Innovative Solutions for High Performance Building Systems

United Technologies

Carrier

turn to the experts℠

OTIS

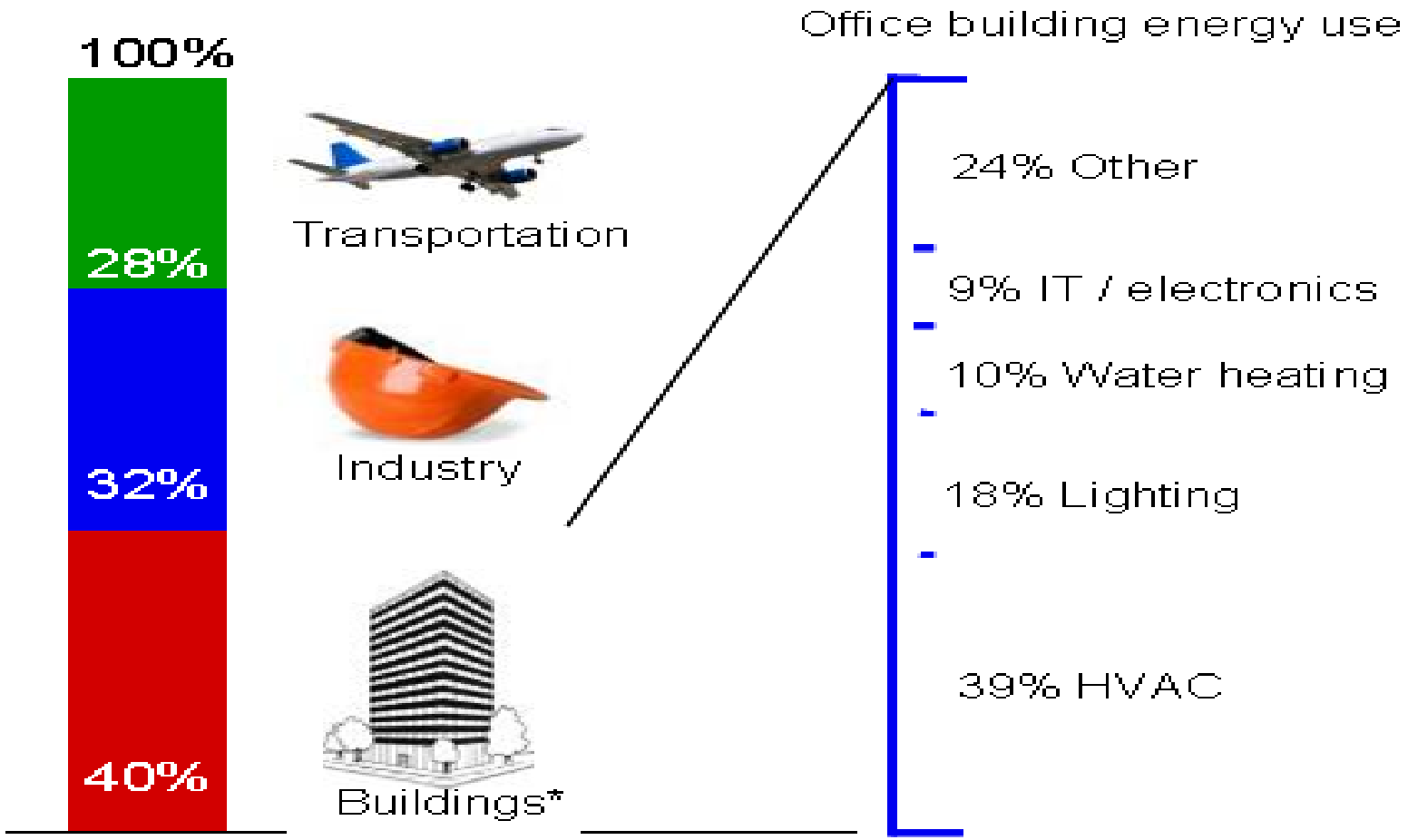
THE WAY TO GREEN™

K Balakrishnan, Director, Govt. Policy & Regulatory Affairs, UTC India (P) Limited

TERI-GRIHA National Conference on Green Design

New Delhi, Feb 15, 2013

Why We?



Source: 2007 Department of Energy Buildings Energy Data book

Integrated Building Solutions

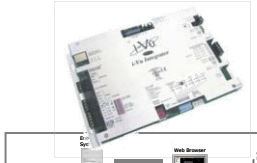
Holistic Approach to Building Systems

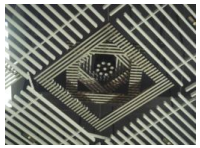
Architecture and building systems choices

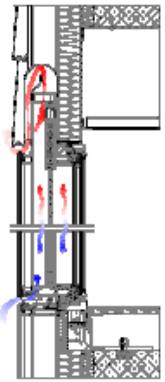
High performance equipment

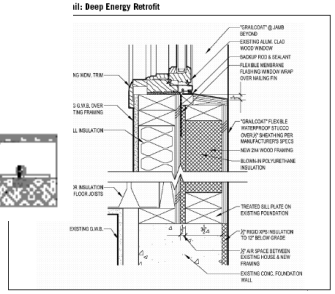
Integrated control

Renewable Resources



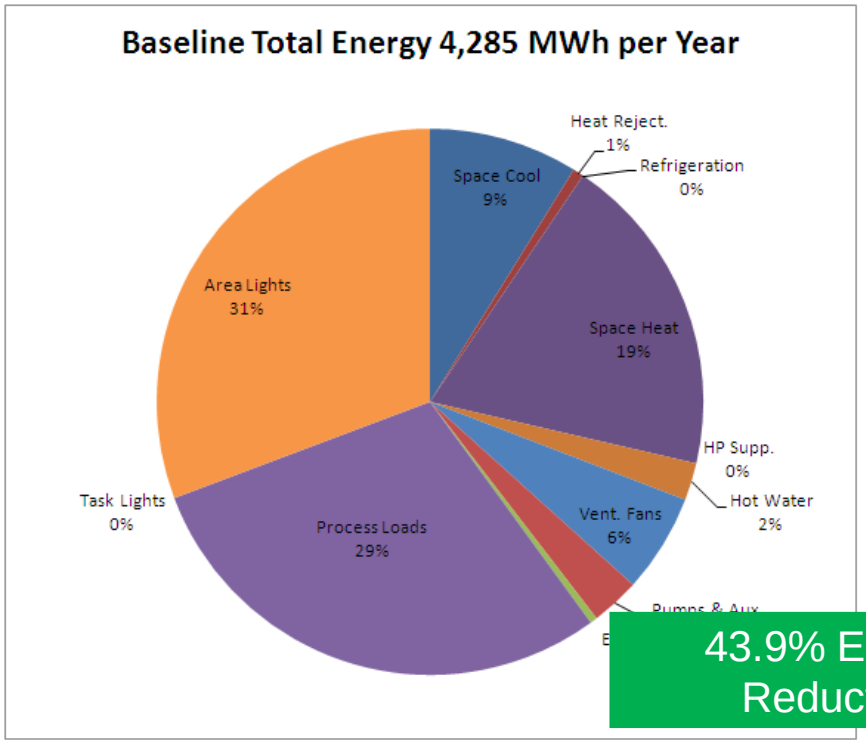


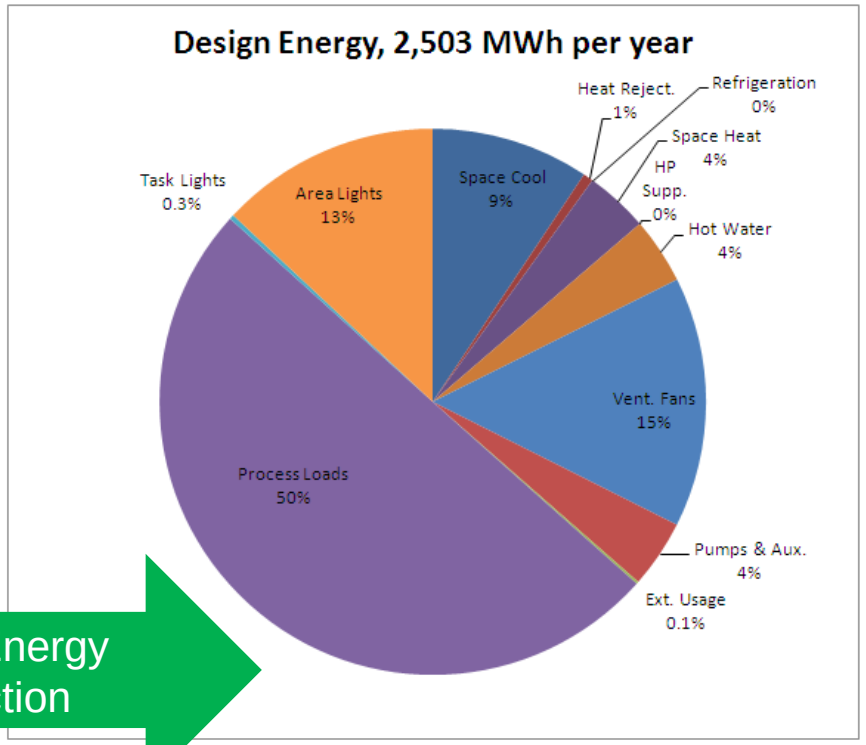




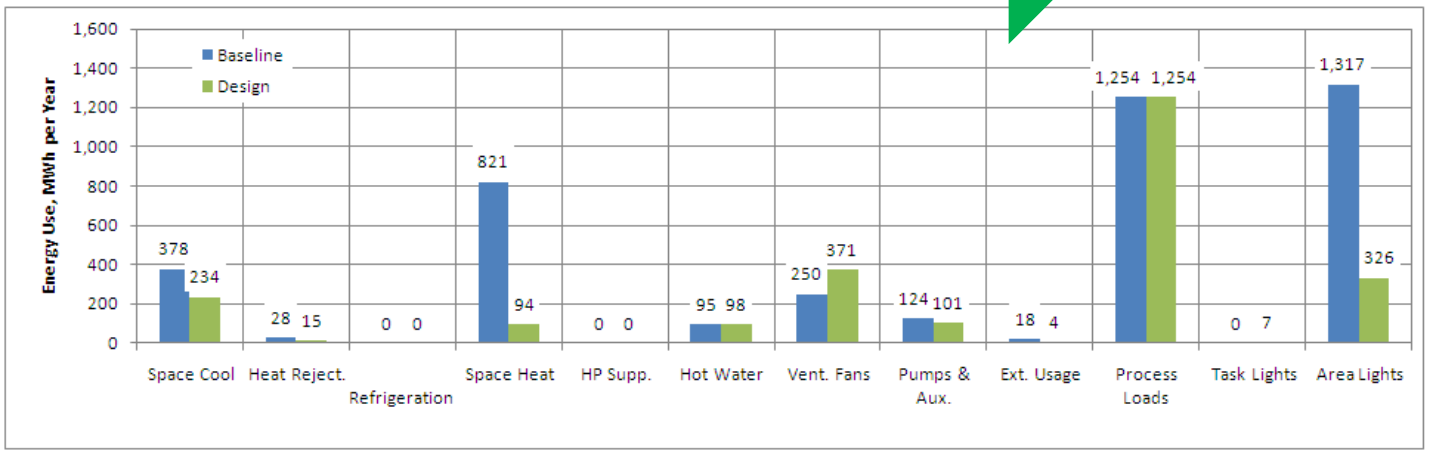
Certified Case Example

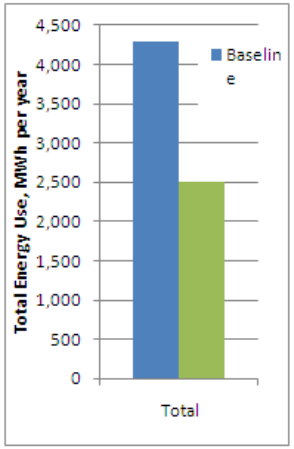
Energy Use Reductions Achieved in Design



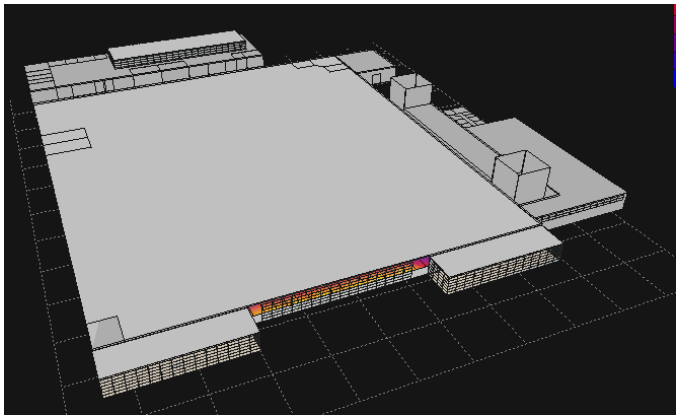


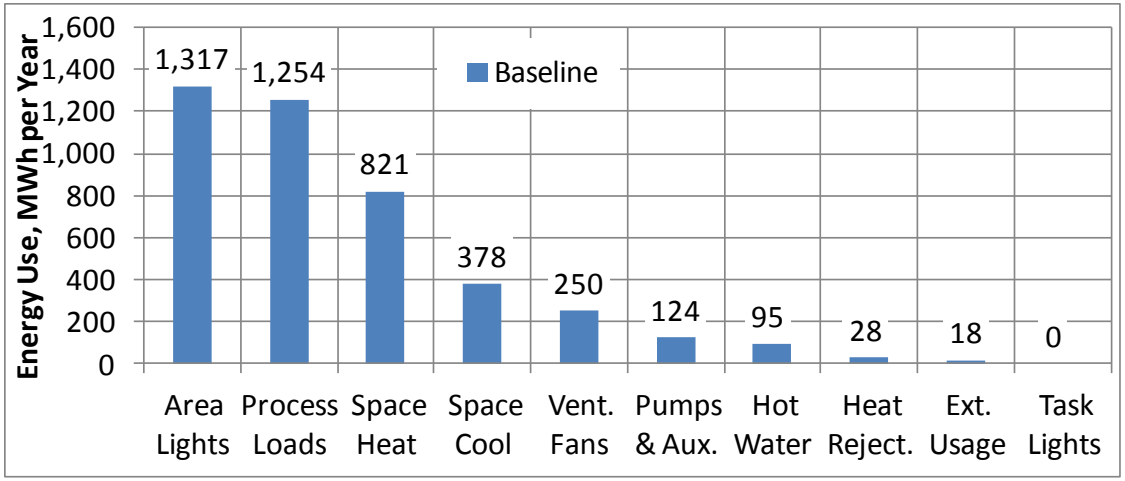
43.9% Energy Reduction

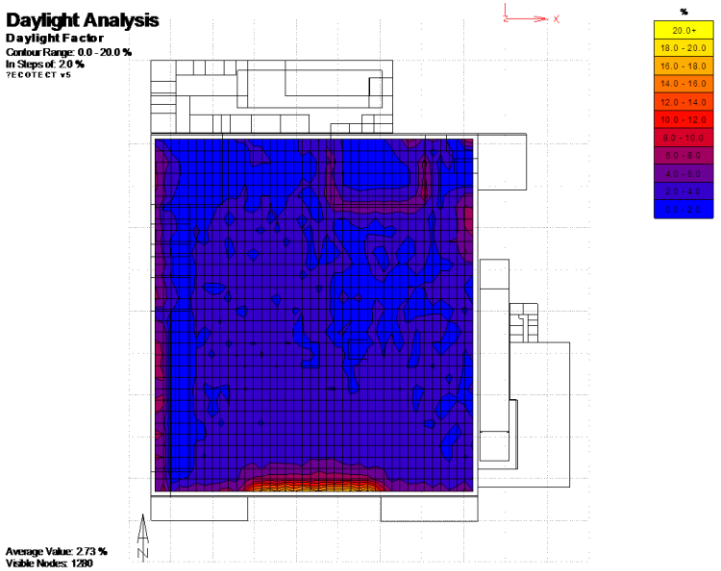




Baseline Architecture and Systems

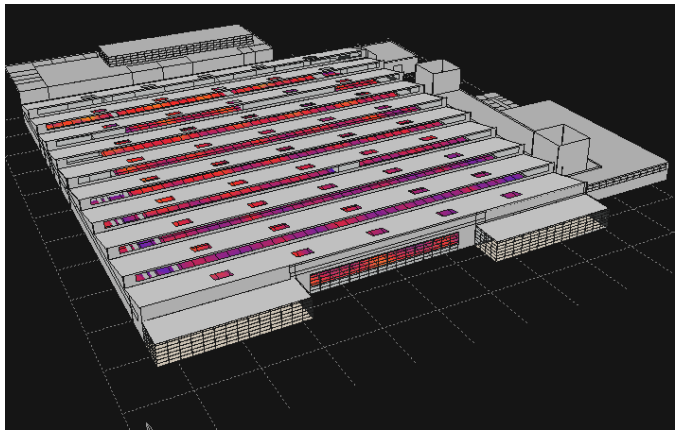


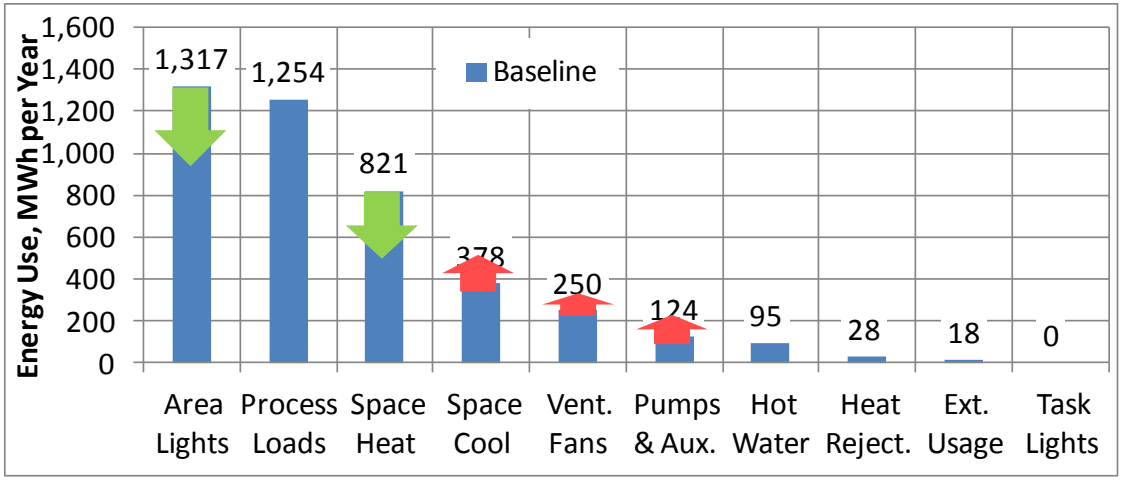


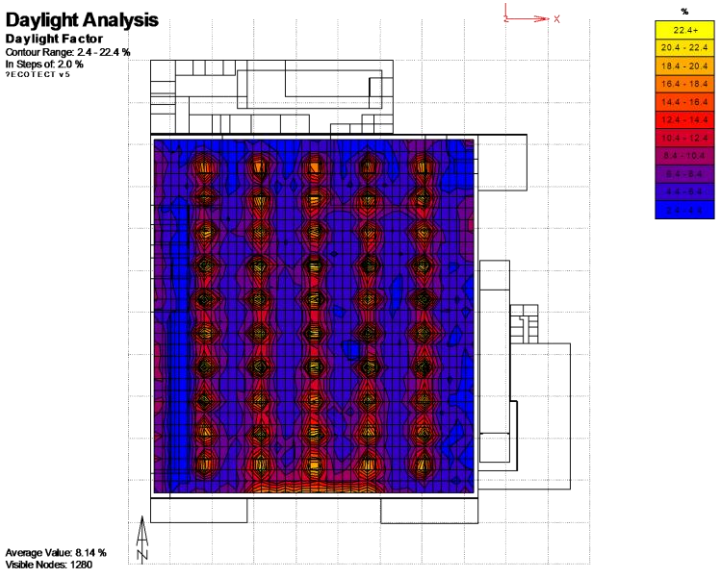


Perimeter glazing
Low natural illuminance

Daylighting Case 1

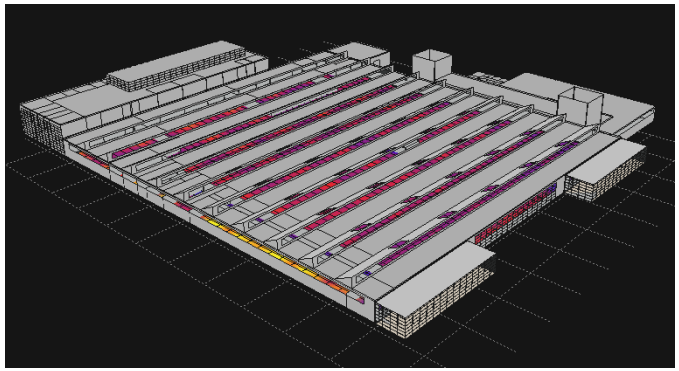


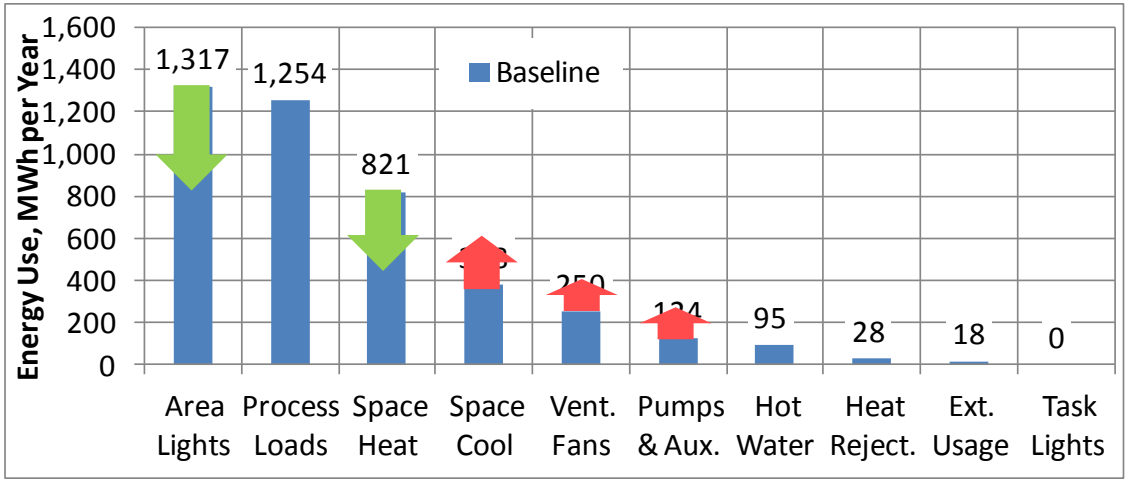


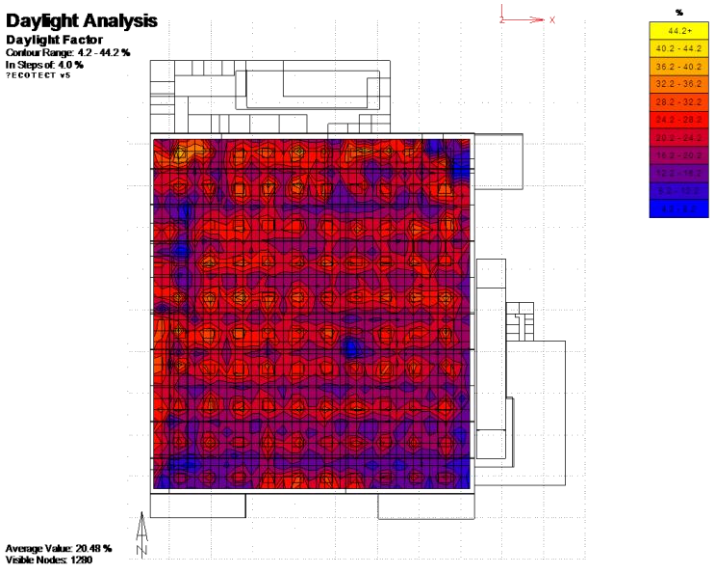


Roof glazing
Non-uniform illuminance

Daylighting Case 2

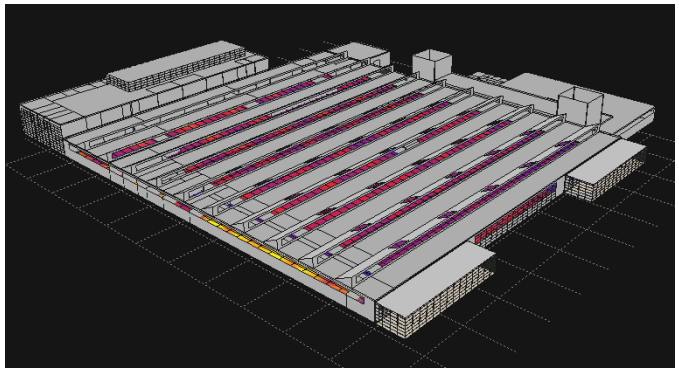


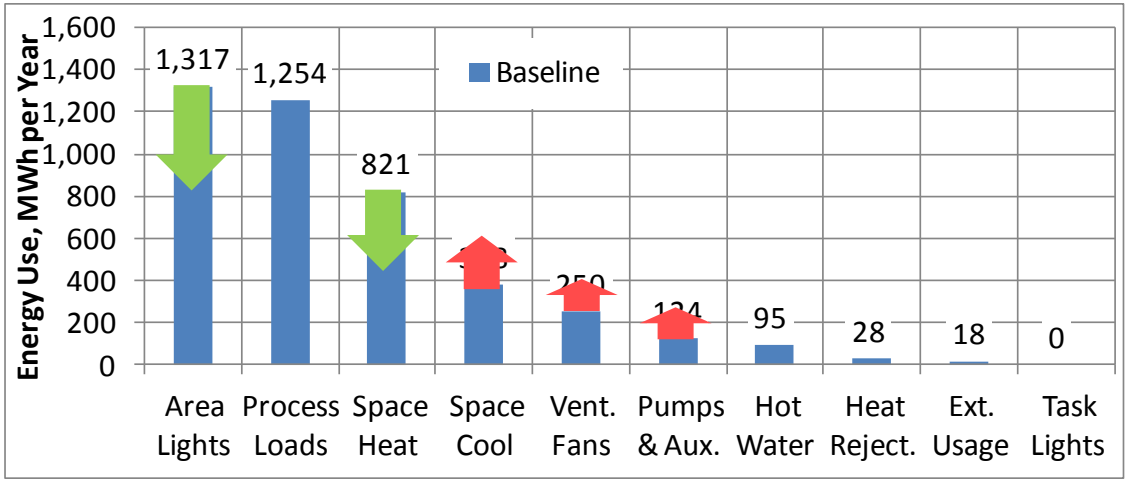


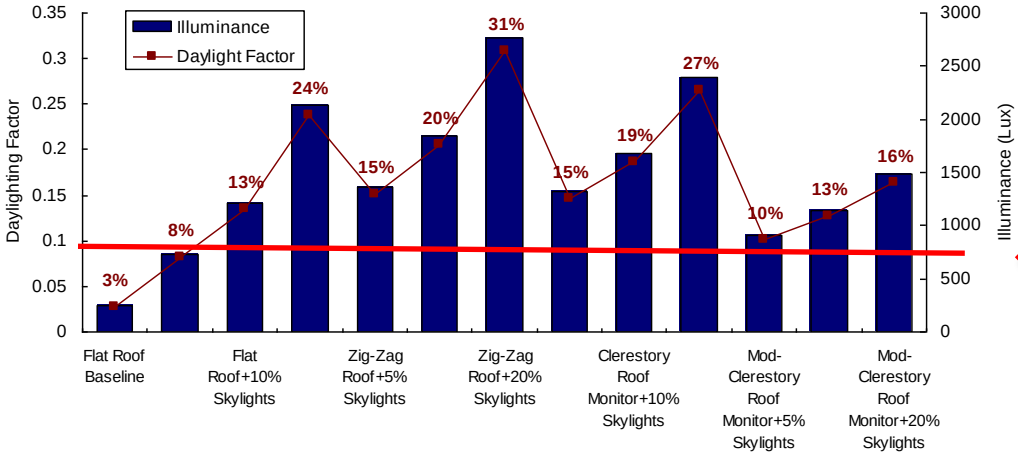


Roof glazing
Good uniform natural illuminance

Daylighting Case 2 Selected

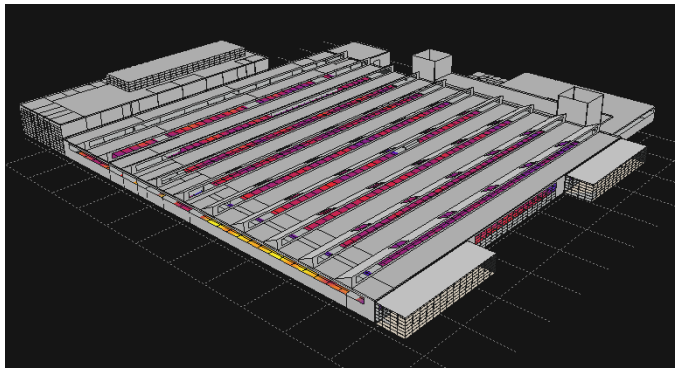


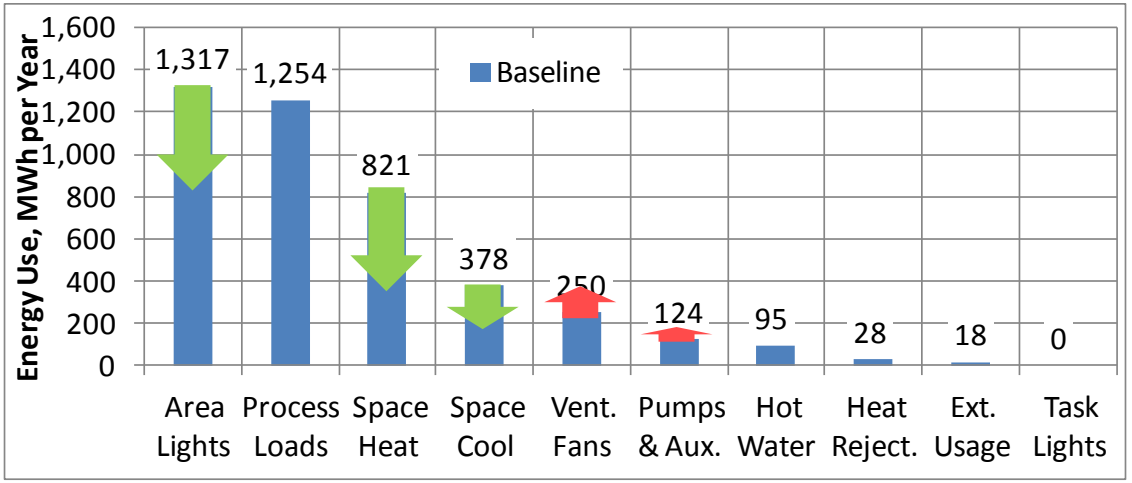




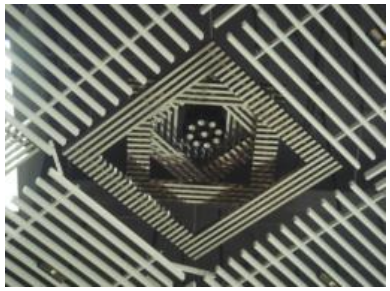
Meets illuminance requirement
Balance lighting savings and thermal loads impact

High Performance Equipment



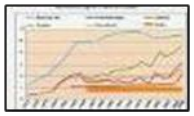


- Hybrid Chiller Plant: Variable Speed Centrifugal + Heat Pumps
- Variable speed pumps
- LED Lighting



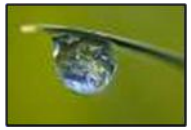
Global HVAC Trends

Energy cost



- Life cycle cost analysis
- Change of energy source

Environment

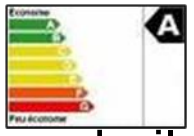


- CO2 emissions
- Renewable energy

Regulations

- ASHRAE 189
- Labeling standards
- Tax incentives

Efficiency



- Zero-net energy buildings
- VFD / Inverter Technology
- Heat recovery systems
- Energy labeling

Refrigerants

- Low GWP & natural refrigerants

New technology & HVAC system requirements

Technology Trends

FS Centri Chillers

FS Screw Chillers

R 11 / R 123

Products

Centri with VFD

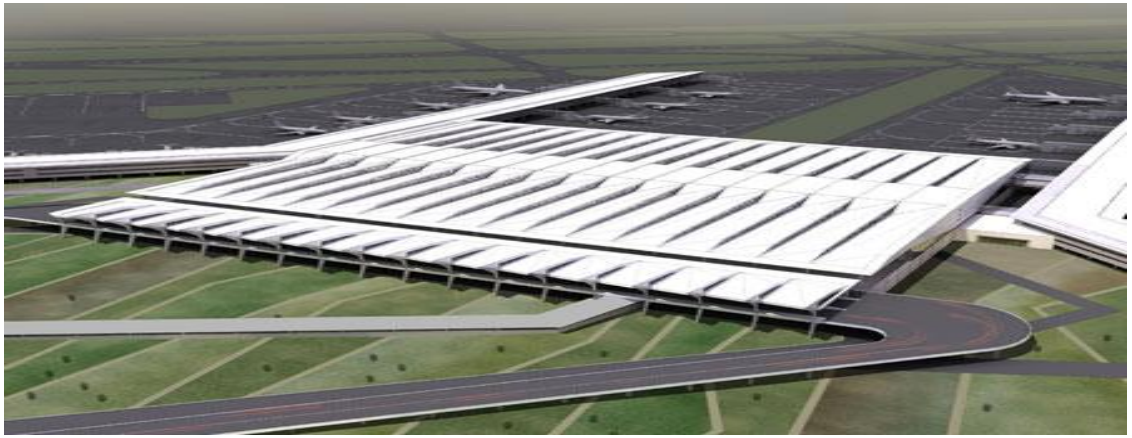
Screw with VFD

R 134a

Solutions

Delhi International Airport

19XRD – 8 x 2500 TR Centrifugal chillers



- **19XR - 300 – 1500 TR with VFD option**
- **19 XRD – 2000-3000 TR on High Voltage**

19XRDCentrifugal Chillers

- Series Counter Flow Design
  - Better Efficiency
- Redundancy - Multi Compressor
- Low Staring Current
- Low Pressure Drop
- Reliability :Semi – hermetic design

ITC Royal Gardenia, Bangalore

23XRV - 3 x 425 TR Water cooled Screw Chillers

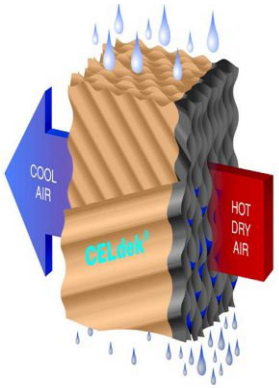
World's largest and Asia's first LEED Platinum Rated Building

23 XRV Water cooled Screw Chillers

- World's first WC Screw Chiller with VFD
- Tri rotor screw
- IPLV as low as 0.3 IKW/TR
- 275 – 550 TR

Cisco Systems, Bangalore

30XA - 6 x 310 TR Air cooled Screw Chillers with Evaporative Cooling System



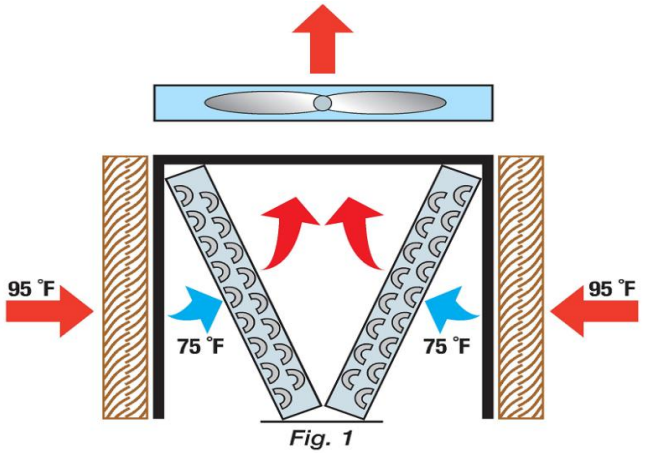


Fig. 1

13% Savings in Annual Consumption

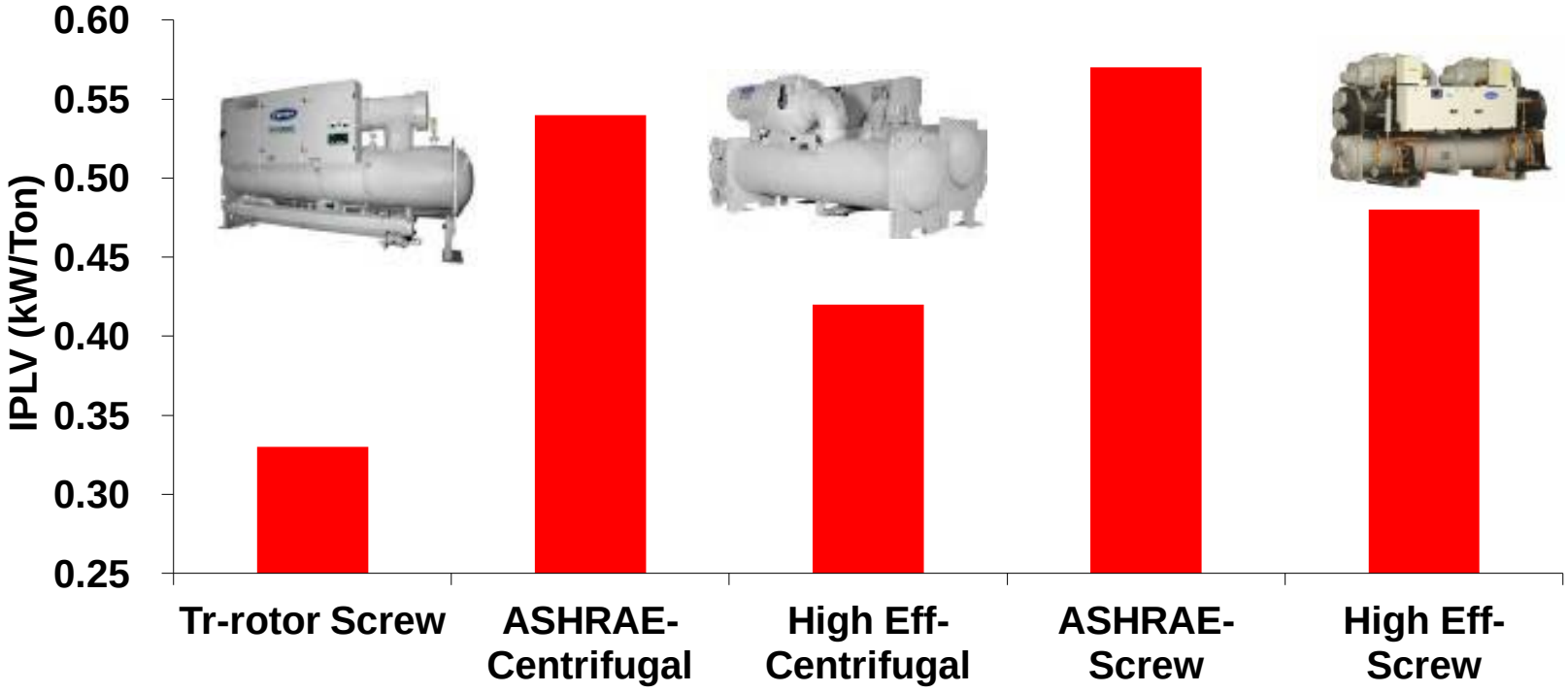
20% Reduction in Connected Load

AQUA THRUST AQUAFORCE

30 XA Air cooled Screw Chillers

- Made in India
- Aqua Thrust – 80-280 TR (9 models)
- Aqua Force – 78-430 TR (17 models)
- Lead time of 4-5 weeks

Chiller Part Load Efficiency



IPLV	**0.33**	**0.54**	**0.42**	**0.57**	**0.48**

40% higher than ASHRAE 90.1

Technology Trends

TOSHIBA
Leading Innovation

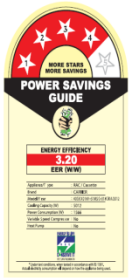
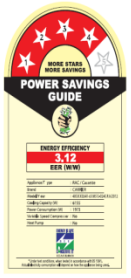
Fixed Speed Systems	Inverter Systems
Partial Inverter VRF	Full Inverter VRF
Unlabelled products	Energy Labeling
Refrigerant R-22	Refrigerant R -410
Inverter Cassettes	Inverter Cassettes

R-410a Cassettes

Retail Outlets

Gymnasiums

Indoor Unit

18K Cassette	24K Cassette
	
4 star	4 star

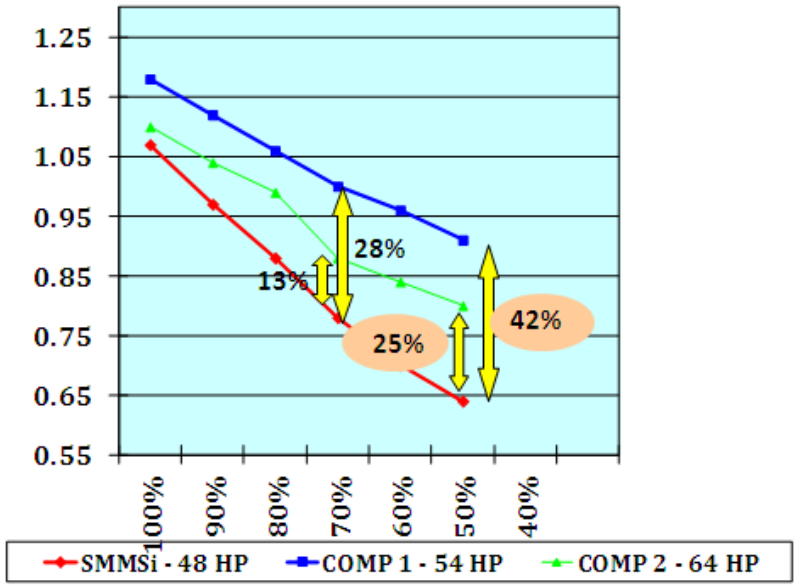
R 410a Cassettes

- 1.5, 2, 3 & 4 TR
- Compact Size
- Low Noise
- Reliable & Durable
- Energy Efficient

VRF Technologies

PART LOAD POWER CONSUMPTION

In Part loads, SMMSi is more efficient on energy saving

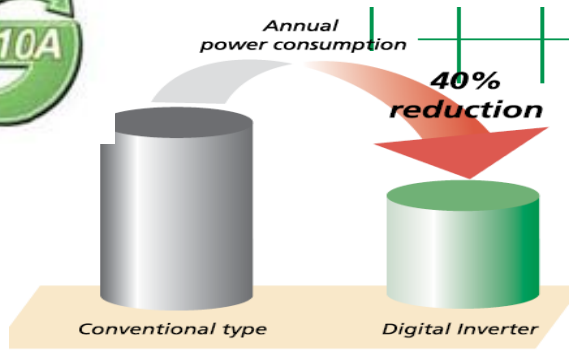


Talwalkars

TOSHIBA
Leading Innovation

Toshiba Digital Inverter Cassettes & hi-wall – 1200TR, 40 Gyms

1.5, 2, 3, 4, 5, 8 TR



Digital Inverters

- Save up to 40% power
- BMS Compatibility
- Long piping Lengths
- Low starting Current
- All weather ACs

Titan

Toshiba Digital Inverters – Cassettes & Ducted – 50 Stores, 1500 TR

Digital Inverters

- Save up to 40% power
- BMS Compatibility
- Long piping Lengths
- Low starting Current
- All weather ACs

Condominium Solutions

SMMS
SUPER MODULAR MULTI SYSTEM

MiNi-SMMS

- Solutions : VRF ,Digital Inverters (1:1), Hi walls (1:1)
- Best-in-class efficiency : value addition for end customers
- Low starting current – helps in reduction of power backup cost
- Redundancy in Toshiba VRF for apartments

Customer Challenges

Different HVAC systems and technologies - what is the right solution for my application?

New Business Process

Design Goals

Energy cost

Energy density

Sustainability/green

First, life cycle cost

System Simulation

AdvanTE^{3}C Solutions Center

Carrier Solution

System architecture

Operational parameters

Existing components

New components

Other design inputs:

- Building use
- Weather data
- Building geometry

Tools:

- Carrier HAP
- TRNSYS
- eQuest

AdvanTE^{3}C is contributing to the design of the future zero net energy buildings

AdvanTE^{3}C Solutions Centre

- Develop unique solutions to meet customer challenges
- Deploy solutions that involve equipment, controls, algorithms
- From equipment approach to system approach
- Leverage Carrier's broad product and technology portfolio

Carrier

AdvanTE^{3}C Solutions Center

Vertical Market Priorities

Large Buildings & Small Offices

Hotels

Cooling & Heating Districts

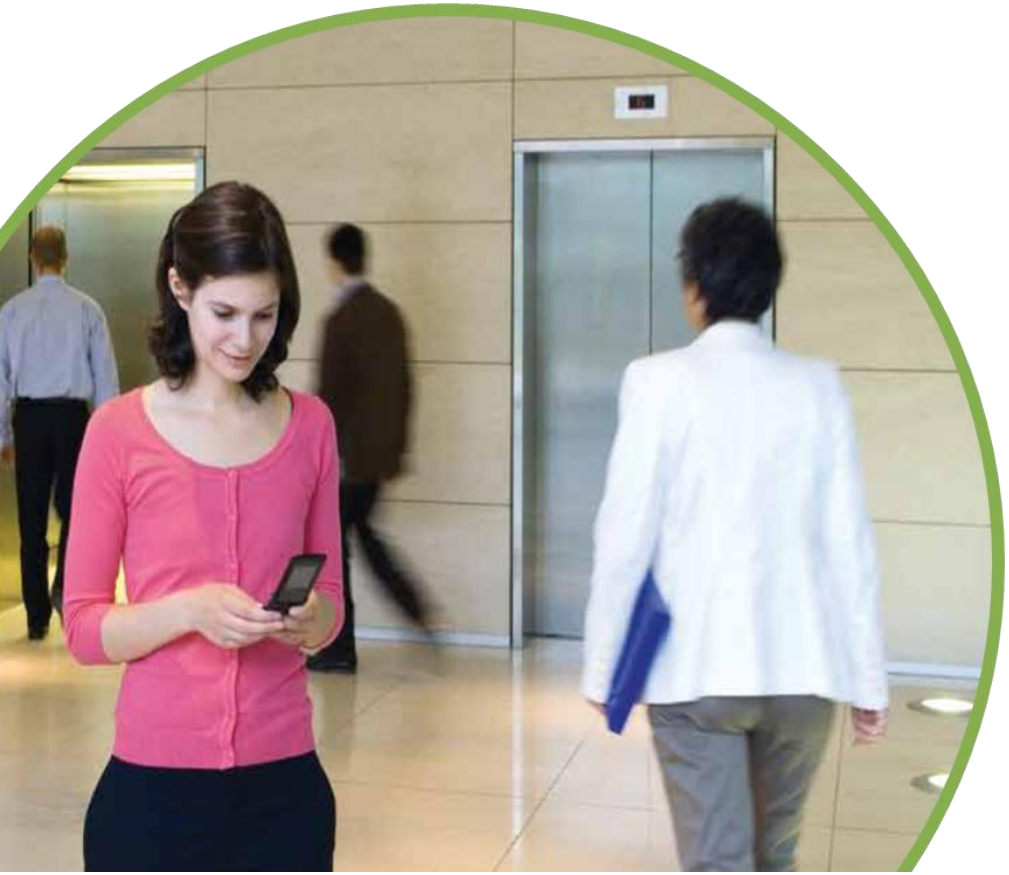
Data Centers

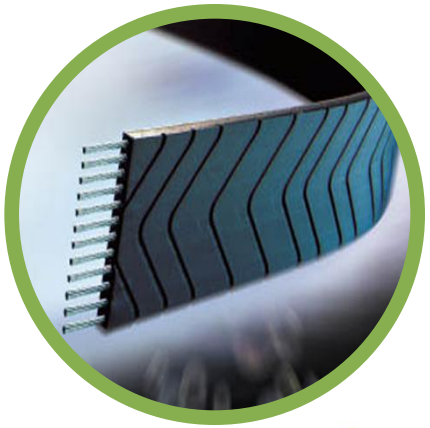
IT Electronic Manufacturing

Hospitals

THE WAY TO GREEN

It is about our commitment to continually moving our company and our customer forward.





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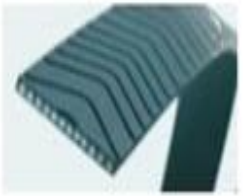
Conventional elevator	GeN2 system
Conventional Steel Rope	Flat Belt
	
Geared Machine	Gearless Machine
	
Conventional Drive	ReGen™ Drive
	

COMPARISON

OTIS
THE WAY TO GREEN™

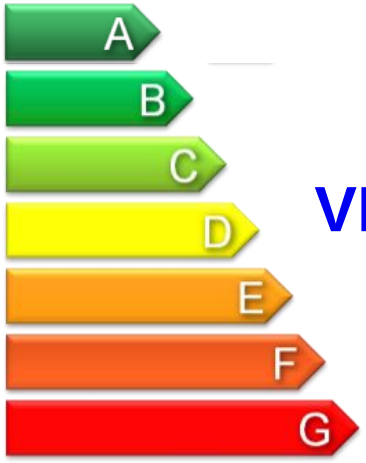
GeN2 REVOLUTIONIZES PROPULSION

Polyurethane
Coated Steel Belt

Compact & efficient
gearless PM machine

ReGen™

Best-in-Class energy savings and performance



VDI 4707 ENERGY – CLASS A CERTIFIED

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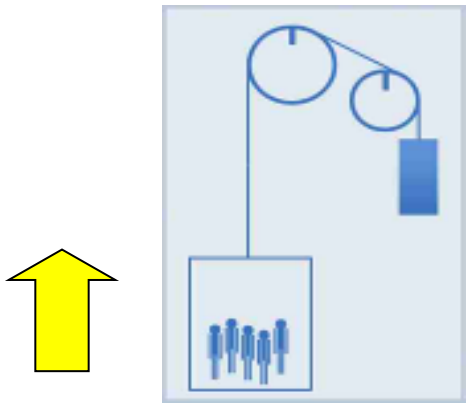
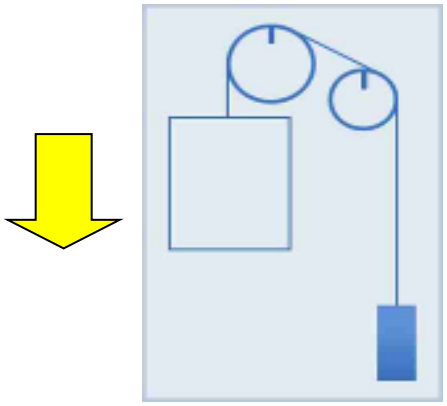
REGEN DRIVE – HOW IT WORKS ?

Electrical power
Consumption

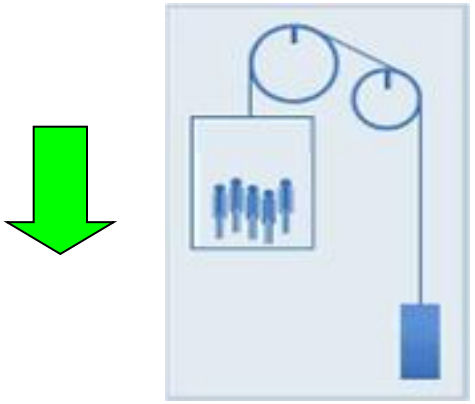


Heavily loaded car

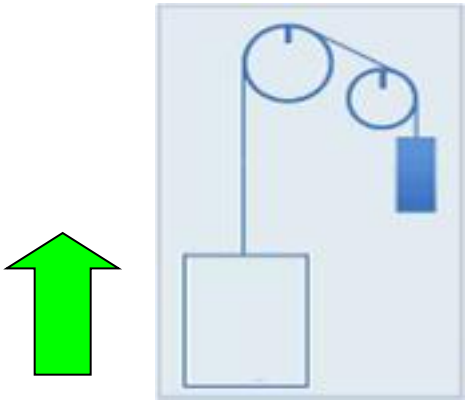


Lightly loaded car

Electrical power
Generation



Heavily loaded car



Lightly loaded car

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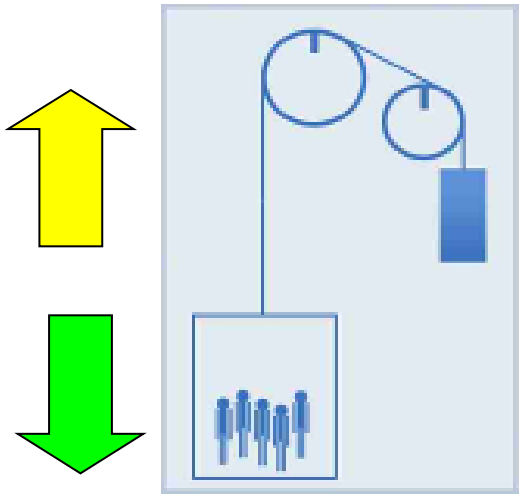
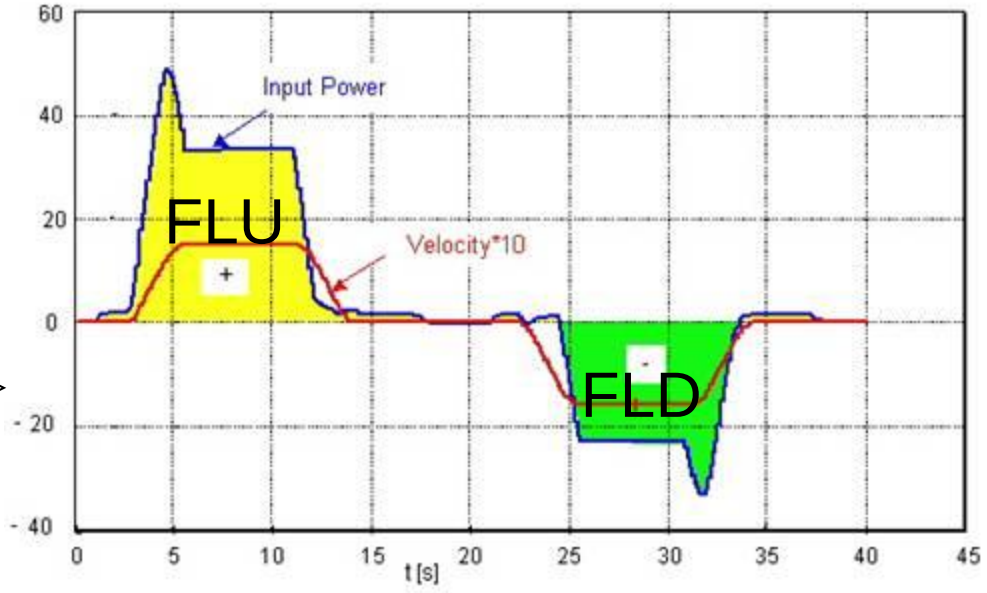
REGEN DRIVE – HOW IT WORKS ?



Fully loaded car

- Energy consumed with fully-loaded car in up direction (FLU)
- Energy generated with fully-loaded car in down direction (FLD)



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COMPASS DESTINATION DISPATCH

- Compass groups passengers going to common or nearby floors to same car
- Controls number of unique stops

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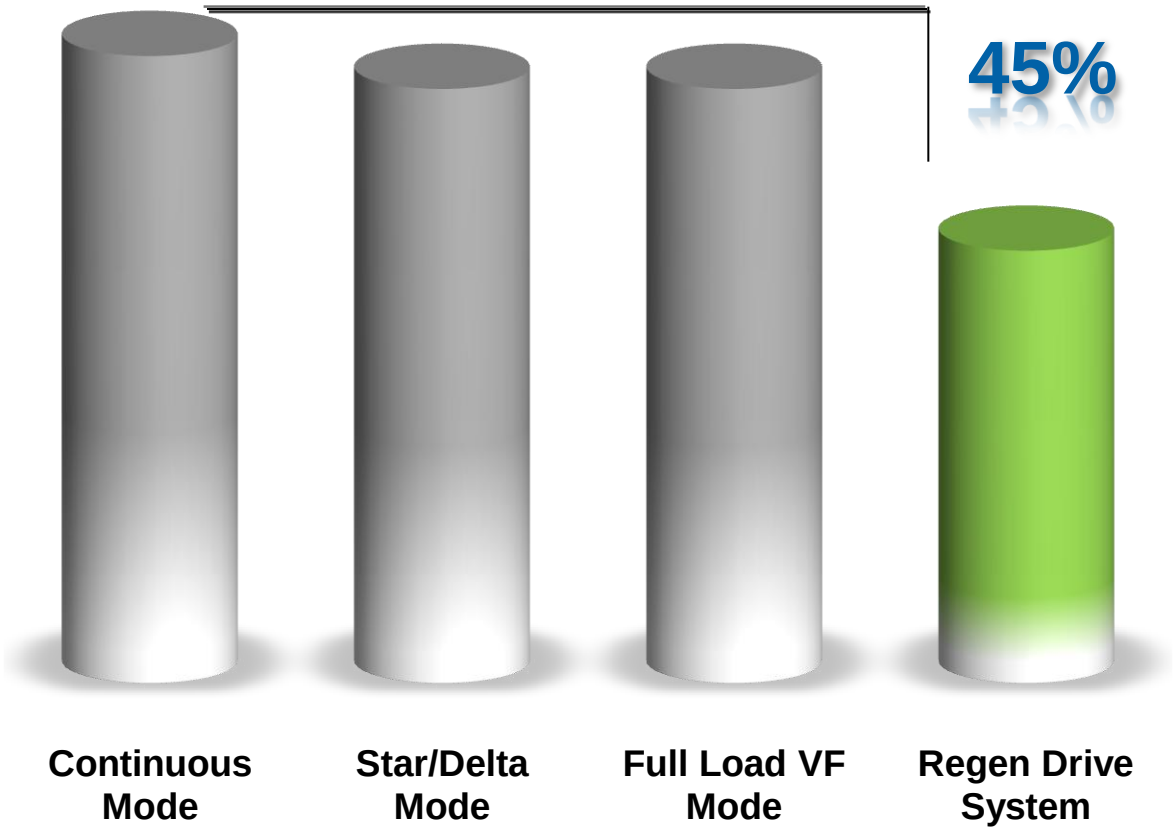
THE WAY TO GREEN™

ESC REGEN DRIVE SAVINGS



Note: Continuous 0.5m/s running escalator without VF function and with IM motor and worm gear @ ISO defined commercial application, light duty and traffic pattern A. Regen is with a PM motor, worm gearbox with 0.25m/s standby speed with INT operation.

OTIS THE WAY TO GREEN™

ECOSY

High Efficient Lubrication System:

Benefit

- Extremely Low Oil Consumption, 95% reduction (40 litre to 1 litre)
- Superior Lubrication
- Very Easy Maintenance

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REFERENCE PROJECTS – GeN2

Beijing Metro Line, China

Great India Place, Noida

Christ the Redeemer, Brazil

Burj Khalifa, UAE

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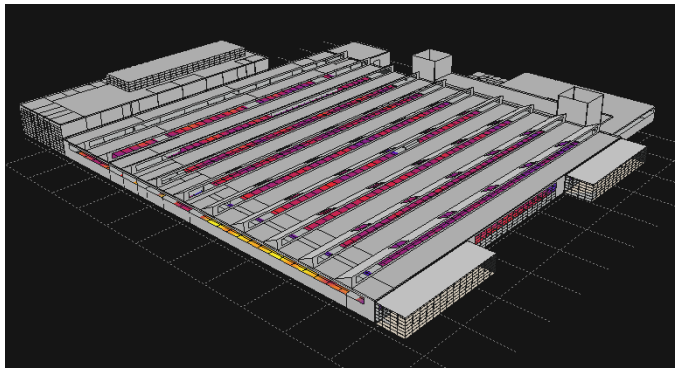
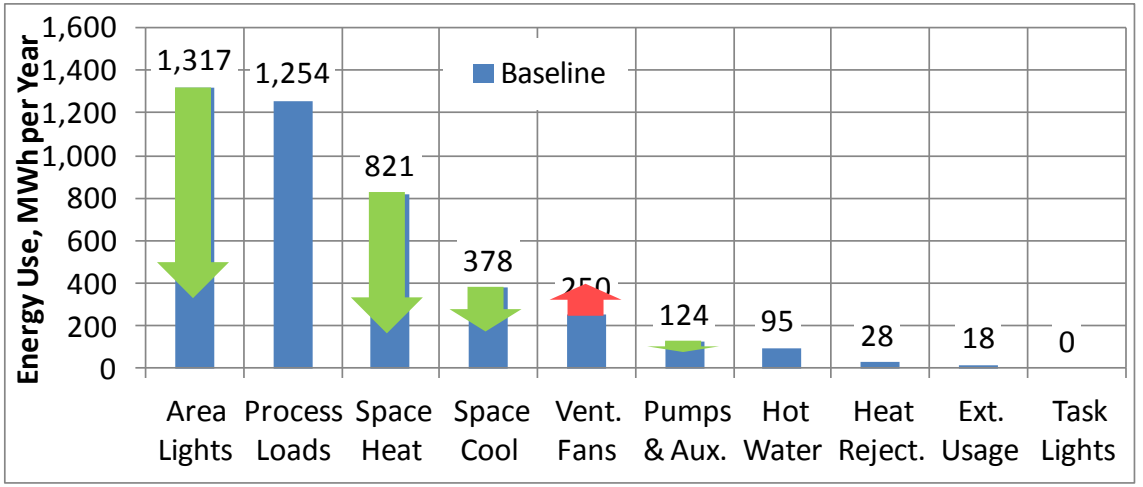
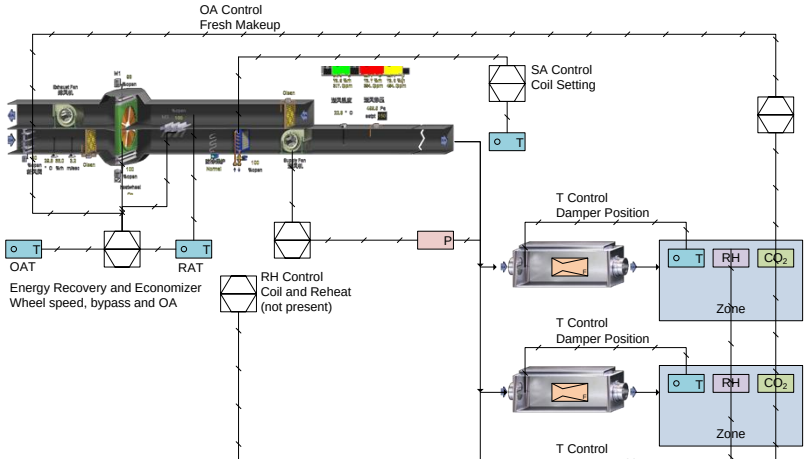
THE WAY TO GREEN™

Effective Automation

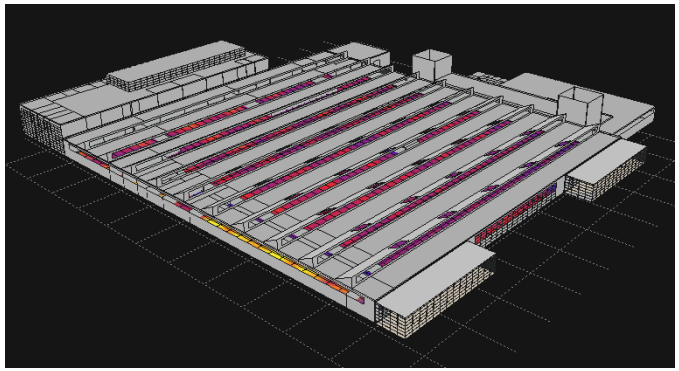


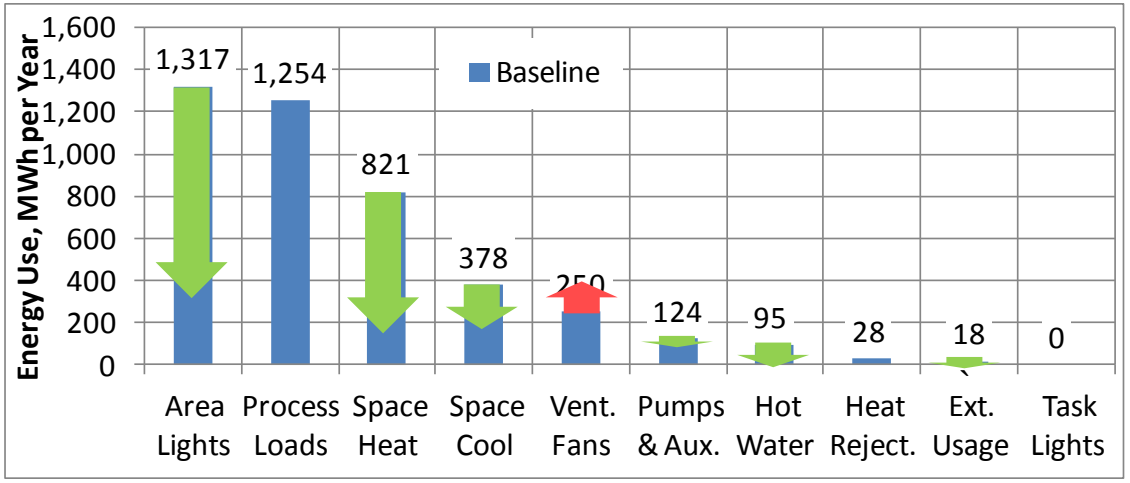


- Lighting Control
- Demand Controlled Ventilation
- Economizer Mode



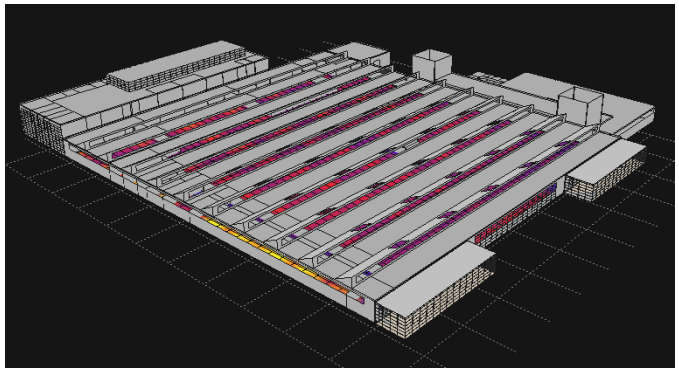
Renewable Resources

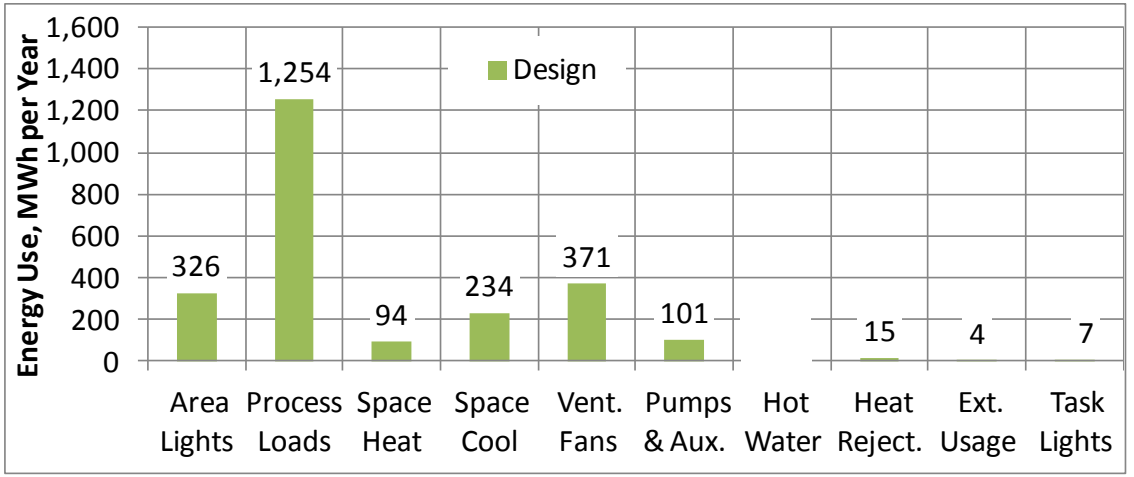


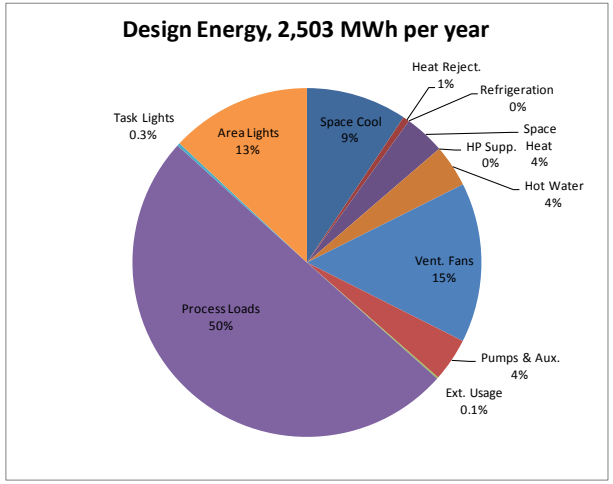


- Solar thermal domestic hot water
- Solar PV + Wind exterior lighting

Design Case End Result







- 43.9% Energy Use Reduction
- 3.1% Energy from Renewable Resources

Observations and Conclusions

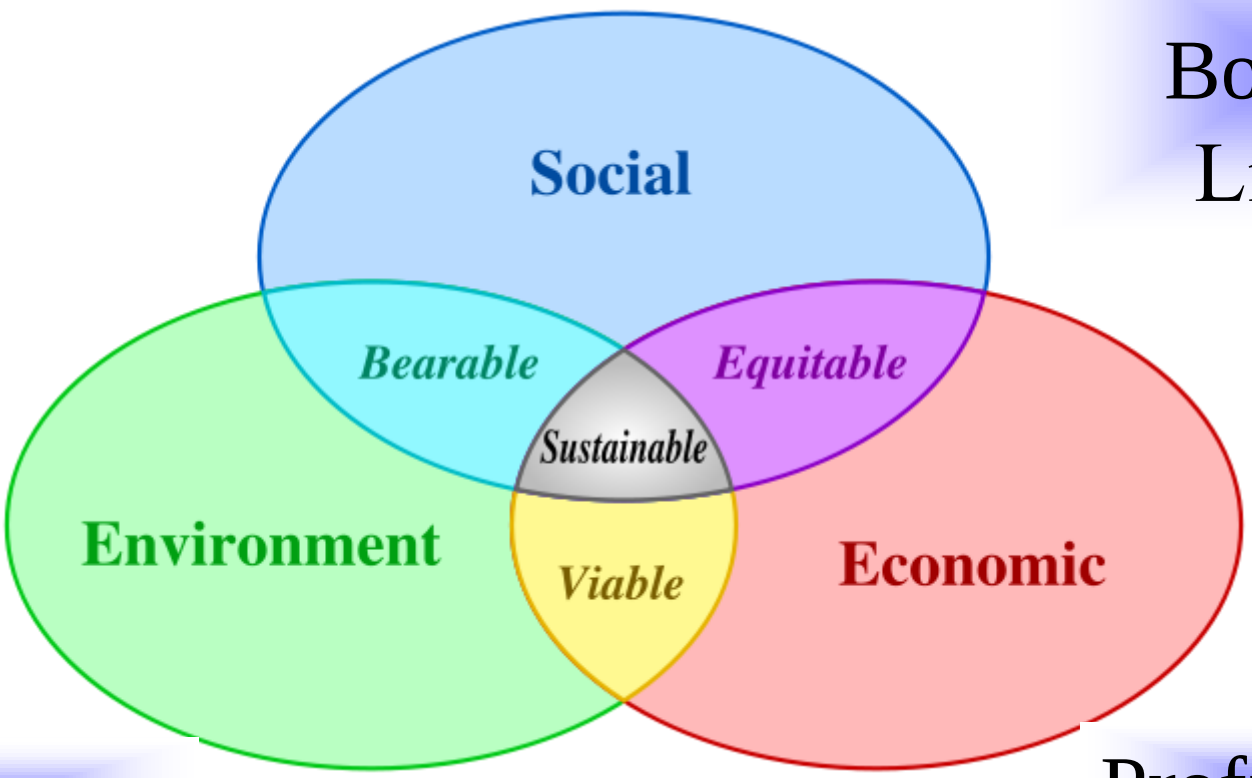
- Holistic approach to building design and operation allows best overall outcome
- Integration and interaction between many systems should be taken into account
- Broader use of existing energy efficient technology can benefit current designs

Sustainable Design as Balance

- Balance between competing forces

People

"Triple Bottom Line"



Planet

Profit

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

Thank you!

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