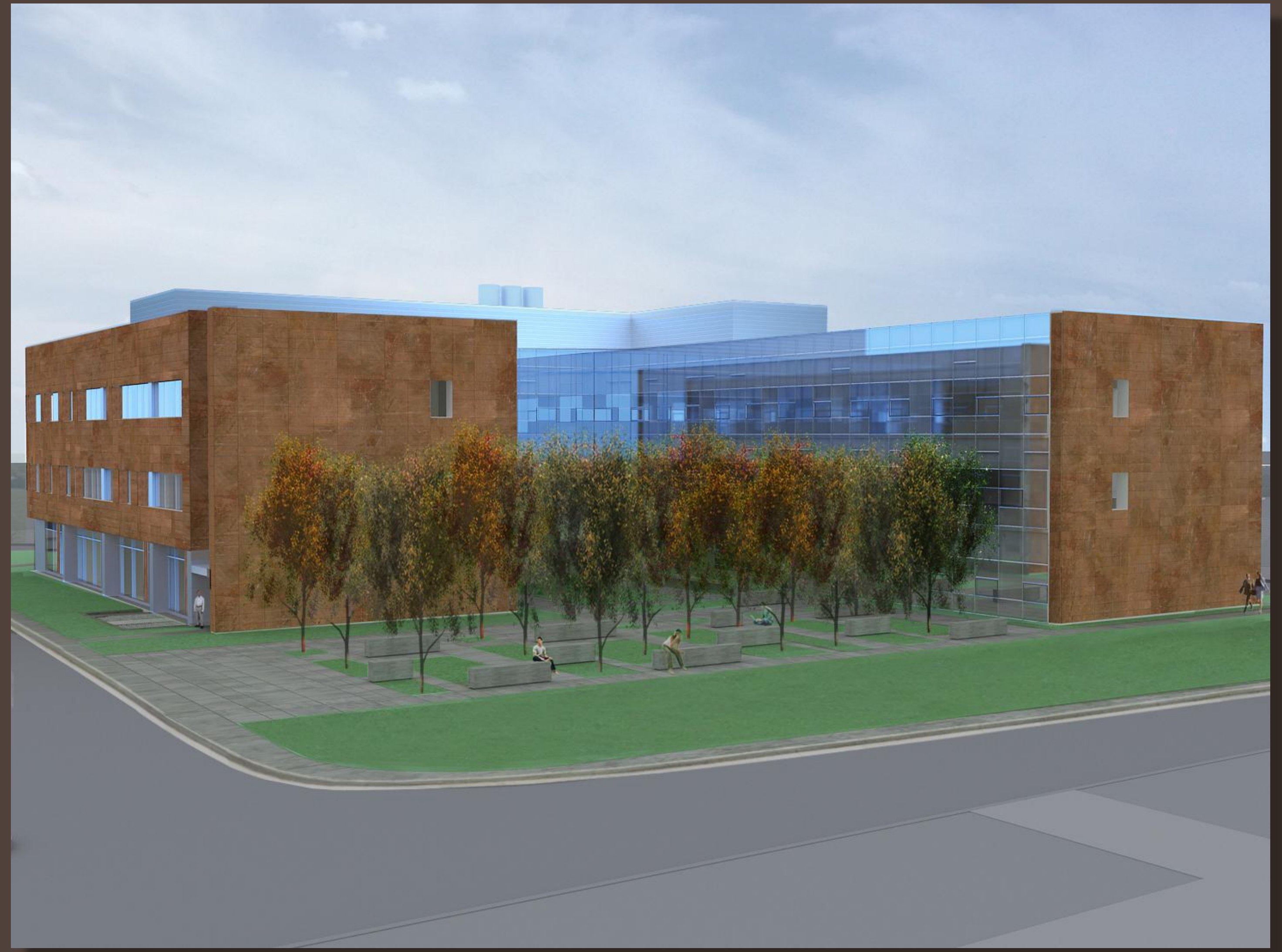
- Existing VAV with Terminal Reheat - $1,254,000
  - Large Air Handling Unit
  - Many VAV Boxes
  - Much Ductwork
  - Less Pumps
  - Less piping

Presentation Outline

- Introduction
- **Depth 1: Decentralized Air System**
  - Design
  - Energy/First Cost
  - **Life Cycle**
- Depth 2: Chiller Plant Design
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

Life Cycle Cost

- VAV with Terminal Reheat
  - 30-year NPV: $1,628,000
- Chilled Beam with Dedicated Outdoor Air System
  - 30-year NPV: $1,470,000
- 9.7% Lower LCC with Chilled Beam/DOAS

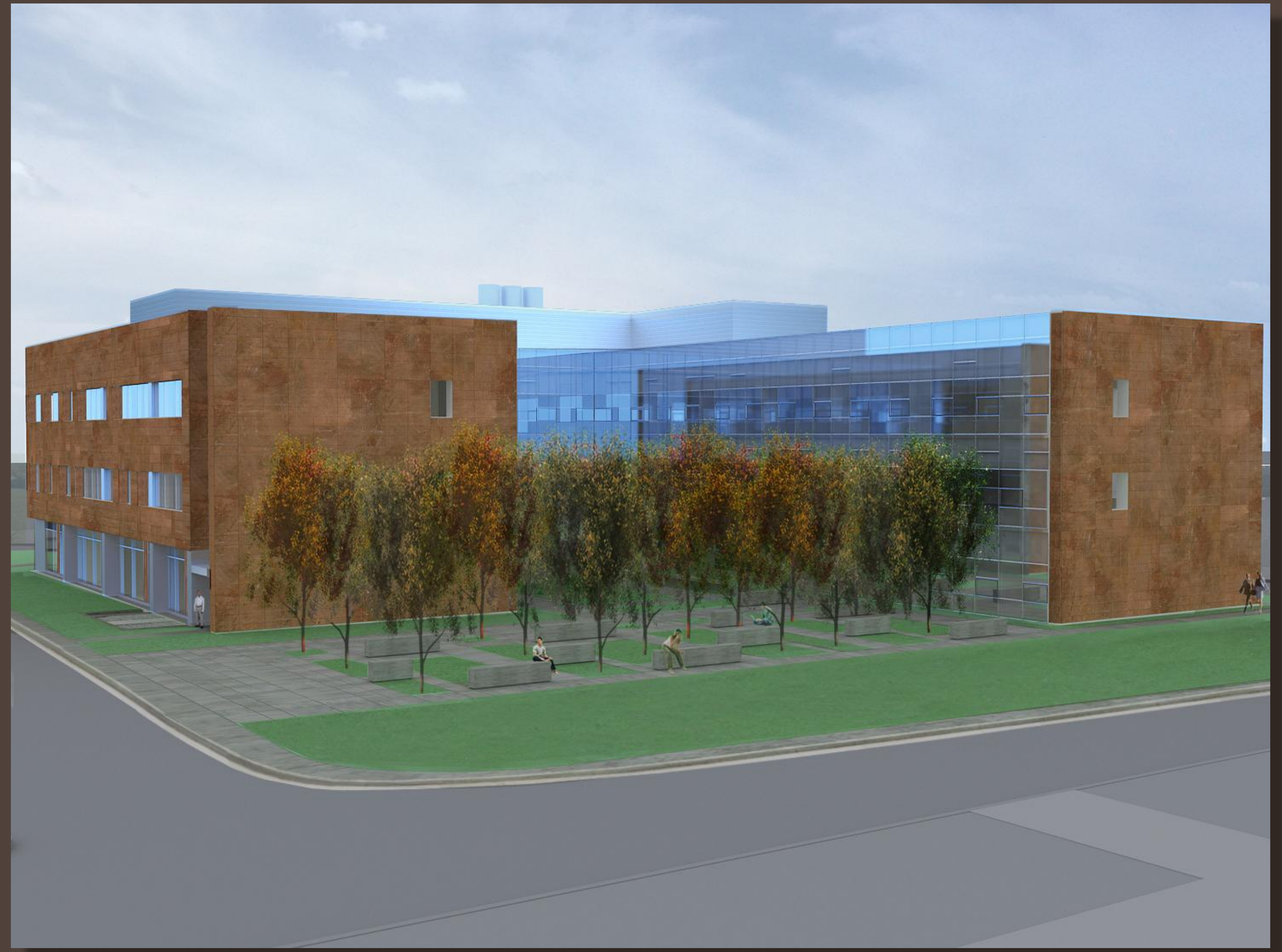


Presentation Outline

- •Introduction
- •Depth 1: Decentralized Air System
- **•Depth 2: Chiller Plant Design**
  - **•Design**
  - •Energy/First Cost
  - •Life Cycle
- •Breadth 1: Daylighting
- •Conclusion
- •Acknowledgements
- •Questions

Chiller Plant

- Equipment
  - Carrier 270 Screw Chiller
  - Bell & Gossett Base-Mounted Pumps
  - Marley Cooling Tower

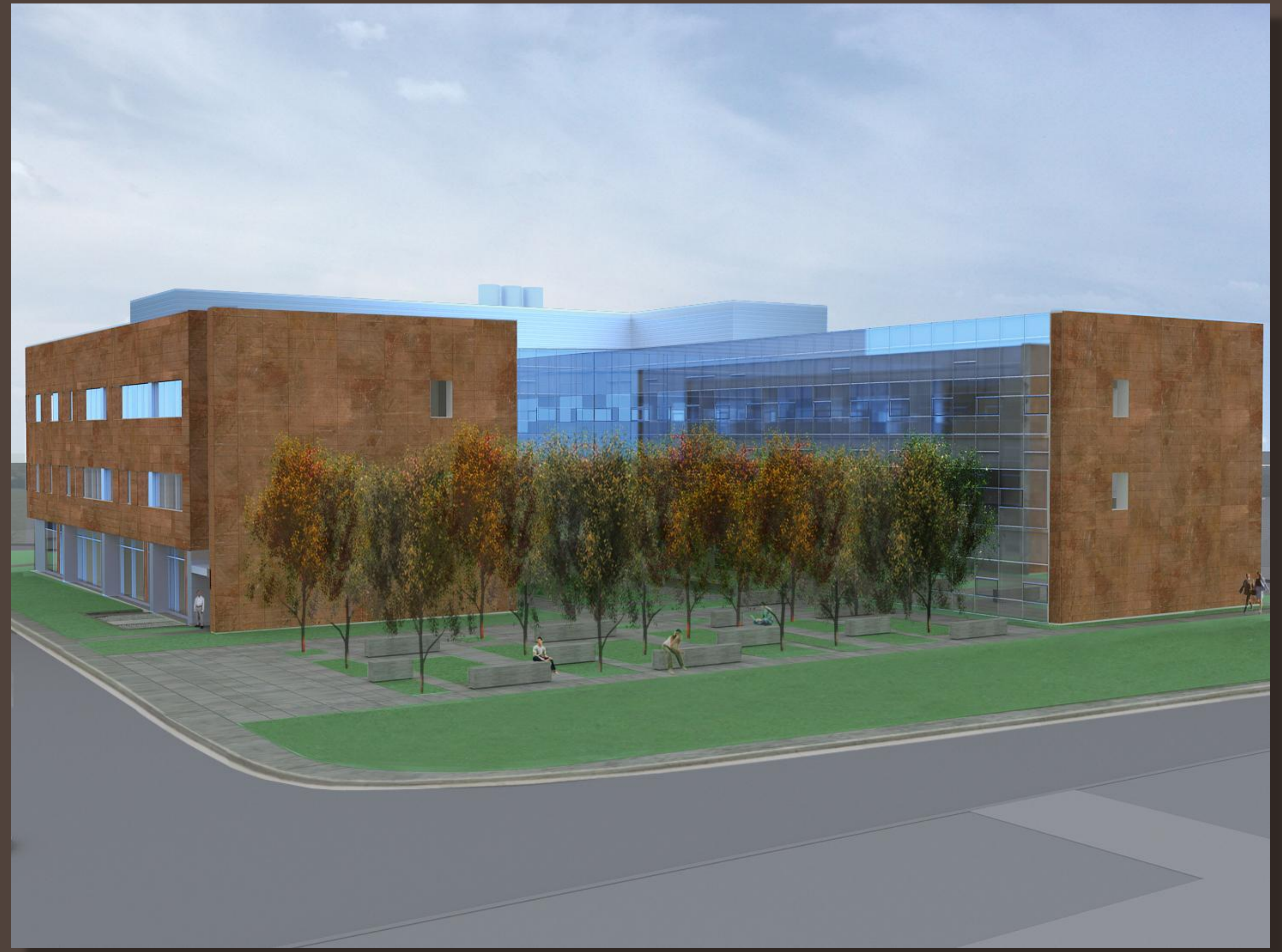


Presentation Outline

- Introduction
- Depth 1: Decentralized Air System
- **Depth 2: Chiller Plant Design**
  - Design
  - **Energy/First Cost**
  - Life Cycle
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

Energy Analysis Procedure

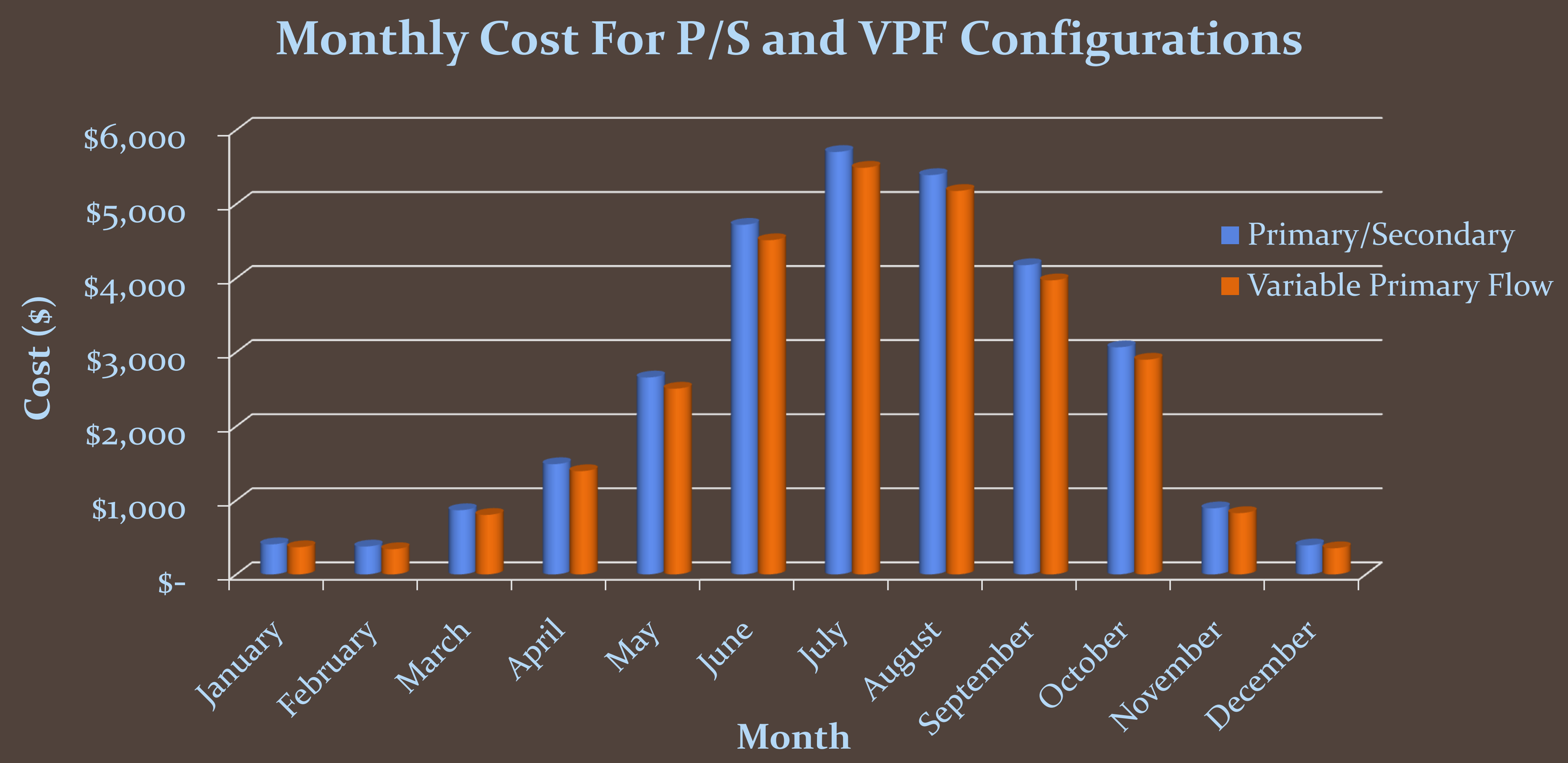
- Obtain design hourly cooling load predictions
- Create regressions illustrating equipment
  - Chiller - California Energy Commission
  - Cooling Tower/Pump - Curve Model
- Use regressions to determine power
- Apply electric rate structure

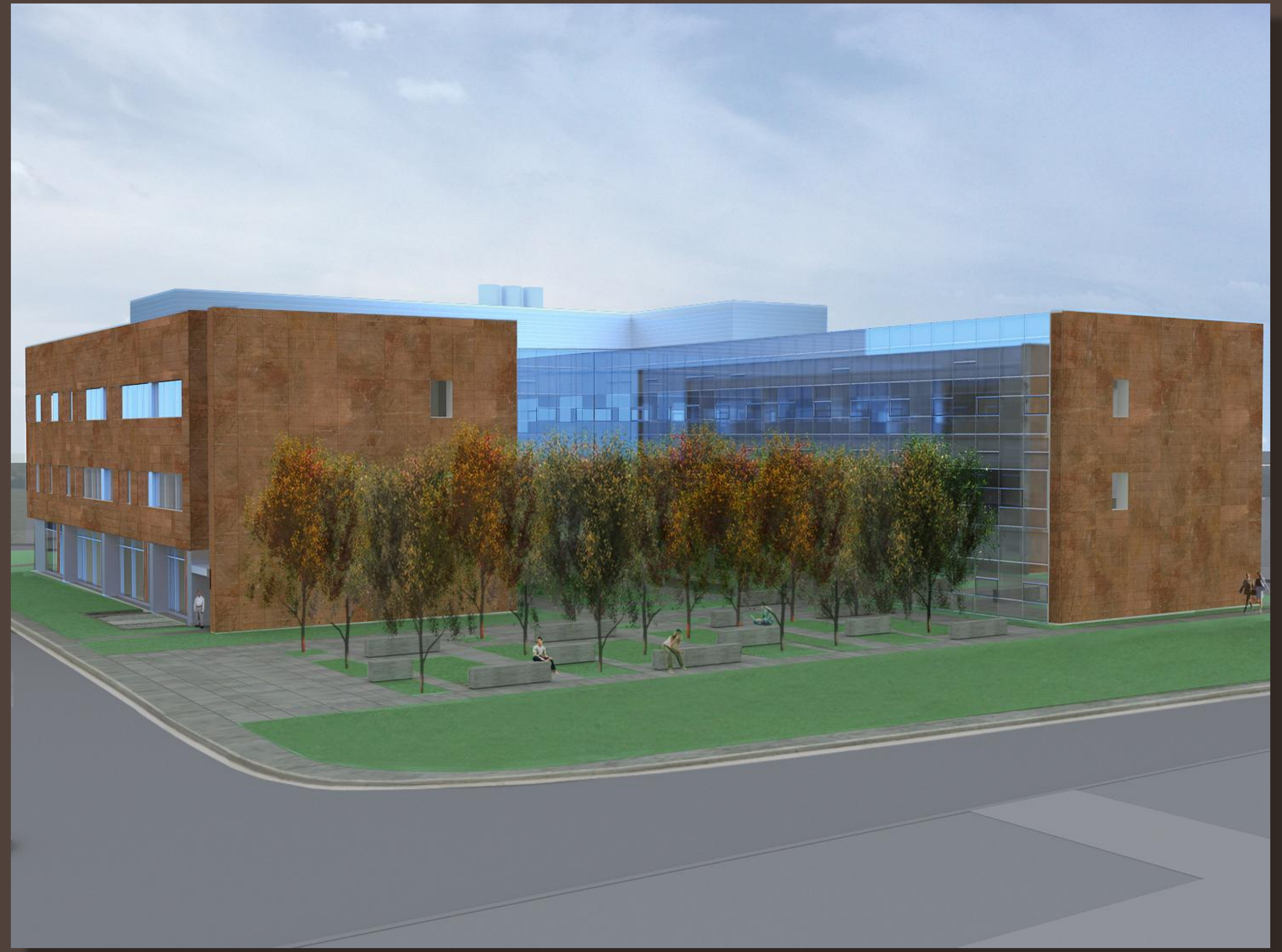


Presentation Outline

- Introduction
- Depth 1: Decentralized Air System
- **Depth 2: Chiller Plant Design**
  - Design
  - **Energy/First Cost**
  - Life Cycle
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

Chiller Plant Energy



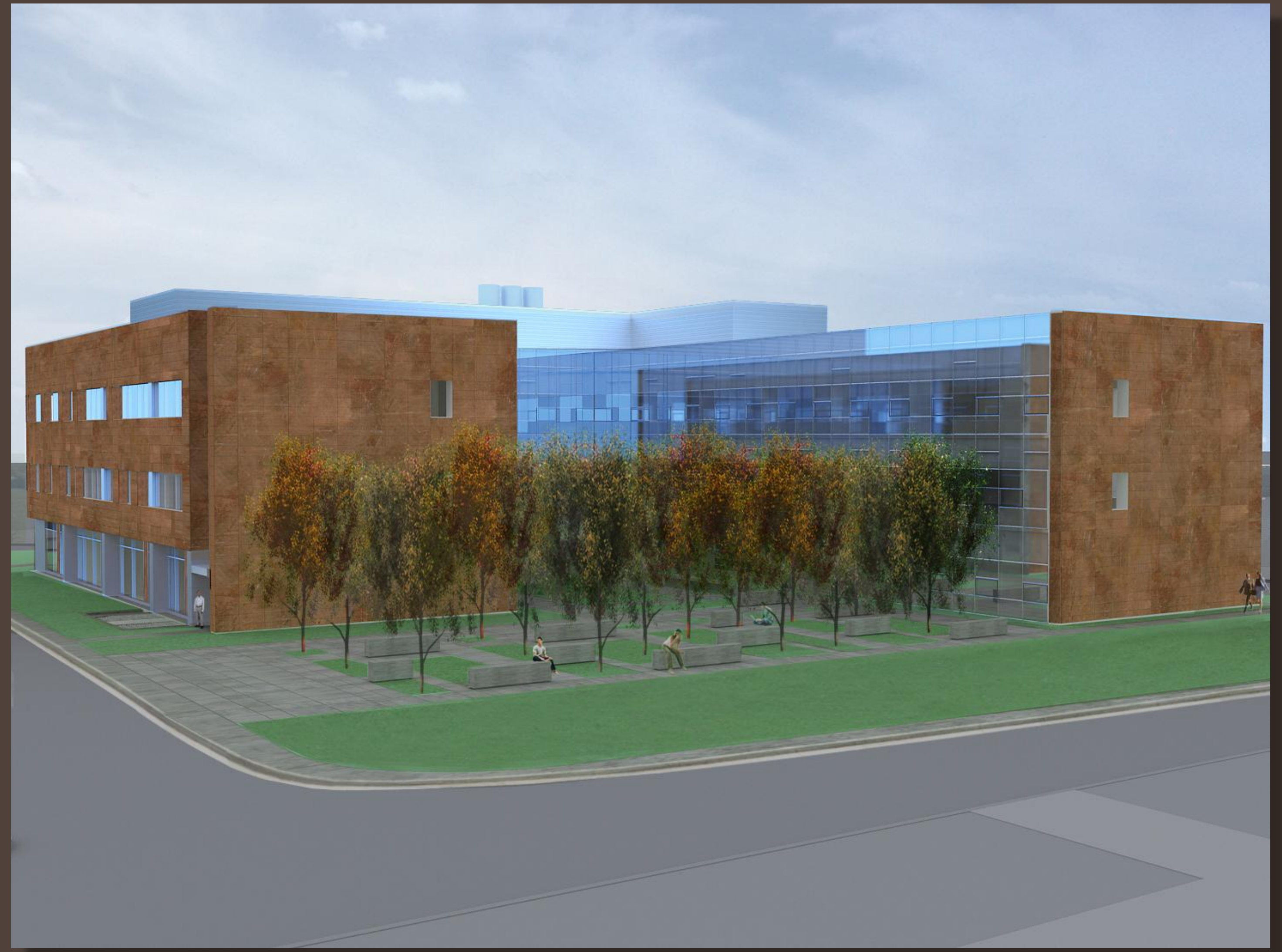


Presentation Outline

- Introduction
- Depth 1: Decentralized Air System
- **Depth 2: Chiller Plant Design**
  - Design
  - **Energy/First Cost**
  - Life Cycle
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

Chiller Plant First Cost

- Primary/Secondary - $243,000
  - Extra set of pumps
  - More Piping
- Variable Primary Flow - $217,000
  - Less Pumps
  - Less Piping
  - 11% decrease in first cost

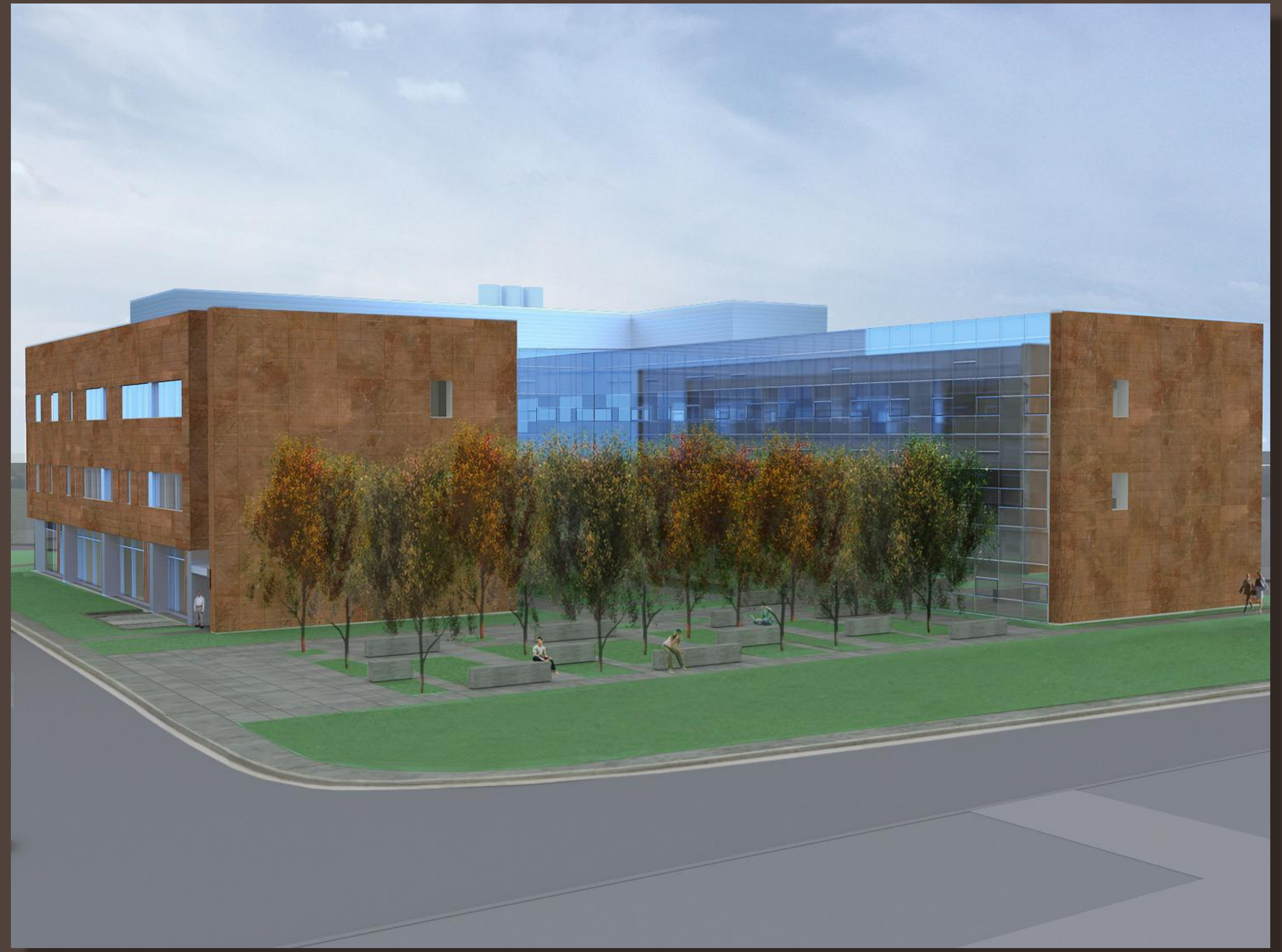


Presentation Outline

- Introduction
- Depth 1: Decentralized Air System
- **Depth 2: Chiller Plant Design**
  - Design
  - Energy/First Cost
  - **Life Cycle**
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- Questions

Chiller Plant Life Cycle Cost

- Primary/Secondary
  - 30-year NPV: $1,231,000
- Variable Primary Flow
  - 30-year NPV: $1,161,000
- 6% Lower LCC with VPF



Presentation Outline

- Introduction
- Depth 1: Decentralized Air System
- Depth 2: Chiller Plant Design
- **Breadth 1: Daylighting**
  - **Objective**
  - Analysis
- Conclusion
- Acknowledgements
- Questions

Daylighting

- Life Sciences Building Design Goals
- LEED Credit 8.1
  - 75% of regularly occupied spaces between 25 fc and 500 fc.
  - September 21 at 9am and 3pm

Presentation Outline

- Introduction
- Depth 1: Decentralized Air System
- Depth 2: Chiller Plant Design
- **Breadth 1: Daylighting**
  - Objective
  - **Analysis**
- Conclusion
- Acknowledgements
- Questions

Daylighting

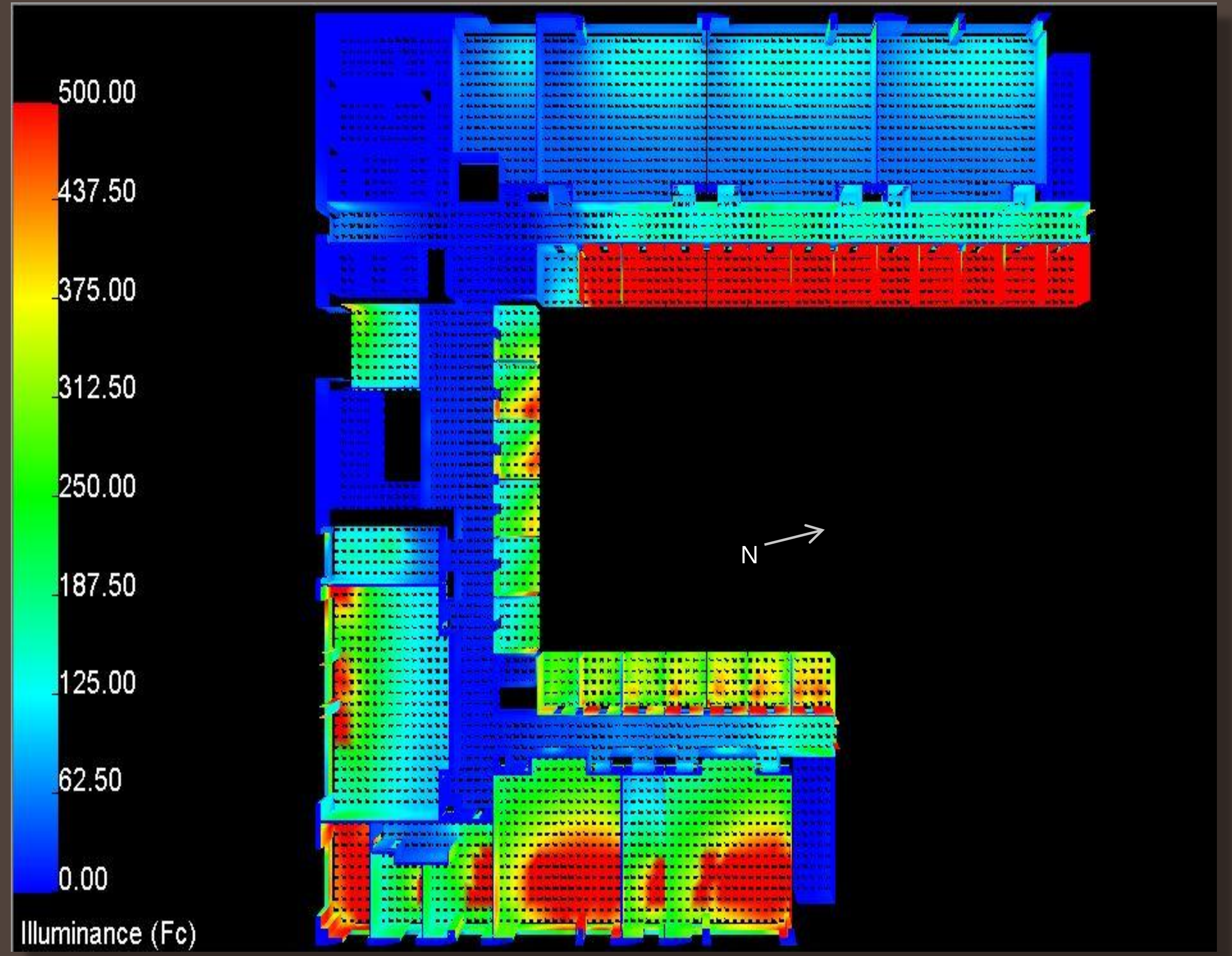
Daylighting

- September 21st
- 9 am
- 1st floor

Presentation Outline

- Introduction
- Depth 1: Decentralized Air System
- Depth 2: Chiller Plant Design
- **Breadth 1: Daylighting**
  - Objective
  - **Analysis**
- Conclusion
- Acknowledgements
- Questions

Daylighting



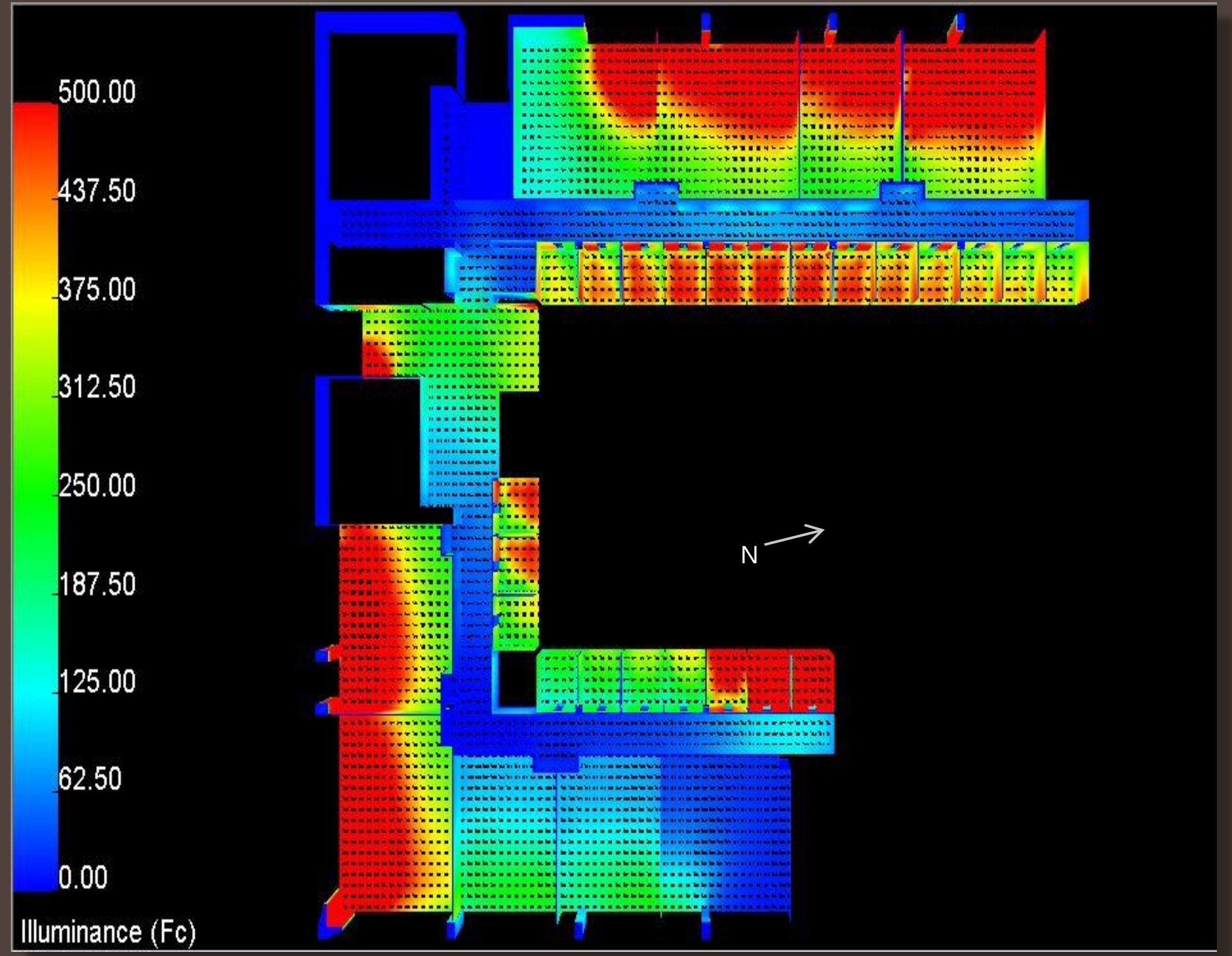
Daylighting

- September 21st
- 9 am
- 2nd floor

Presentation Outline

- Introduction
- Depth 1: Decentralized Air System
- Depth 2: Chiller Plant Design
- **Breadth 1: Daylighting**
  - Objective
  - **Analysis**
- Conclusion
- Acknowledgements
- Questions

Daylighting



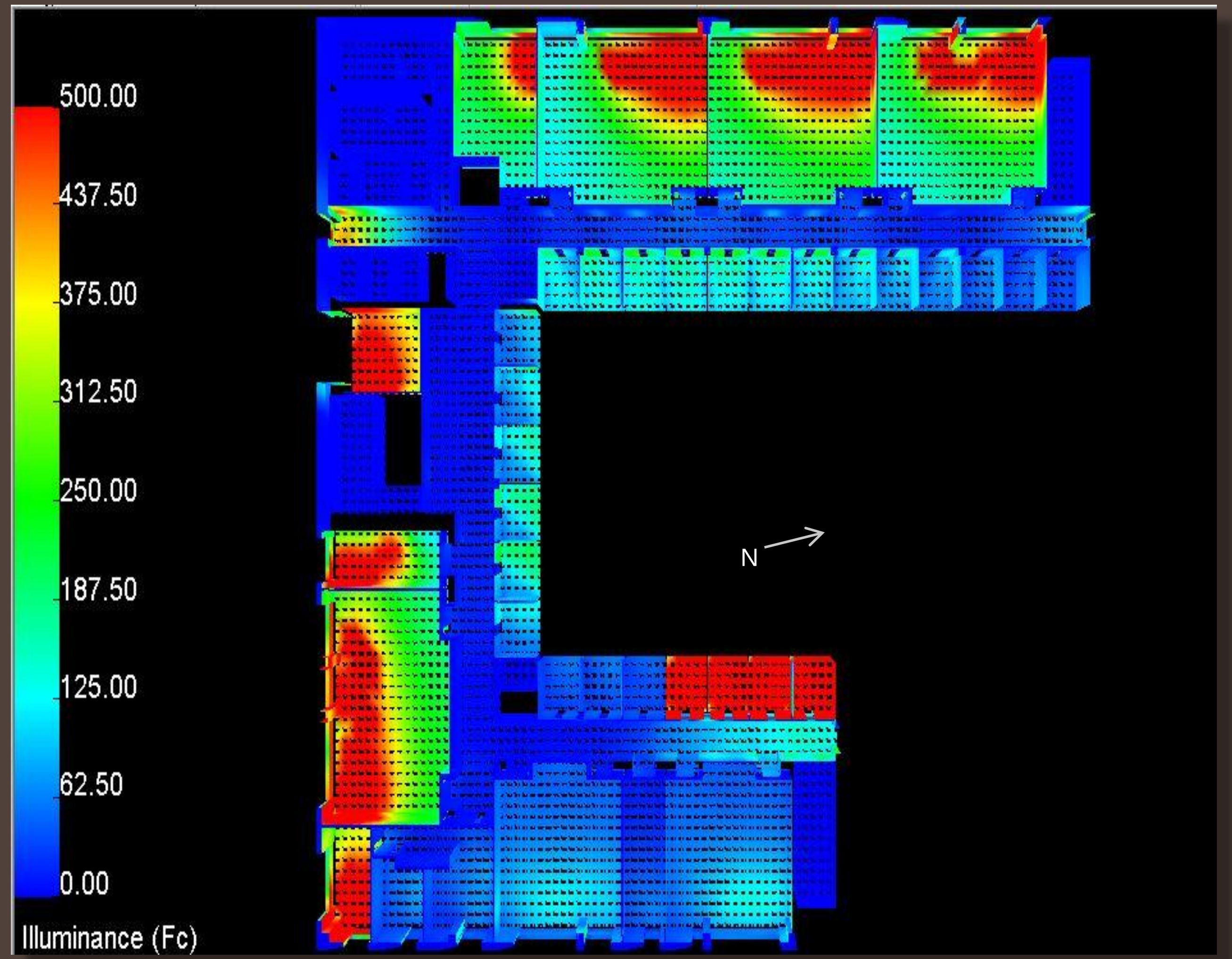
Daylighting

- September 21st
- 3 pm
- 1st floor

Presentation Outline

- •Introduction
- •Depth 1: Decentralized Air System
- •Depth 2: Chiller Plant Design
- **•Breadth 1: Daylighting**
  - •Objective
  - **•Analysis**
- •Conclusion
- •Acknowledgements
- •Questions

Daylighting



Daylighting

- September 21st
- 3 pm
- 2nd floor

Presentation Outline

- Introduction
- Depth 1: Decentralized Air System
- Depth 2: Chiller Plant Design
- **Breadth 1: Daylighting**
  - Objective
  - **Analysis**
- Conclusion
- Acknowledgements
- Questions

Daylighting

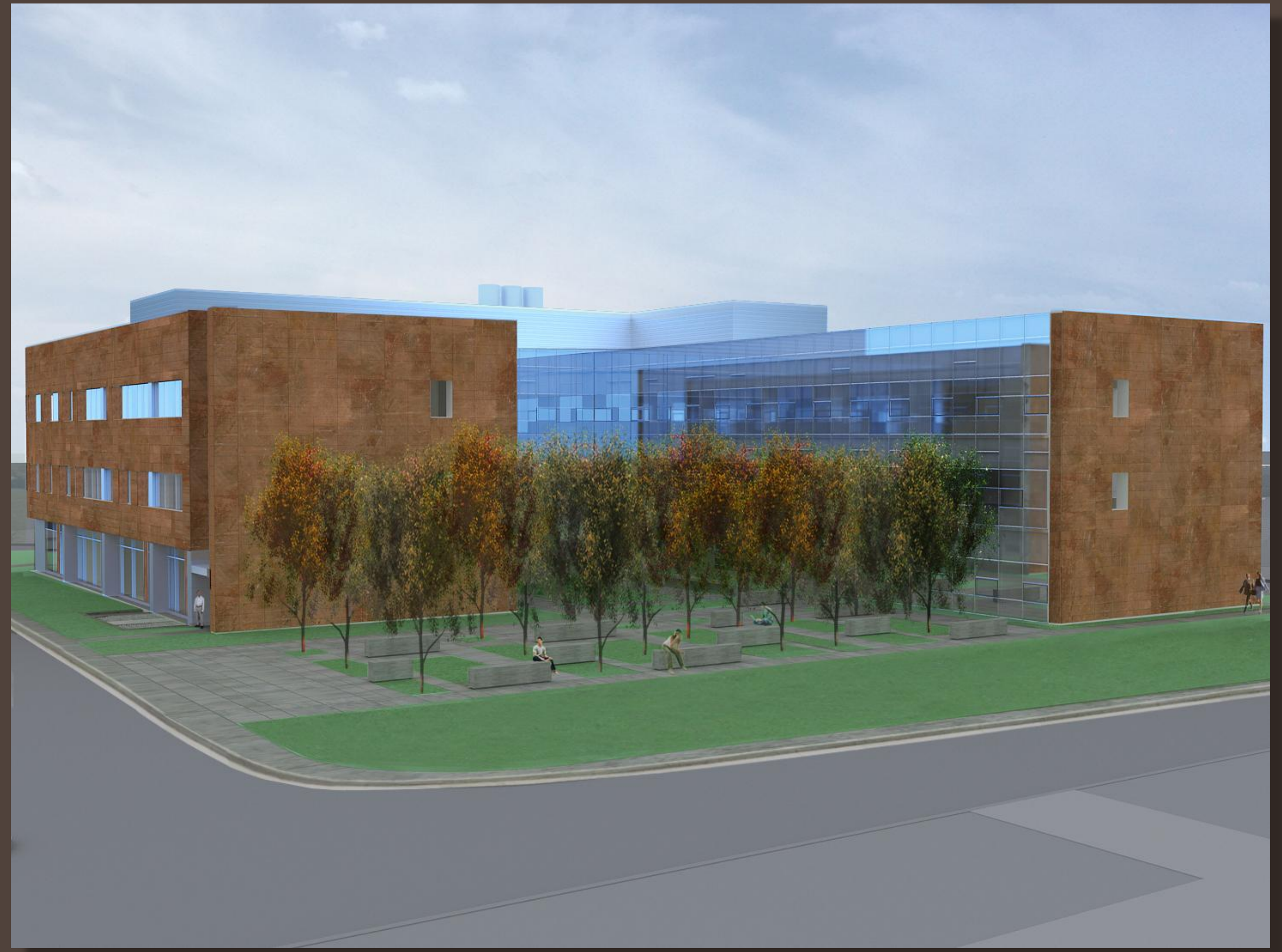
- Conclusion
  - 1st floor, 9am – non-compliant
  - 73% at 9am
  - 82% at 3pm

Presentation Outline

- Introduction
- Depth 1: Decentralized Air System
- Depth 2: Chiller Plant Design
- Breadth 1: Daylighting
- **Conclusion**
- Acknowledgments
- Questions

Conclusion

- Decentralized Air System
  - $254,000 decrease in first cost
  - 20% higher annual energy cost
  - 9.7% smaller LCC
- P/S vs. VPF
  - $26,000 decrease in first cost with VPF
  - 5% decrease in annual energy cost with VPF
  - 6% smaller LCC with VPF

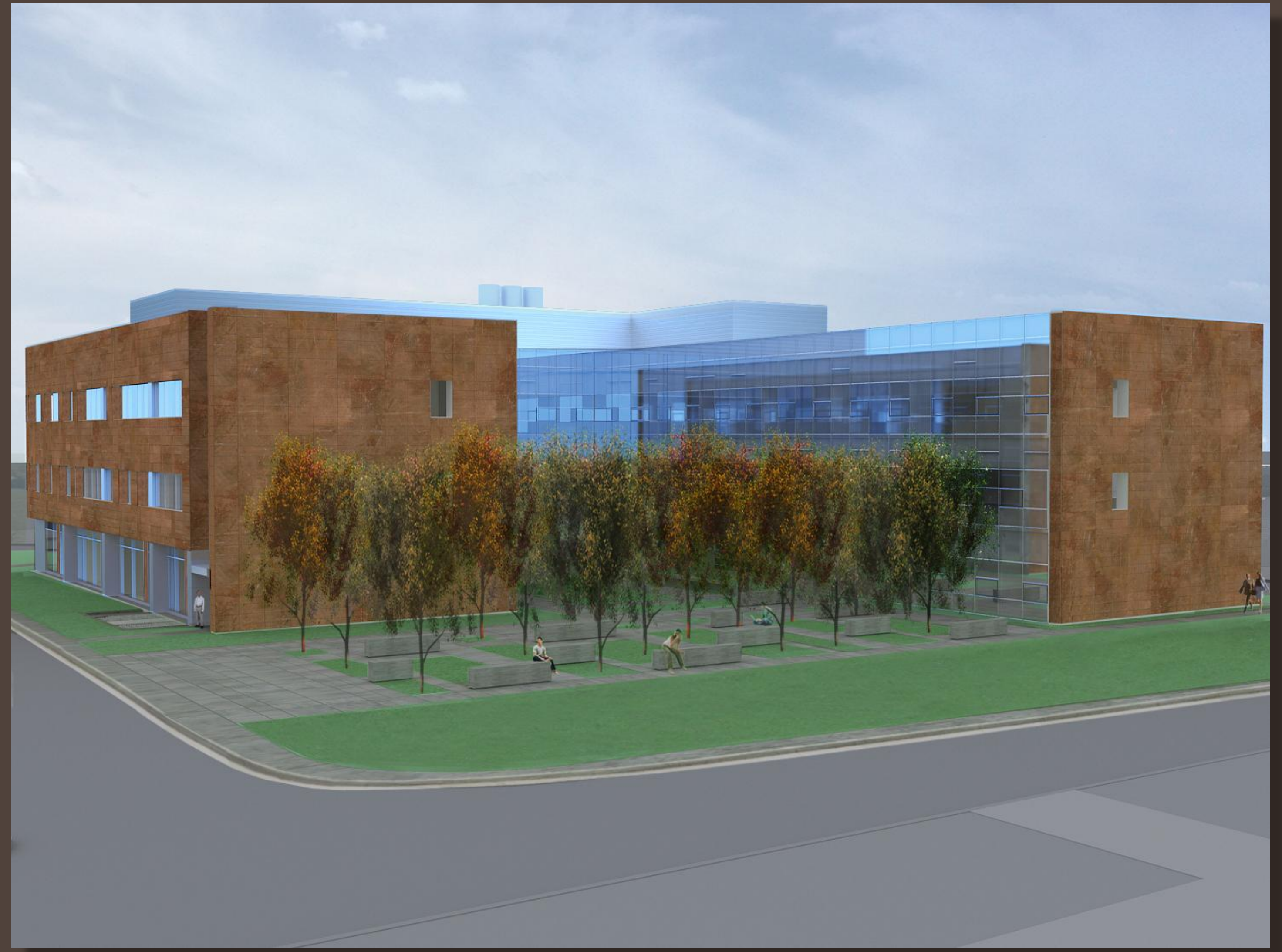


Presentation Outline

- Introduction
- Depth 1: Decentralized Air System
- Depth 2: Chiller Plant Design
- Breadth 1: Daylighting
- Conclusion
- **Acknowledgements**
- Questions

Acknowledgements

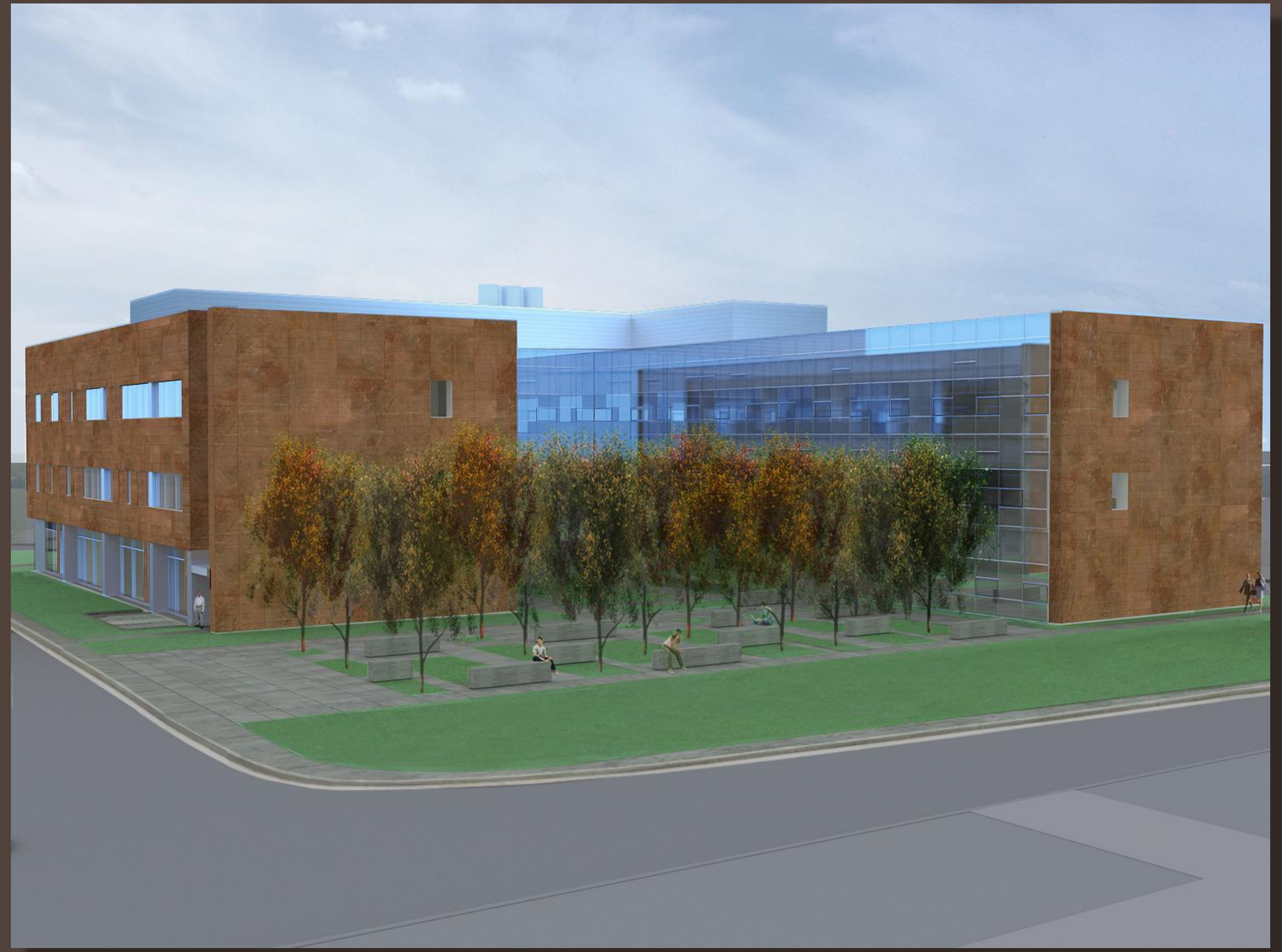
Dr. James Freihaut	Faculty Advisor, Penn State
Dustin Eplee	Faculty Advisor, Energy Wall
Jan Gasparec	Mechanical Engineer, Cannon Design
Eric Lindstrom	Mechanical Engineer, Cannon Design
Mike Kirkpatrick	Electrical Engineer, Cannon Design
Dr. William Bahnfleth	Mechanical Instructor, Penn State
Dr. Jelena Srebric	Mechanical Instructor, Penn State
Moses Ling	Mechanical Instructor, Penn State
Michael Reilly Sr.	Owner, Reilly Plumbing & Heating
AE Friends	



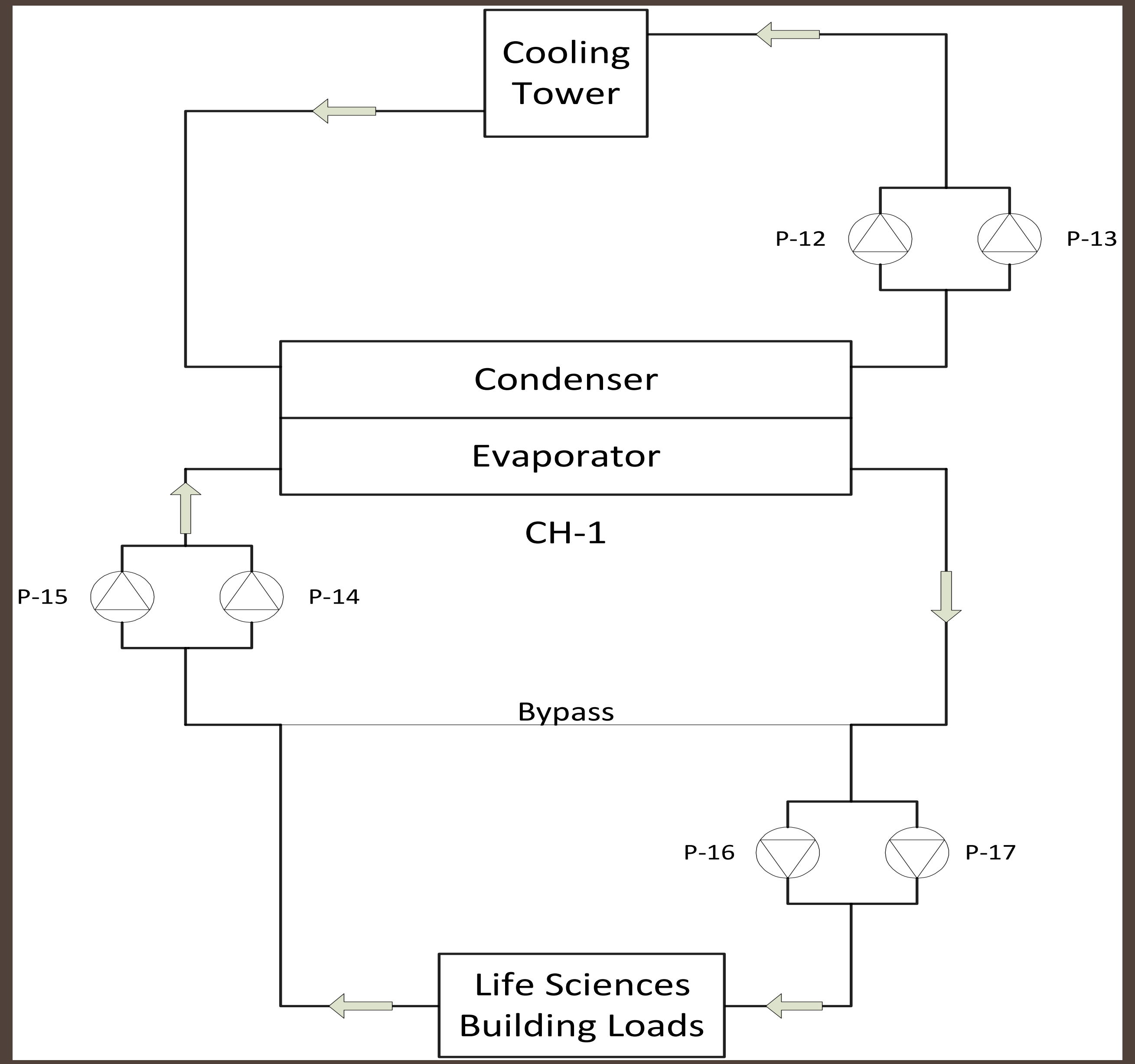
Presentation Outline

- Introduction
- Depth 1: Decentralized Air System
- Depth 2: Chiller Plant Design
- Breadth 1: Daylighting
- Conclusion
- Acknowledgements
- **Questions**

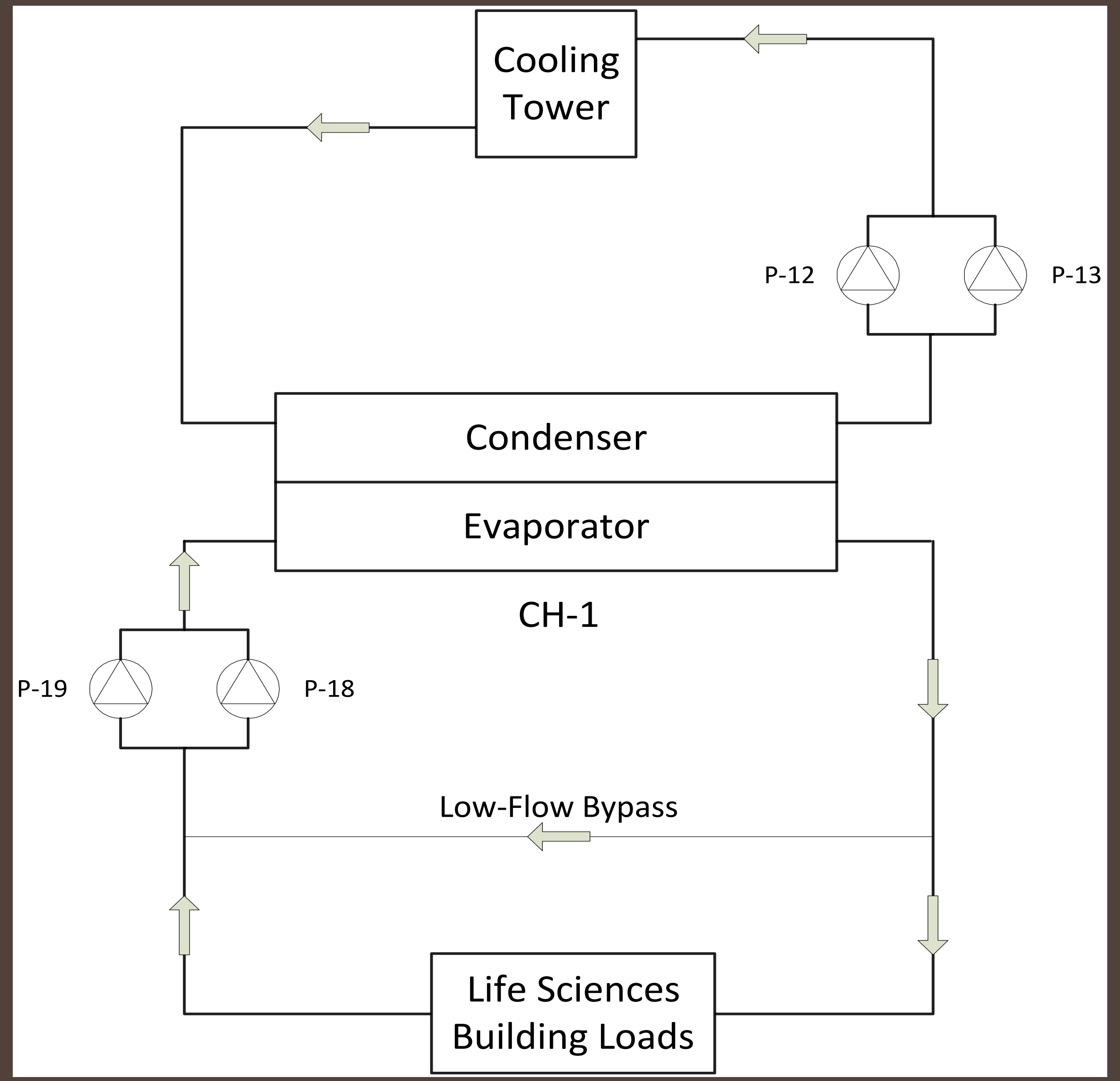
Questions ?



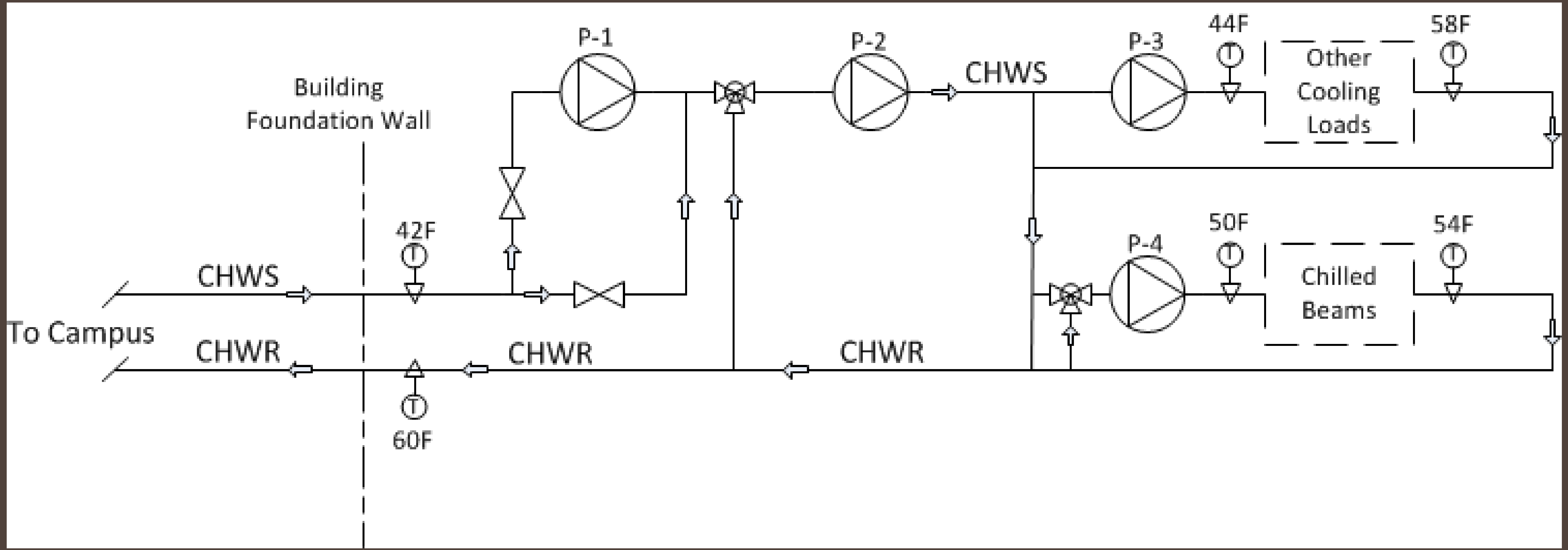
Primary/Secondary



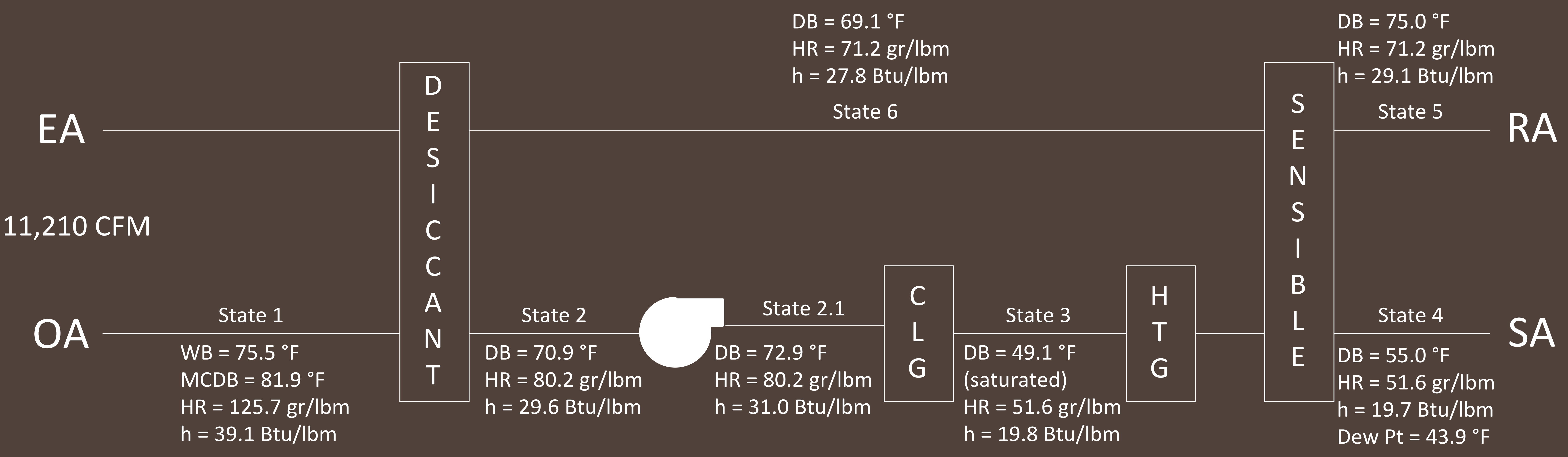
Variable Primary Flow



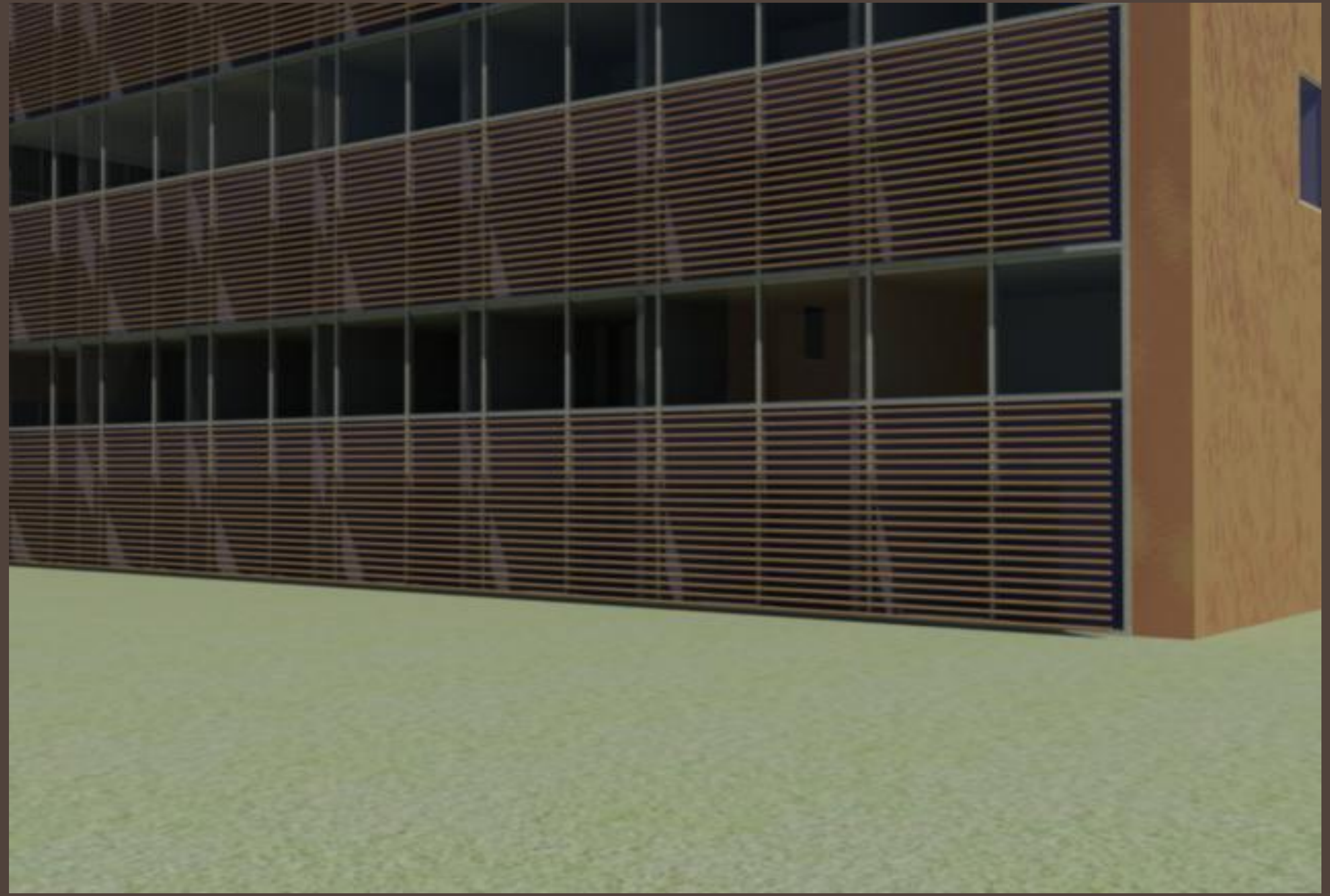
Chilled Beam Chilled Water Pumping Schematic

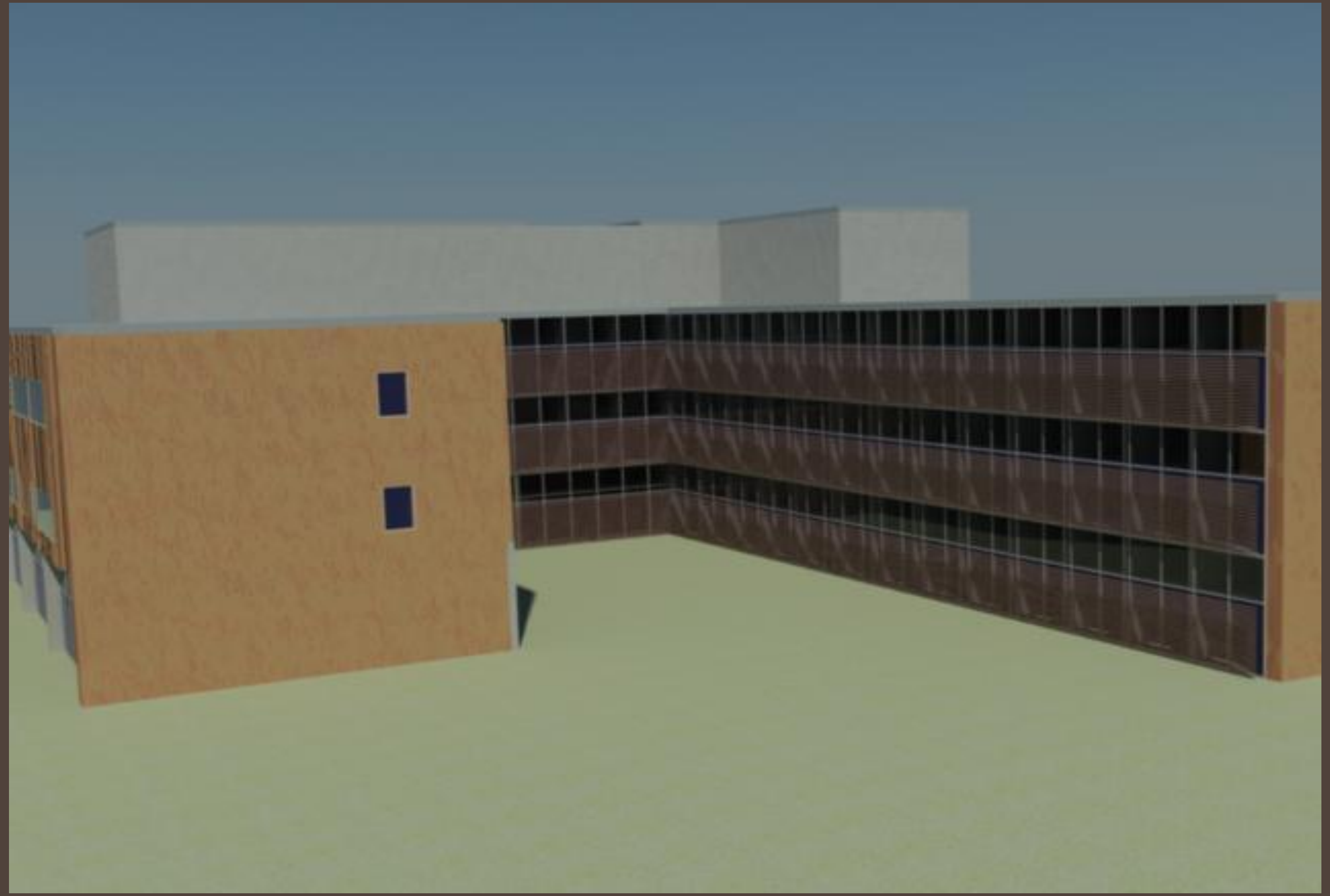


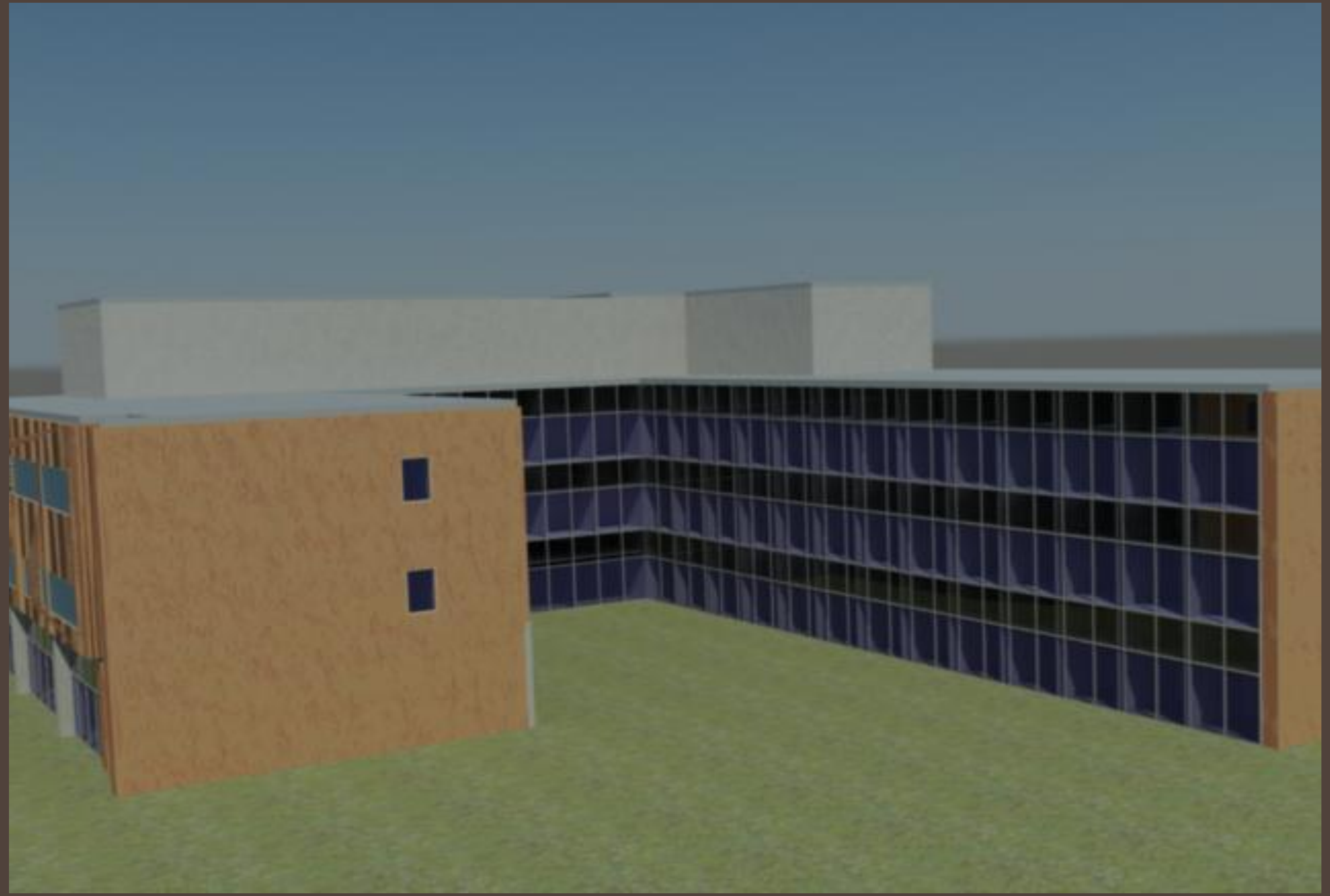
Dedicated Outdoor Air Unit Schematic



Architectural Breadth/ Daylight Shading

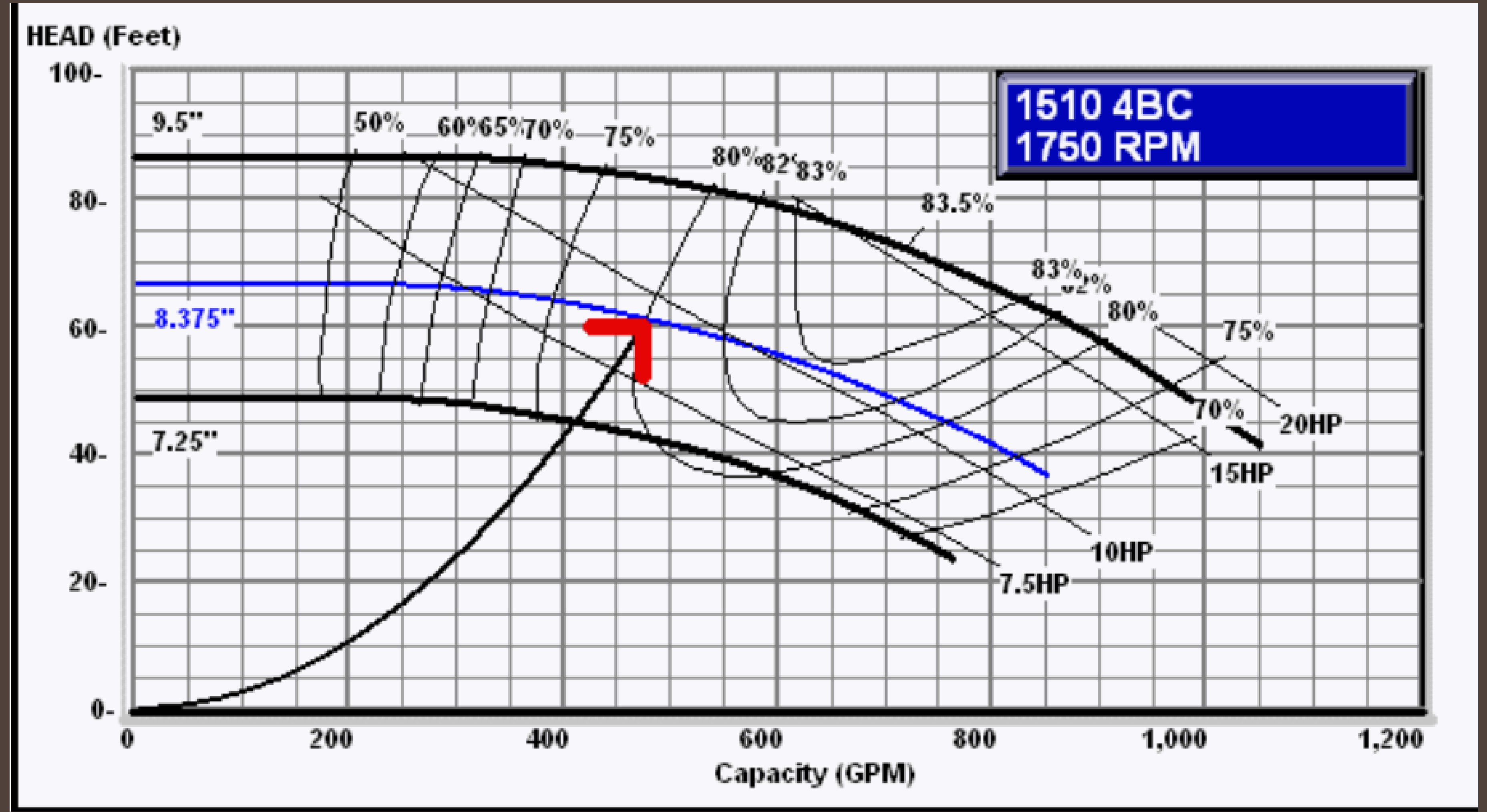






Chiller Plant Location

DOAS Pump Curve



DOAS Unit Fan Curve