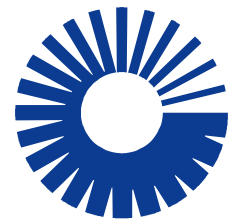


# Integrated Solutions for High Performance Building Systems



**United  
Technologies**

Presented by:

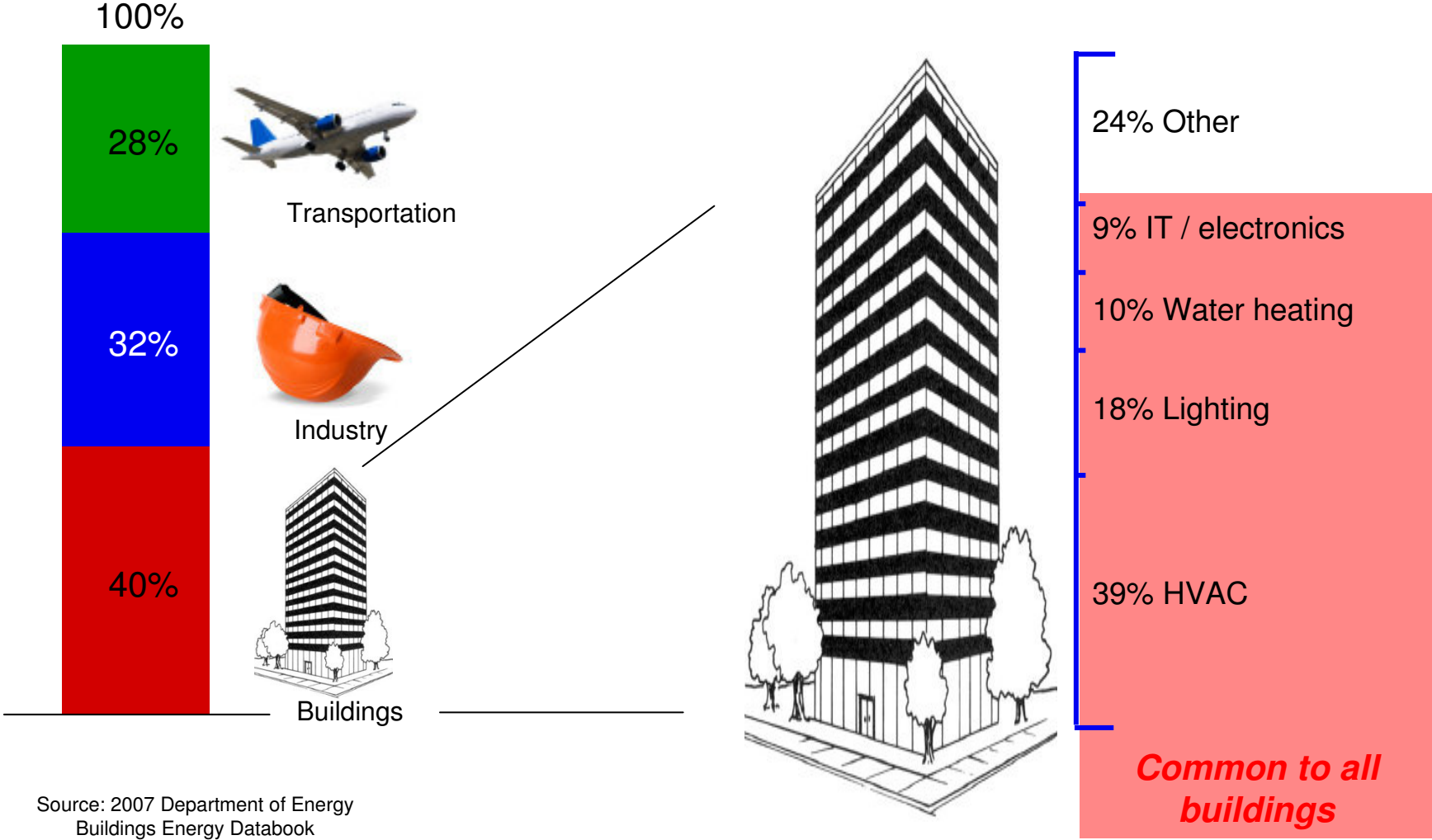
**Vineet Kashyap**

United Technologies Corporation

7 January 2011

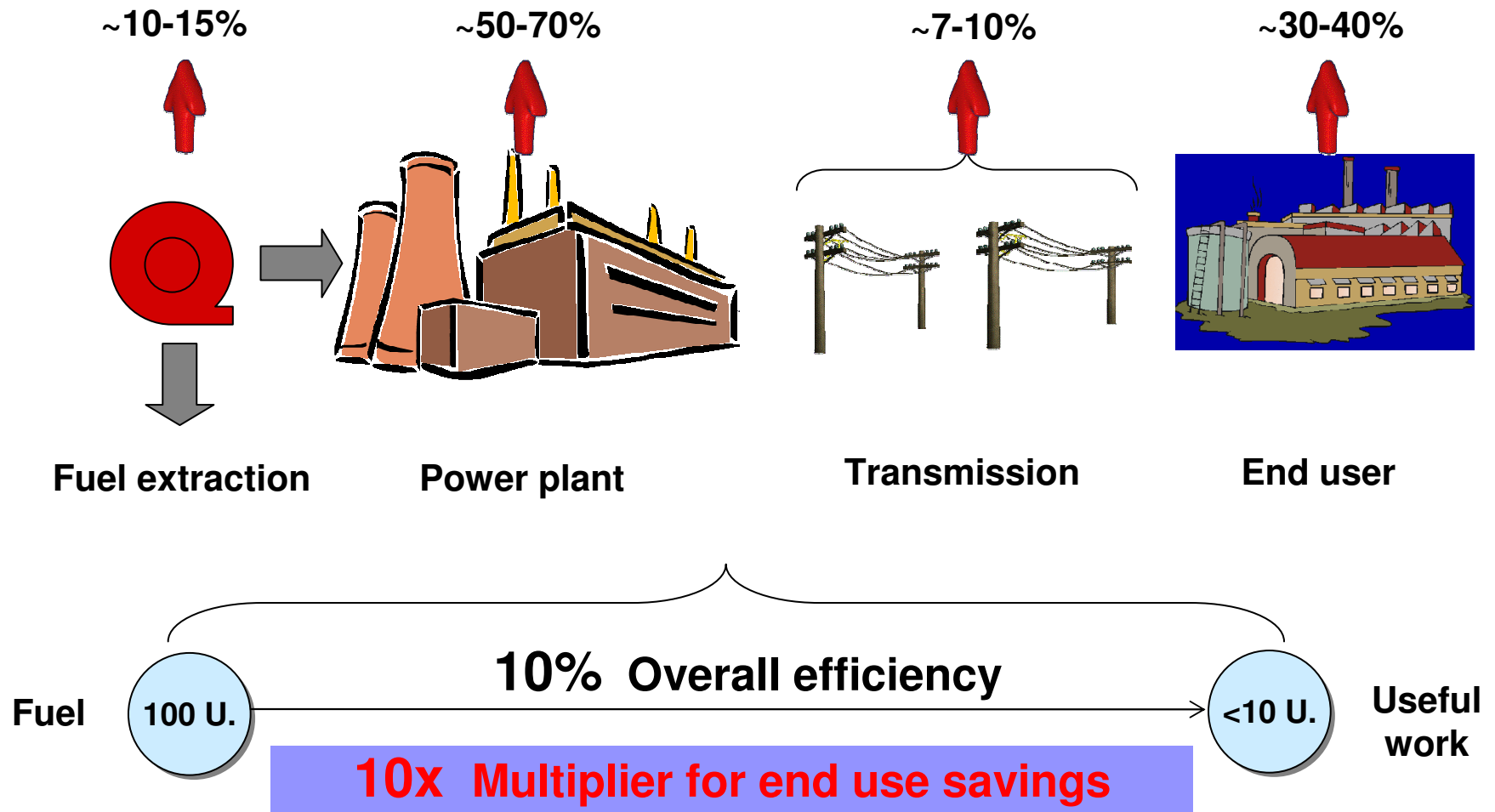
National Conference on Green Building Design

# Energy Consumption



Source: 2007 Department of Energy Buildings Energy Databook

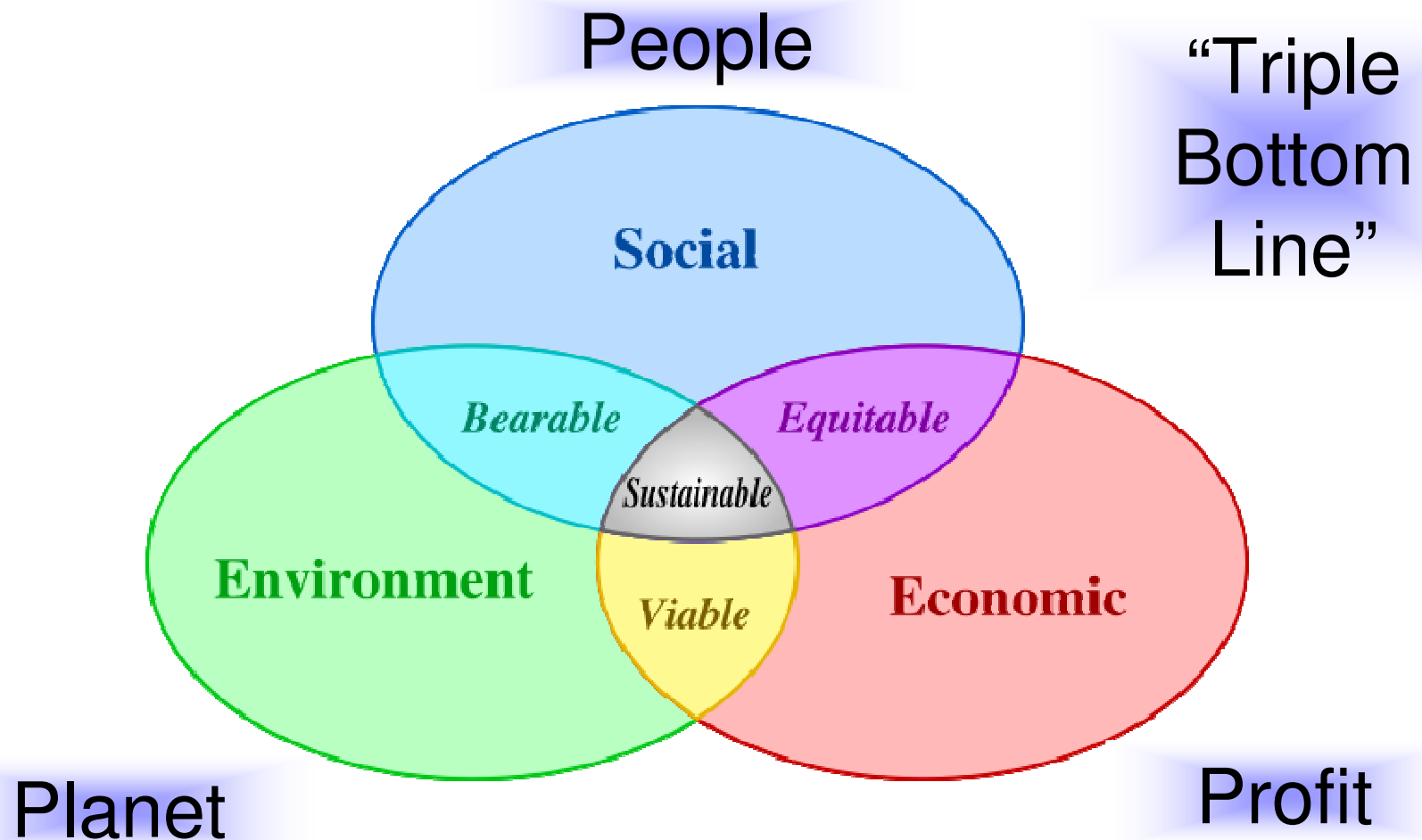
# System Energy Losses



# Sustainable Design as Balance

---

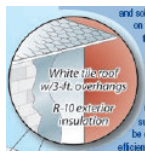
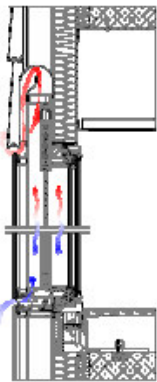
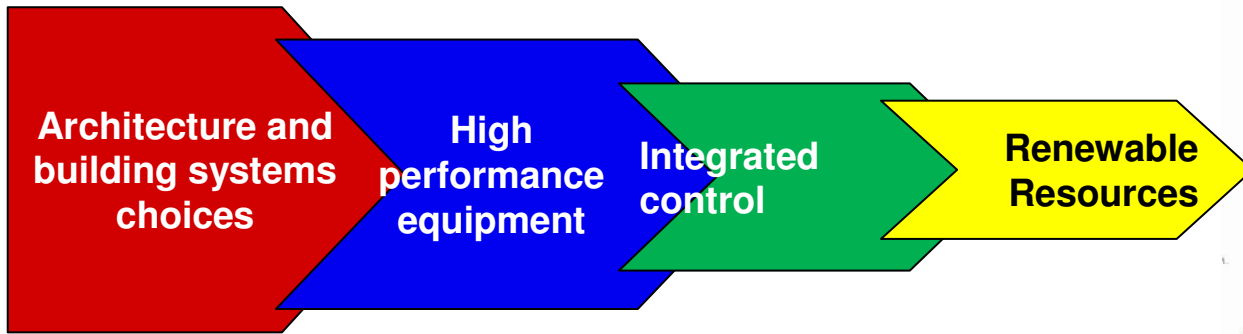
Balance between competing forces



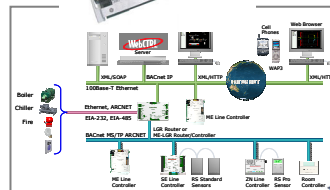
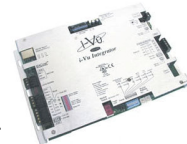
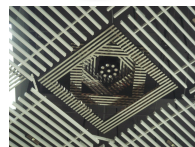
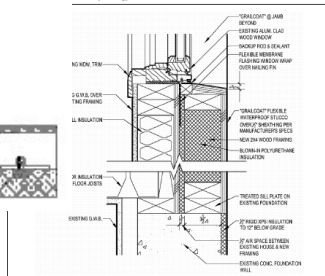
Source: Multiple Sources including Andy Savitz (*The Triple Bottom Line*) and John Elkington (*Cannibals with Forks: the Triple Bottom Line of 21st Century Business*)

# Integrated Building Solutions

## Holistic Approach to Building Systems



iii: Deep Energy Retrofit



# Certified Case Example

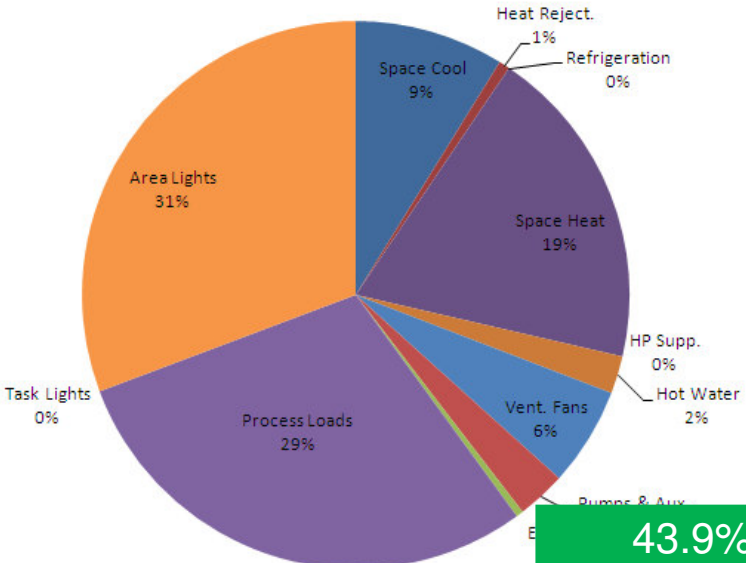
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## **Pratt & Whitney – China Eastern Airlines Shanghai Engine Center**

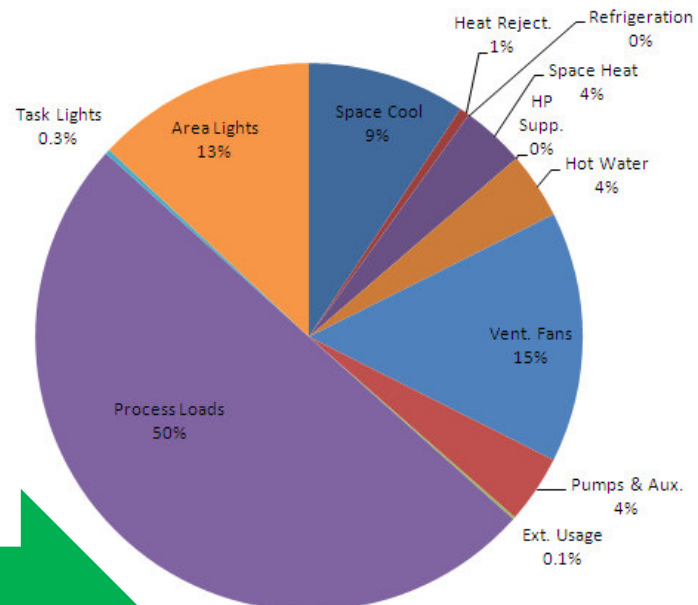


# Energy Use Reductions Achieved in Design

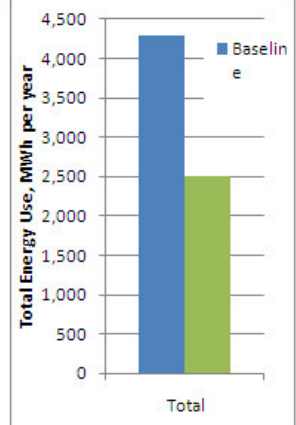
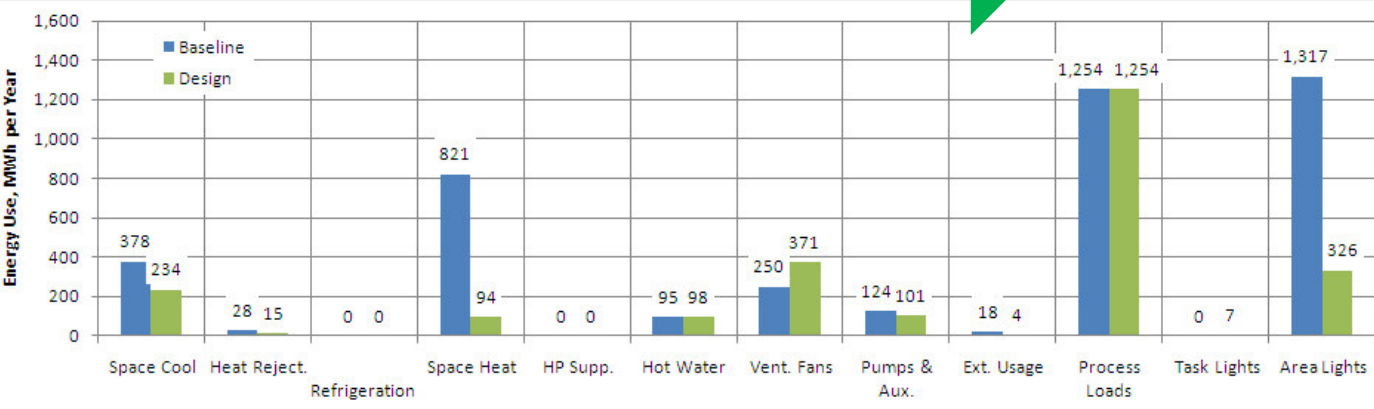
Baseline Total Energy 4,285 MWh per Year



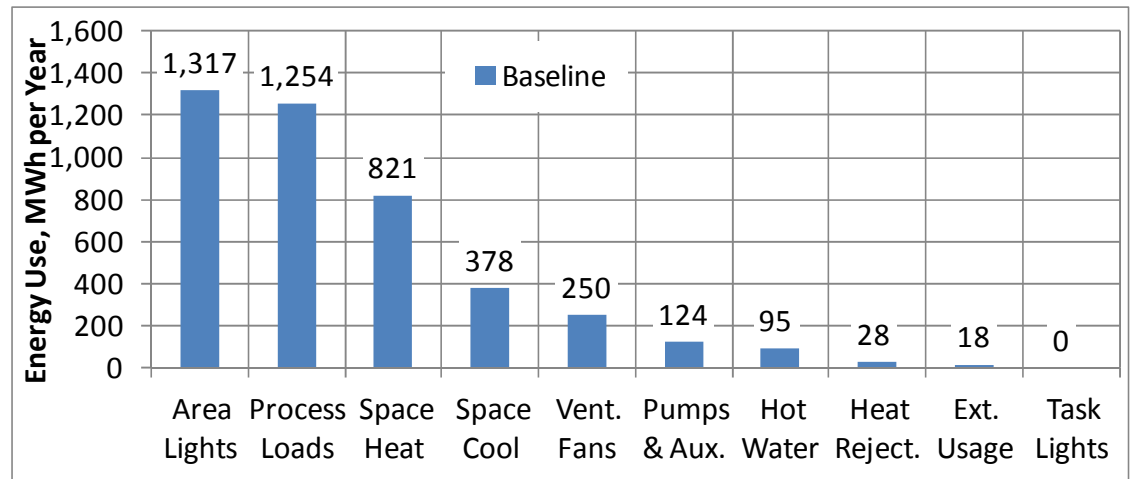
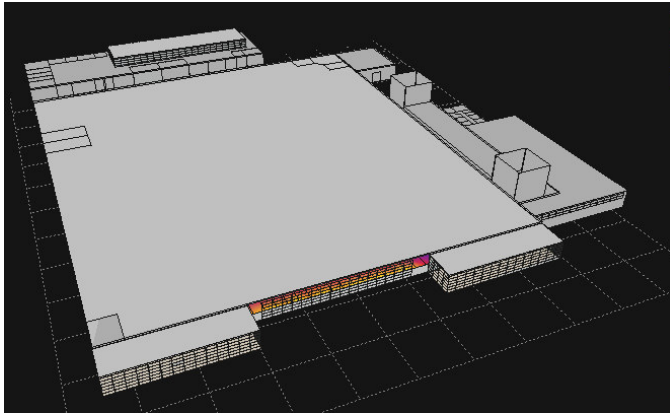
Design Energy, 2,503 MWh per year



43.9% Energy Reduction

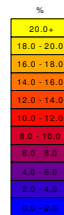
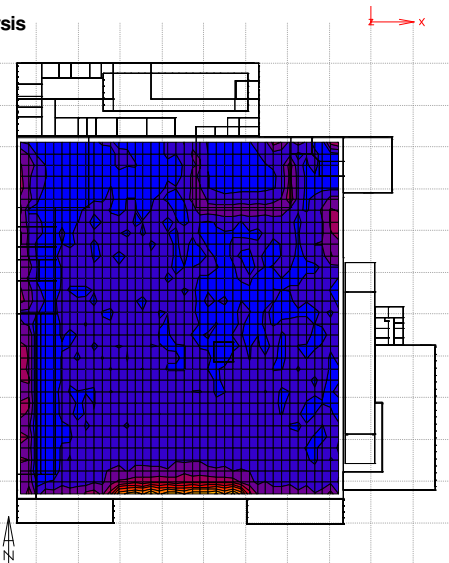


# Baseline Architecture and Systems



## Daylight Analysis

Daylight Factor  
Contour Range: 0.0 - 20.0 %  
In Steps of: 2.0 %  
VECOEACT v3

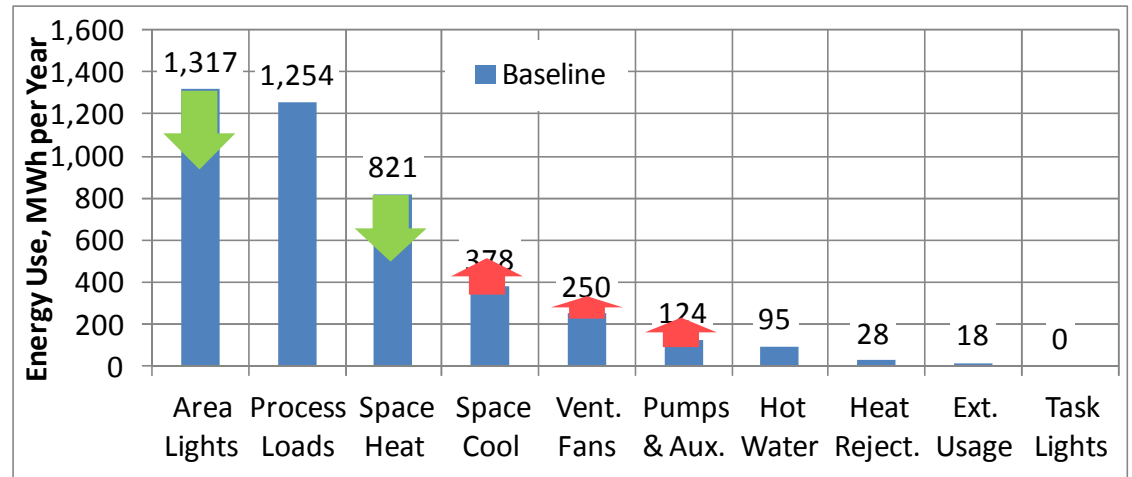
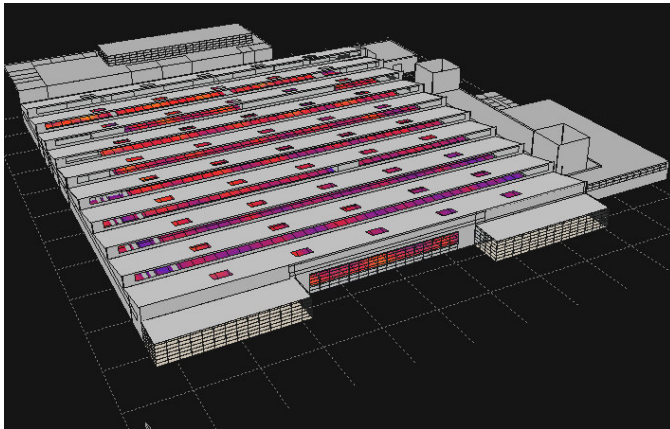


Average Value: 2.73 %  
Visible Nodes: 1280



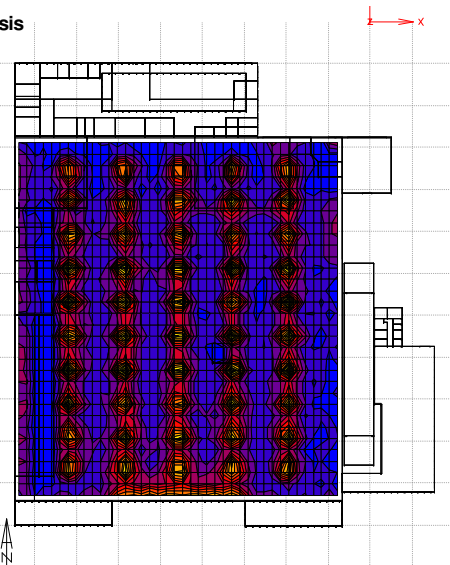


# Daylighting Case 1



## Daylight Analysis

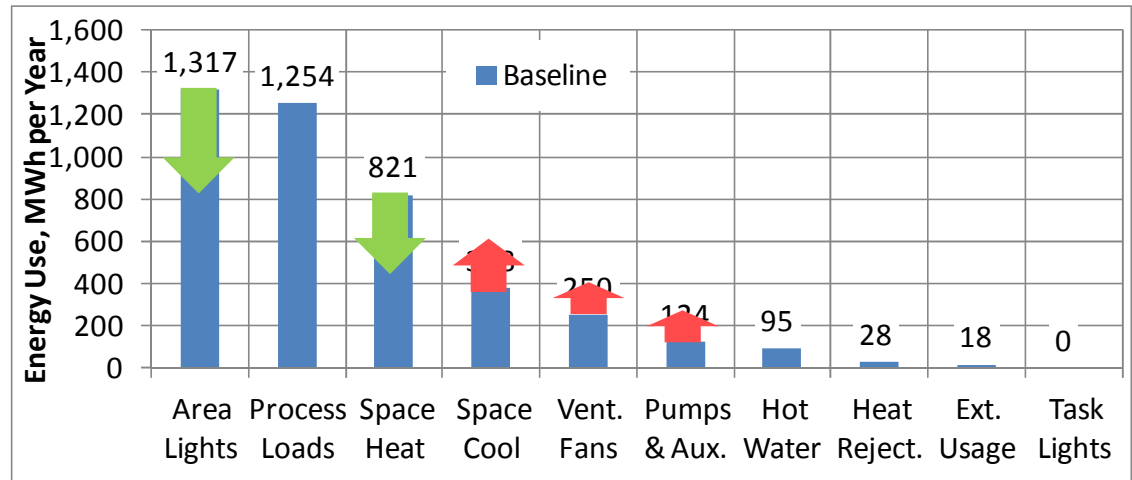
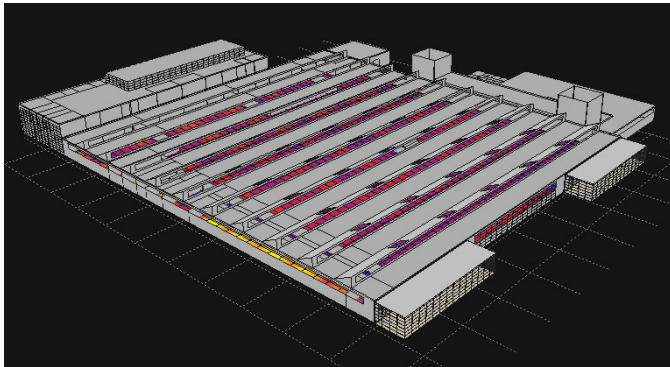
Daylight Factor  
 Contour Range: 2.4 - 22.4 %  
 In Steps of: 2.0 %  
 ECOTECT v8



Average Value: 8.14 %  
 Visible Nodes: 1280

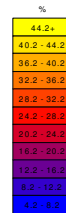
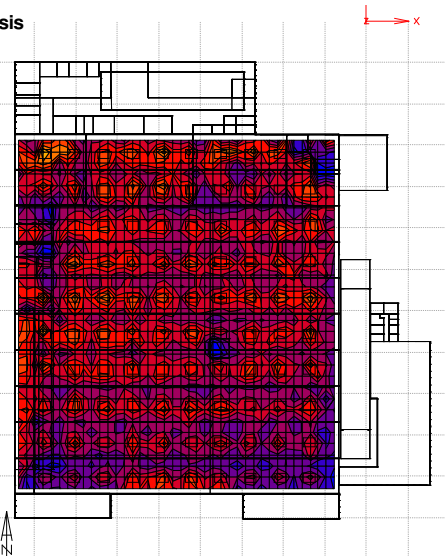


# Daylighting Case 2



## Daylight Analysis

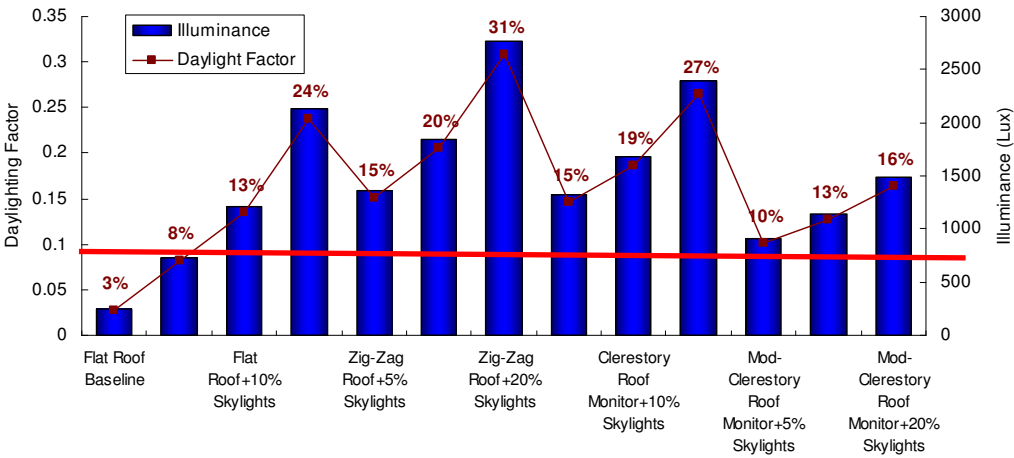
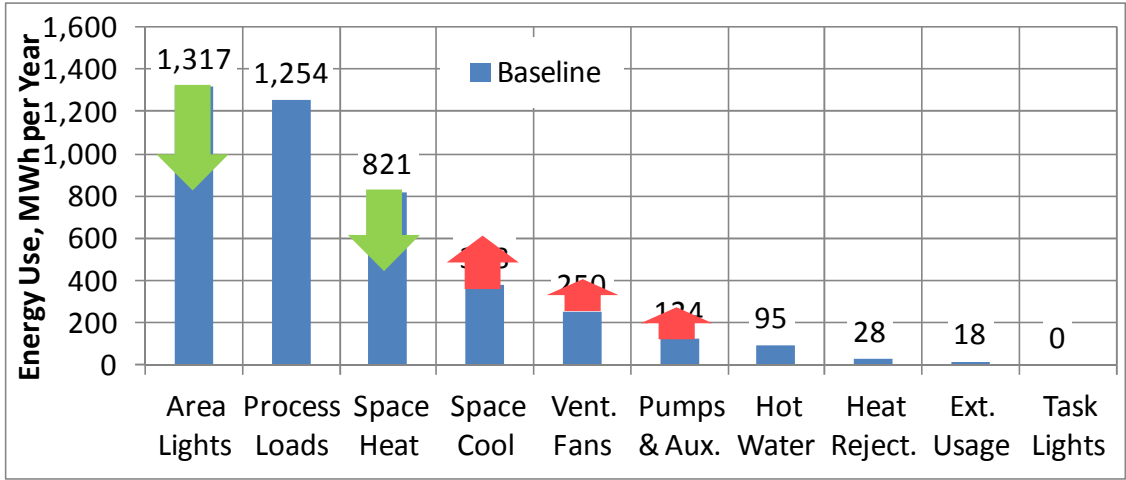
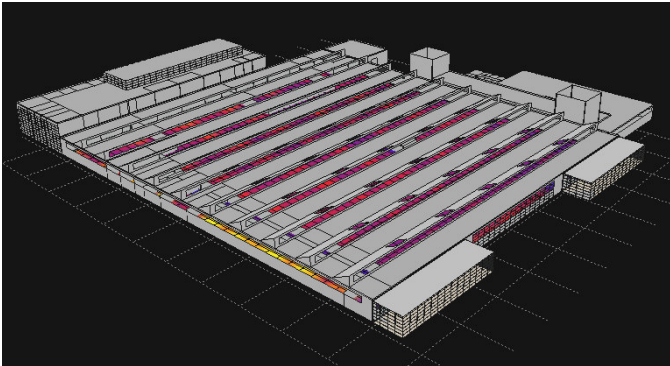
Daylight Factor  
 Contour Range: 4.2 - 44.2 %  
 In Steps of: 4.0 %  
 ECOTECT v8



Average Value: 20.48 %  
 Visible Nodes: 1260

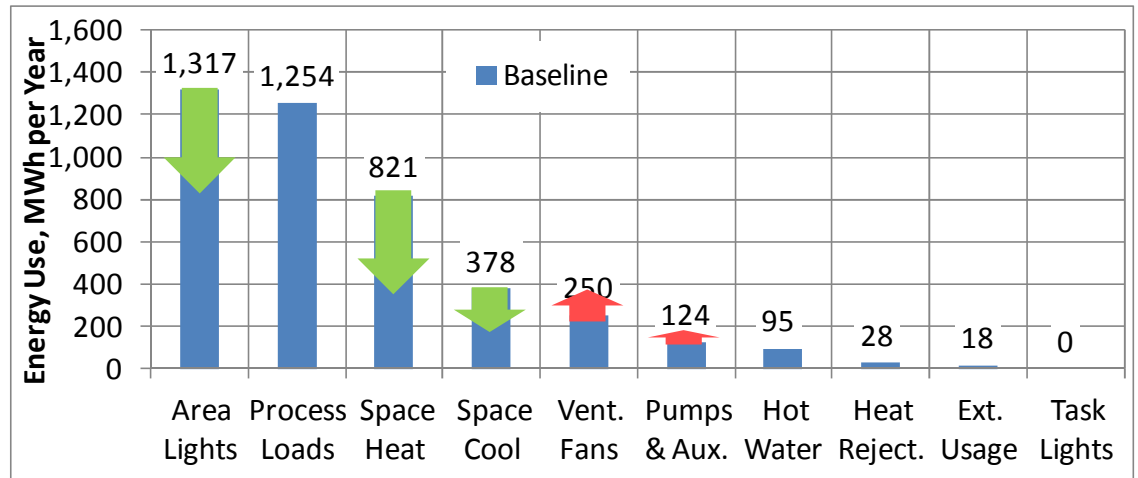
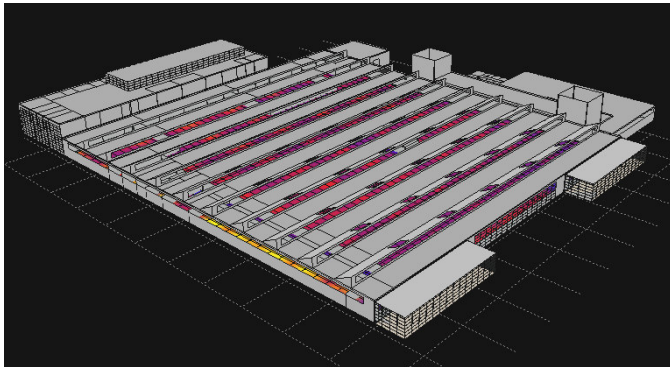


# Daylighting Case 2 Selected

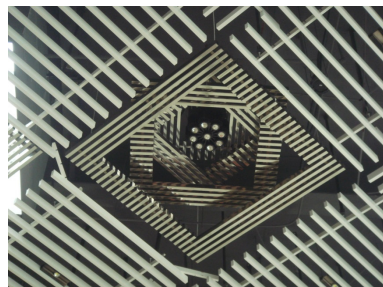


Meets illuminance requirement  
Balance lighting savings and thermal loads impact

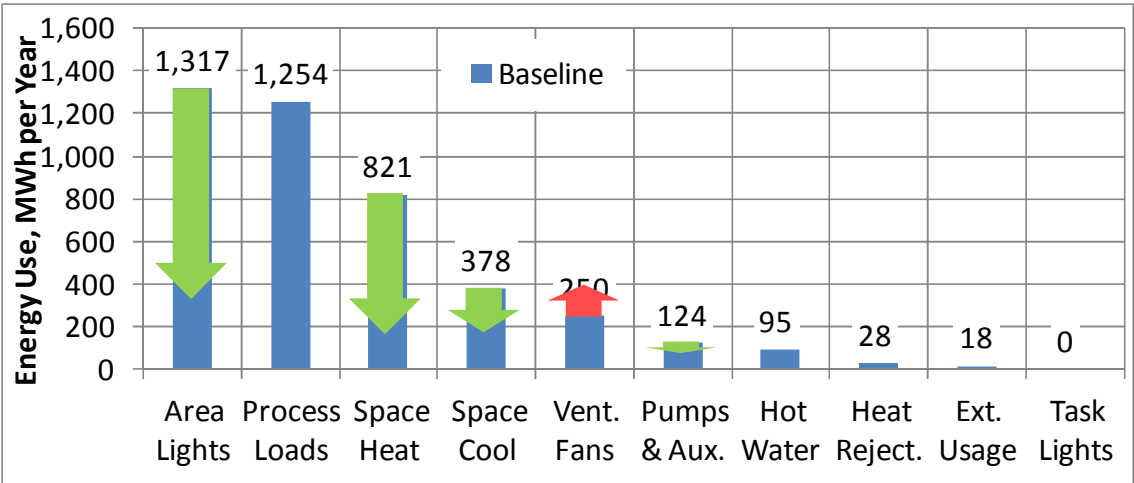
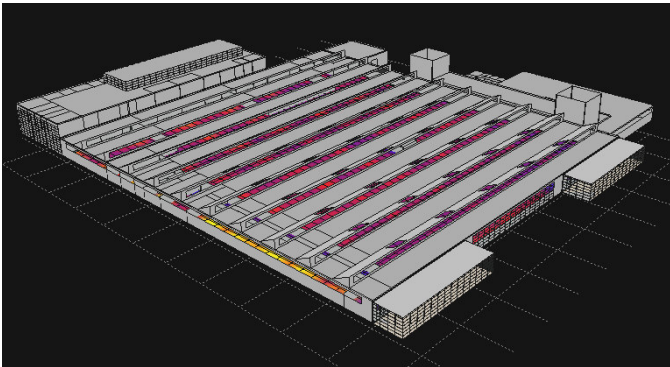
# High Performance Equipment



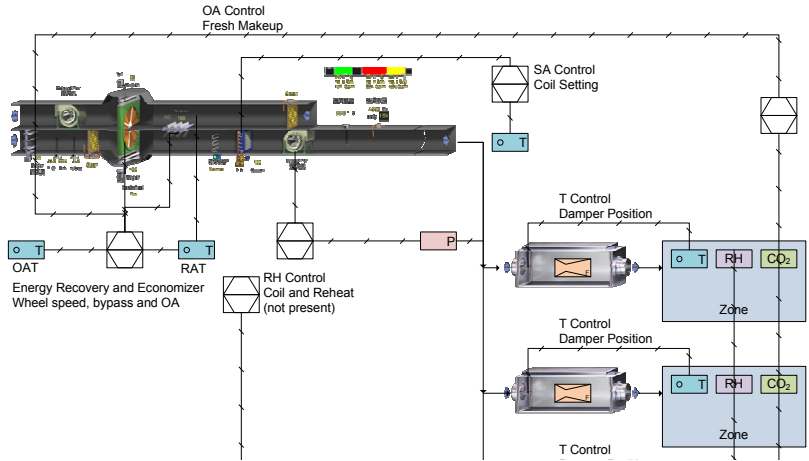
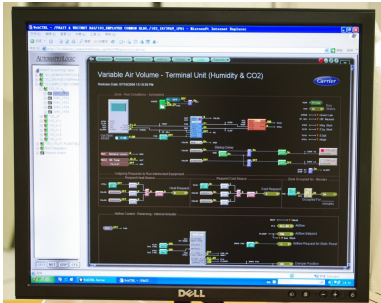
- Hybrid Chiller Plant: Variable Speed Centrifugal + Heat Pumps
- Variable speed pumps
- LED Lighting



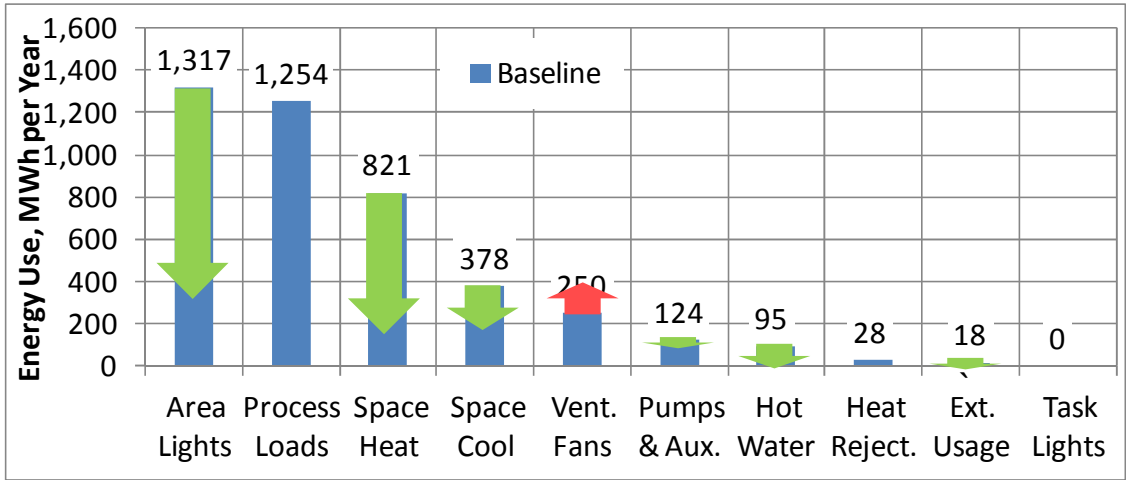
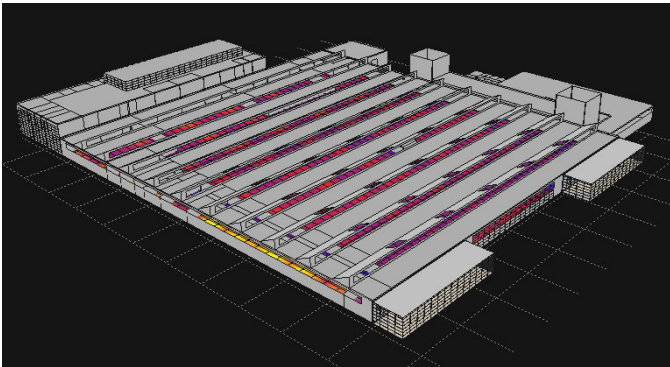
# Effective Automation



- Lighting Control
- Demand Controlled Ventilation
- Economizer Mode

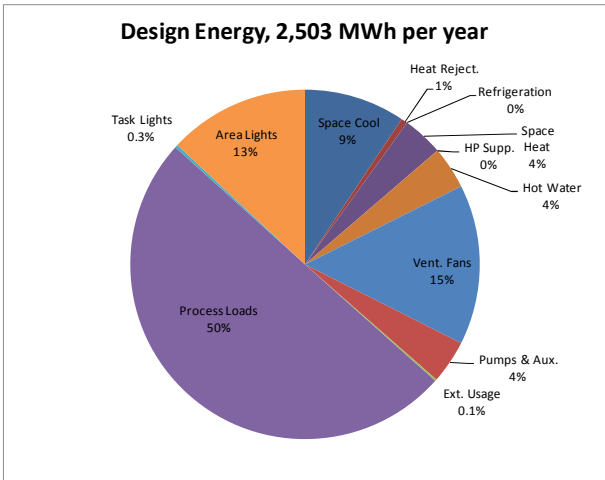
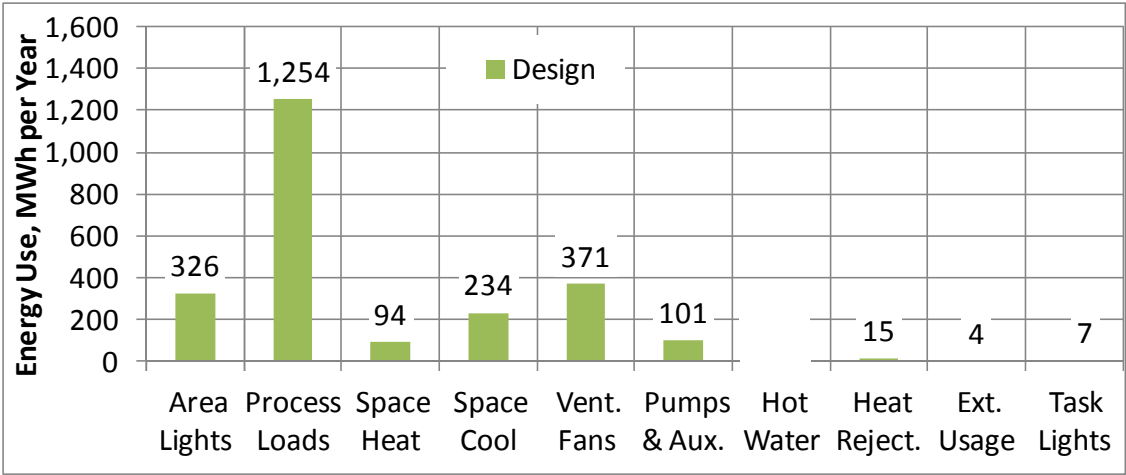
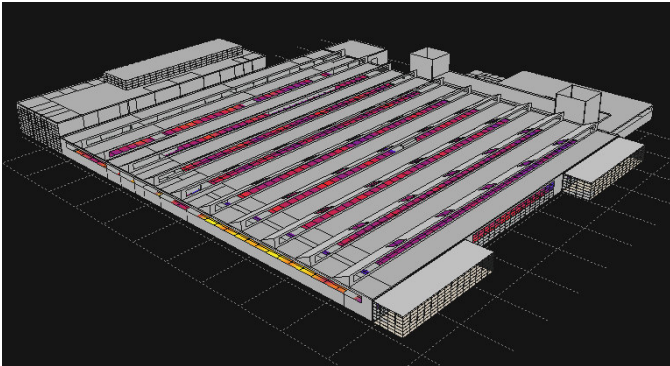


# Renewable Resources



- Solar thermal domestic hot water
- Solar PV + Wind exterior lighting

# Design Case End Result



43.9% Energy Use Reduction  
 3.1% Energy from Renewable Resources

# Observations and Conclusions

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- Holistic approach to building design and operation allows best overall outcome
- Integration and interaction between many systems should be taken into account
- Broader use of existing energy efficient technology can benefit current designs