

EDUCATION BUILDING MECHANICAL CONTROLS REDESIGN

Group 3

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Overview

- Project Description
- Common Language
- Energy Saving Alternatives
- Alternative Evaluation
- Final Design
- Cost Estimate
- Conclusions
- Recommendations



(Rootsweb.ancestry, 2013)

Project Description

- Client: U of S Office of Sustainability
- Objectives:
 - ▣ Analyze energy usage
 - ▣ Assess improvements
 - ▣ 15% energy reduction
- Constraints:
 - ▣ Use existing equipment
 - ▣ Delta Controls
 - ▣ Codes/Standards



(CopperTree Analytics, 2015)

Common Language

- HVAC: Heating, Ventilation, and Air Conditioning
- Mechanical Control System
- Dual Duct System
 - ▣ Hot Deck
 - ▣ Cold Deck
 - ▣ Outdoor Air
 - ▣ Return Air
 - ▣ Mixed Air
 - ▣ Exhaust Air

Current System

- Four Separate HVAC Zones:
 - Audio/Visual Room
 - Quance Theatre
 - Gym, Locker Rooms, Pool
 - Penthouse/Main System

Energy Saving Alternatives

- Filter/Pressure Sensors
- Enthalpy Sensors
- CO₂ Sensors
- Nighttime Purge
- Optimum Start
- Set Point Adjustment
- Hydronics

Filter/Pressure Sensors

- Pressure sensors across filters connected to alarms
- Lower the set point on the alarms in order to change the filters more regularly
- Leads to reduced fan load
- Reduced energy consumption

Enthalpy Sensors

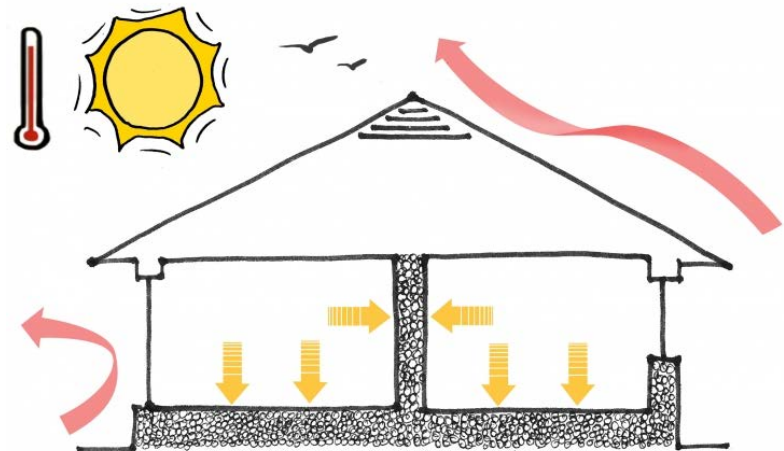
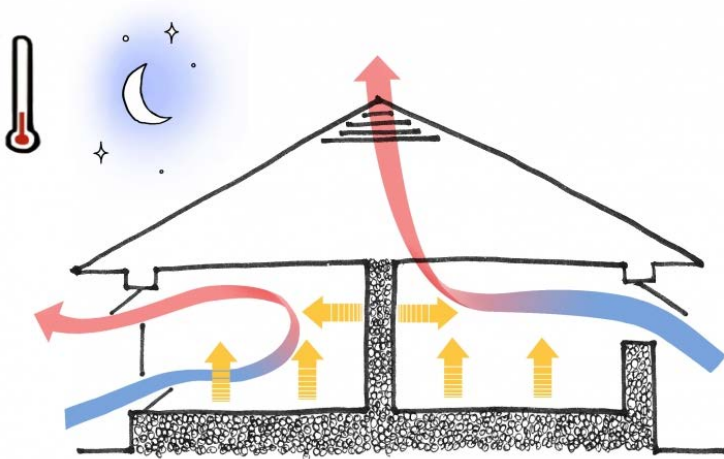
- Add sensors in strategic locations
- Accounts for humidity
- Heat/cool the air more effectively
- High efficiency system

CO₂ Sensors

- Add sensors in areas with large occupancy
- Accounts for number of people
- Adjusts temperature based on CO₂ sensors
- Less wasted energy

Nighttime Purge

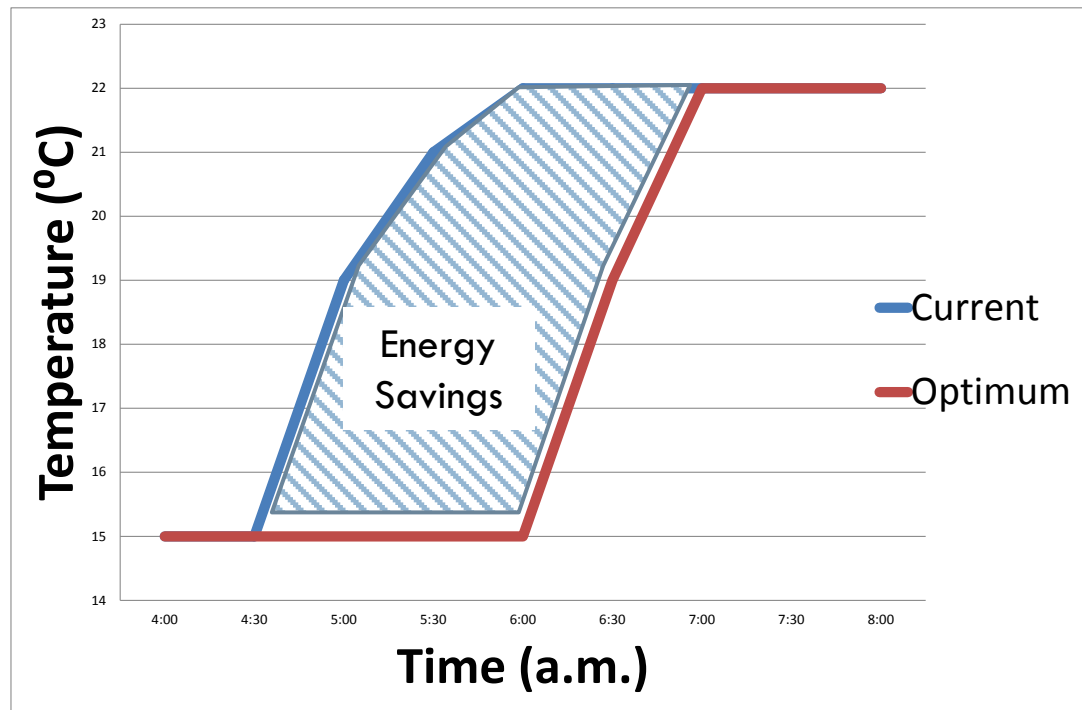
- Open outside air dampers
- Delay operation of A/C
- Relevant during summer months



(Sustainability Workshop, 2011)

Optimum Start

- Delay HVAC start-up
- Based on outdoor air conditions
- Easy implementation



Set Point Adjustment

- Temperature:
 - ▣ Hot Deck
 - ▣ Cold Deck
 - ▣ Mixed Air

- Airflow:
 - ▣ Hot Deck
 - ▣ Cold Deck
 - ▣ Mixed Air



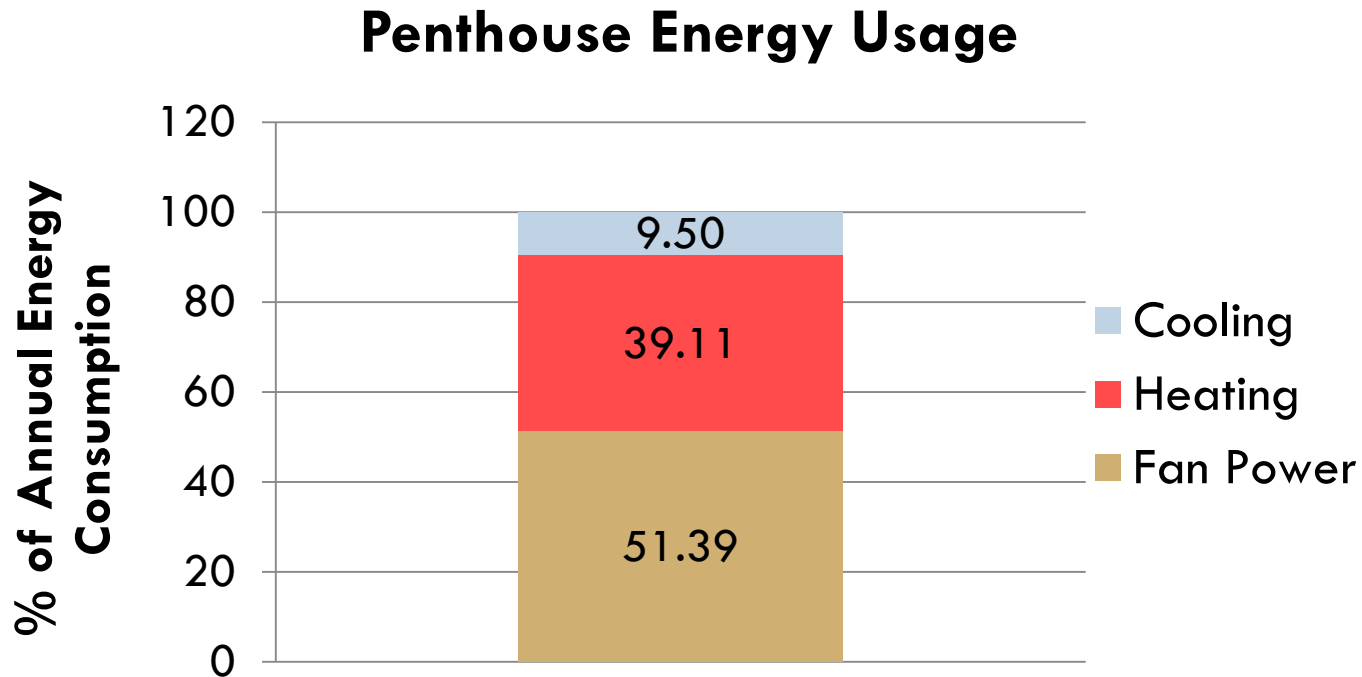
(Achr News, 2012)

Alternative Evaluation

<u>Alternatives</u>	Implementing Cost (10)	Maintenance (10)	Potential Savings (x3)	Difficulty of Analysis (.5)	Availability of Data (Pass/Fail)	Total
Filter/Pressure Sensors	8	3	3	7	Pass	27
Enthalpy	4	3	3	5	Pass	21
CO ₂ Sensors	3	8	6	5	Pass	34
Nighttime Purge	9	6	8	7	Pass	46
Optimum Start	9	9	7	7	Pass	46
Set Point Adjustment	10	10	8	7	Pass	51
Hydronics System	N/A	N/A	N/A	N/A	FAIL	N/A

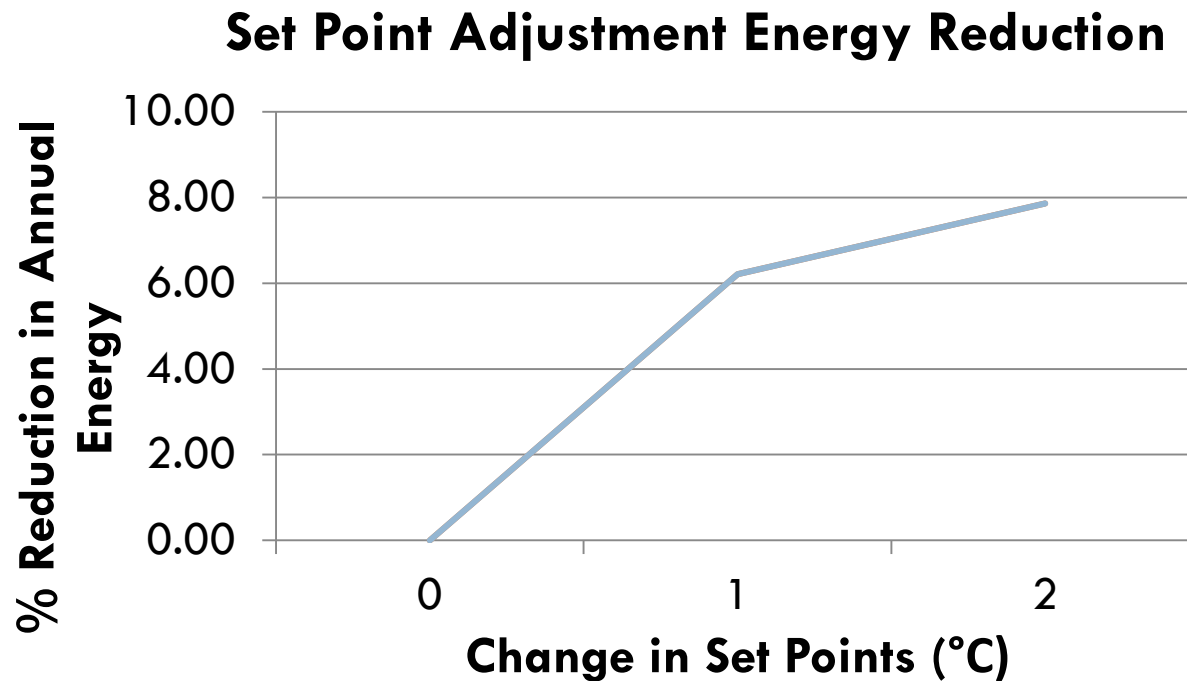
Final Design - Penthouse

- Model of current HVAC system
- 7,143 GJ annual HVAC energy consumption



Final Design - Penthouse

- Set Point Adjustment
 - ▣ 2°C change yields 561.44 GJ reduction (7.86%)



Final Design - Penthouse

- Nighttime Purge
 - July and August
 - Run fans 2 hours
 - Delay HVAC until 11:00 am
 - 22.96 GJ annual energy reduction (0.32%)

Final Design - Penthouse

- Optimum Start
 - ▣ Maximum conditioning time of 2 hours
 - ▣ Start time based on outdoor air temperature
 - ▣ 443.32 GJ annual energy reduction (6.21%)

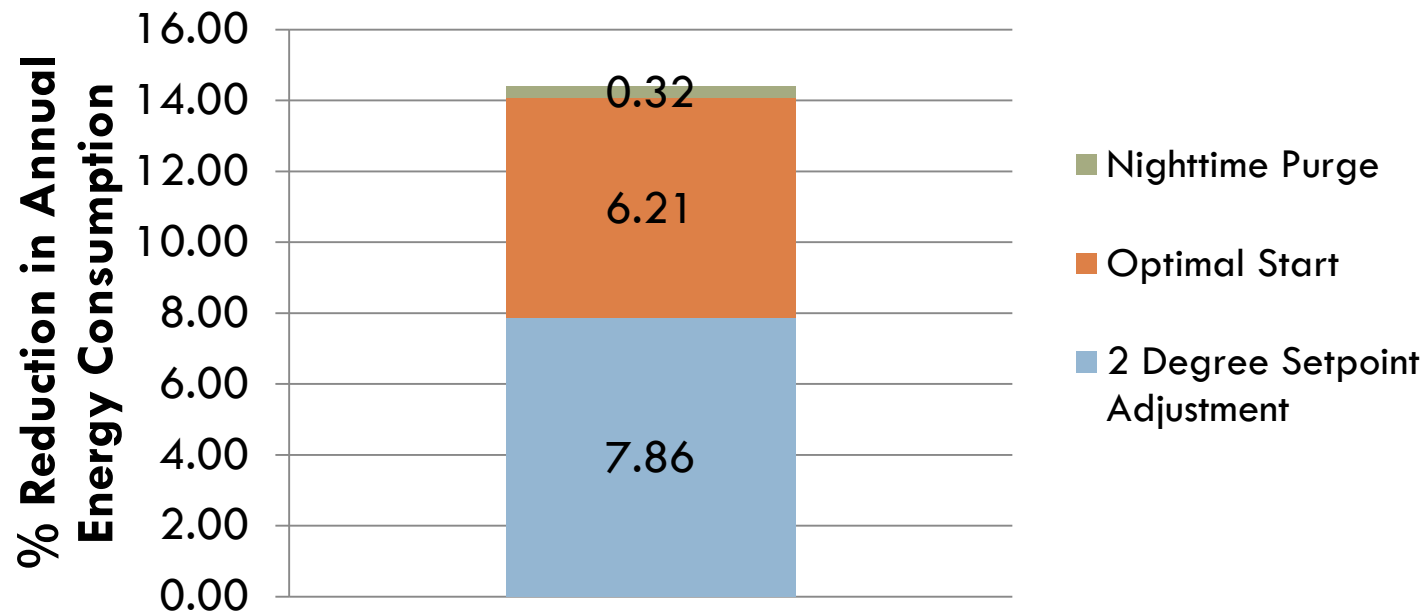
Cost Estimate

<u>Project Cost</u>			
<u>Cost Implementing Alternatives</u>			
Alternative	Hours	Rate	Cost
Set Point Adjustment	2.5	\$150.00	\$375.00
Optimum Start	1	\$150.00	\$150.00
Nighttime Purge	1	\$150.00	\$150.00
Total	4.5	\$150.00	\$675.00
<u>Cost Group Design</u>			
Group 3	344	\$116.00	\$39,904.00
<u>Total Cost</u>			\$40,579.00

Conclusion

- 14.39% total annual HVAC energy reduction

Reduction in Energy Consumption



Recommendations

- Apply alternatives to gym, locker rooms, pool
- CO₂ sensor in gym
- Improved heat recovery schedule
- Optimum start in Quance Theatre
- Increased set point adjustment

Acknowledgements

- Darell Hart, Safety Consultant
- Margret Asmuss, Sustainability Coordinator
- Kathryn Theede, P. Eng., Energy & Emissions Officer
- Ken Coutu, P. Eng, Faculty Advisor



Questions?

References

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- www.coppertreeanalytics.com
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