

## 2. Green Hospital



**Biomed Healthtech (P) Ltd.**

**Marthanda 207, 2<sup>nd</sup> floor , Dr. A. B. Road,  
Worli Naka, Mumbai – 400 018.**

**+91 98333 56602 +91 8657495402 022-43339200**

 **[www.biomedhealthtech.com](http://www.biomedhealthtech.com)**

 **[marketing@biomedhealthtech.com](mailto:marketing@biomedhealthtech.com)**



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# Digitising Energy Efficiency through Virtual Audits in Hospital Buildings

15%

Faster  
recovery rate

Patients feel  
calmer, more at  
ease and more  
comfortable

41%

reduction in the  
length of patients  
stay in sunlit  
rooms

Exit



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# Our Mission

Energy intelligence to simplify decision making in the hospital environment



Virtual Audits <sup>Live</sup>

Virtual Audits



Green Certification



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# Market Context

- Buildings are the largest consumers of energy on the planet – 40%
- Over the next 20 years, governments and private players will spend \$22 trillion on retrofits in buildings to save energy
- Rapid urbanization will increase the building footprint to 1.7 times current number by 2040 (4.2 trillion sq. ft.)





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# What is a Green Building?

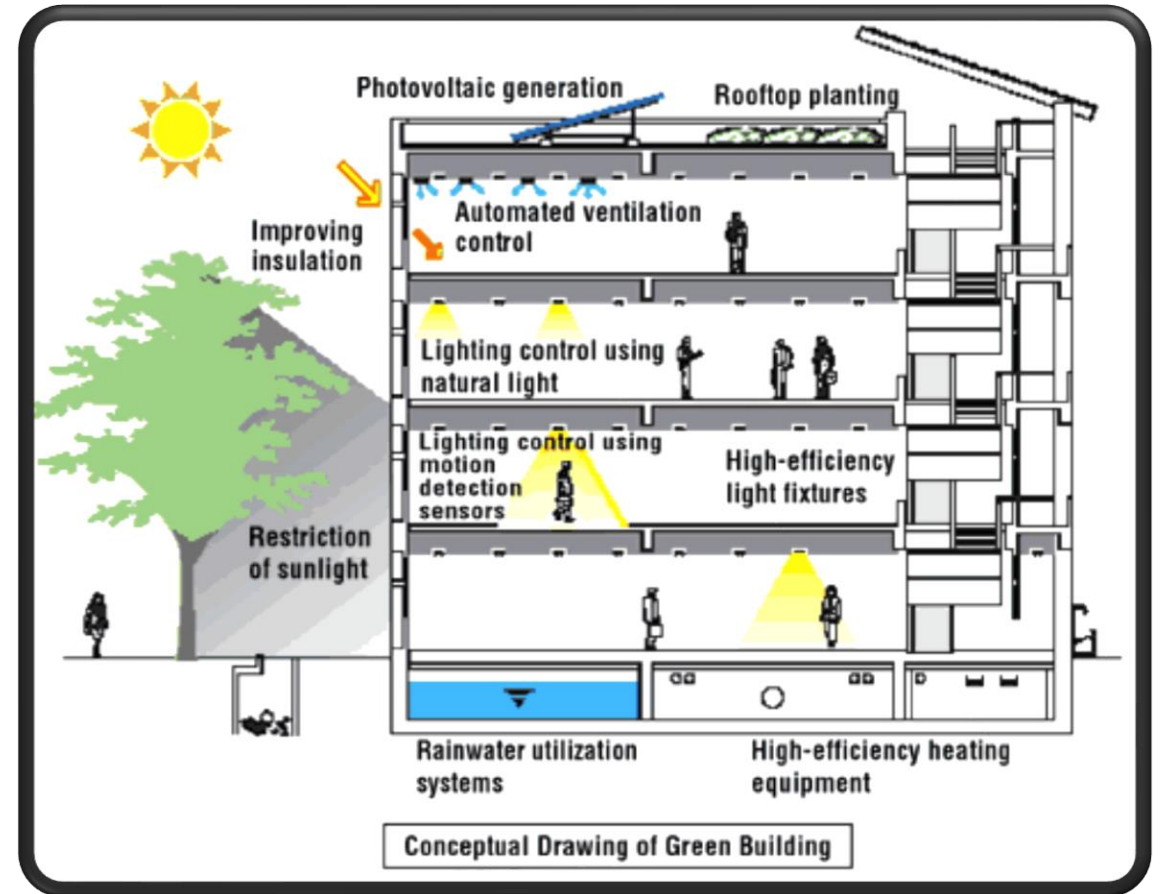
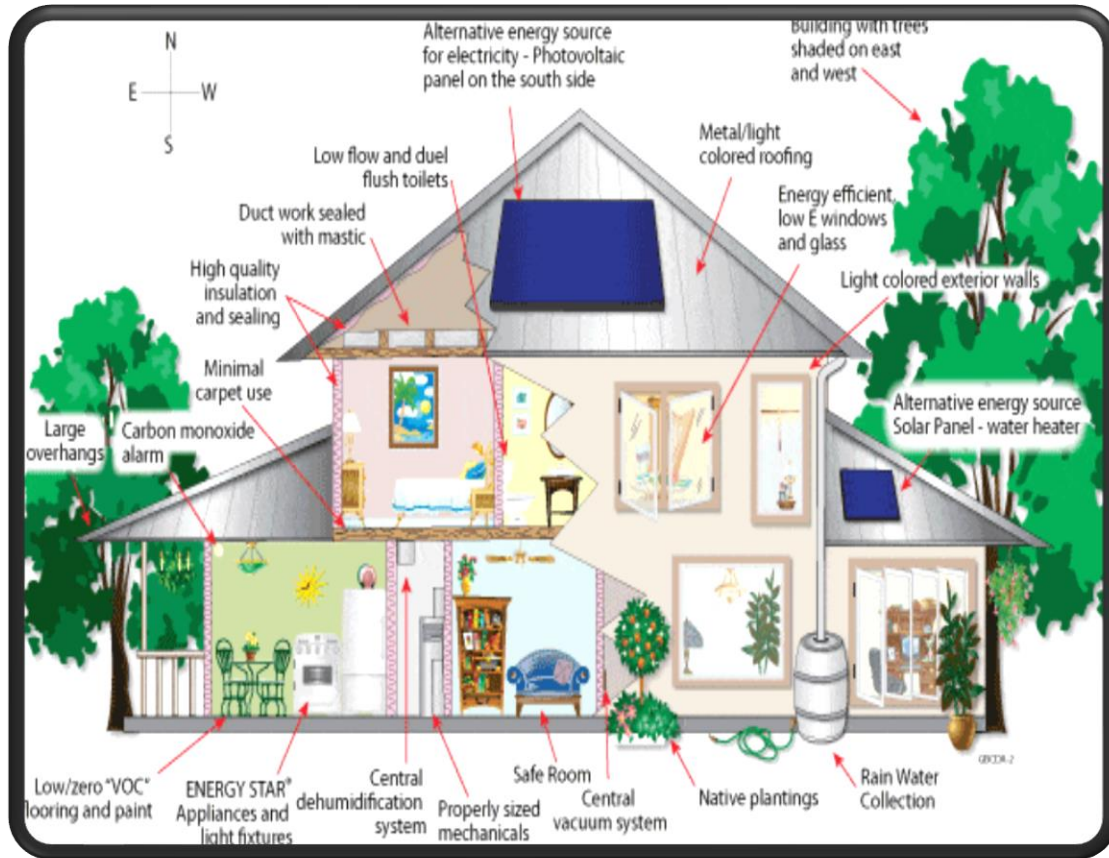
- **Green Buildings today aim at Energy Generation rather than Energy Consumption.**
- **The buildings of tomorrow target to be Net Zero Energy Buildings which are Net Energy Generators than Net Energy Consumers.**
- **As the owners of the Hospitals, being able to feed energy back into the grid would be a dream come true!.**
- **The means and ways of achieving the Green Building Goals & Milestones would be to get a LEED or GRIHA Certification.**





# What does it take to be a Green Building?

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# What does it take to be a Green Building?

- **Green Building Certifications such as LEED, Griha, WELL, etc.**
- **Harnessing the Renewable Energy Techniques and Technologies**
- **Designing the building services (Mechanical, Electrical, Plumbing, Fire & Acoustics) based on the Geographical Location, Atmospheric Data, Sun Path Analysis & Weather Data**
- **Selecting Equipment based on best combination of design data again based on Permutation & Combination of the Building Services**





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# What does it take to be a Green Building?

- **Using:**

- **Zoning Techniques to create balanced Design of services rather than creating a Uniform Design avoiding Overdesign**
- **Sun Path Analysis**
- **Wind Direction Orientation**
- **Solar Shading**
- **Thermal Mass design**
- **Lesser Usage of Glazing on the Building Envelope**

**resulting in Passive Design for Energy Savings & leading to Lesser Impact of Environment Conditions & hence resulting in LOWER OpEx**

**TO ACHIEVE A MINIMUM OF 25% ENERGY SAVINGS compared to Baseline Tech!**



# How do we paint it Green?

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- **Virtual Audits**

- Value Differentiators
- Methodology
- Processes

- **Case Study of Virtual Audits**

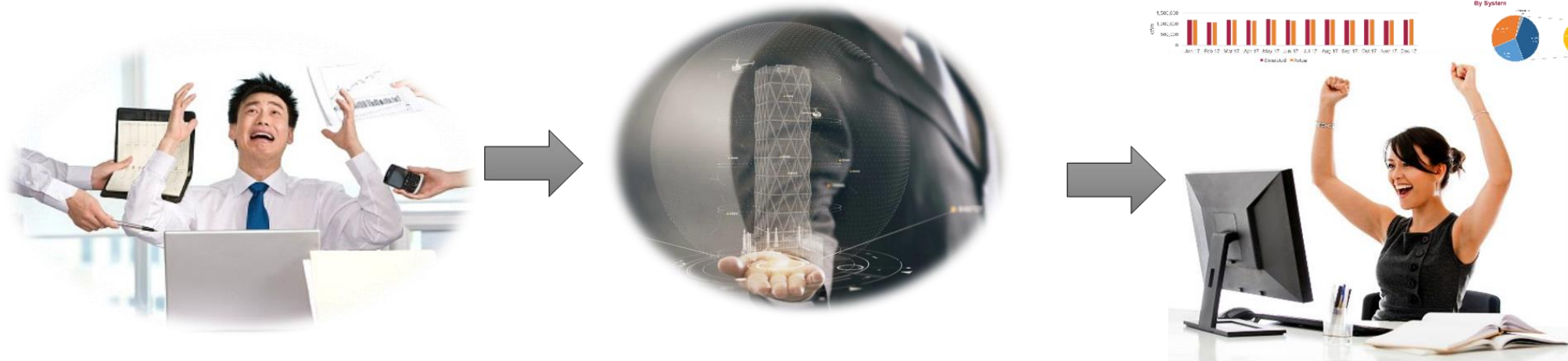
- Digital Twin
- Energy Breakdown Analysis
- Energy Demand & Renewables Integration Analysis
- Energy Conservation Measures (ECMs)
- Virtual Audits LIVE



# Virtual Audits

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- For many years energy audits have been done manually.
- We use unparallel software to do energy analysis which is virtual audit solution.
- Which gives perfect calculation of energy usage and does efficient audit.



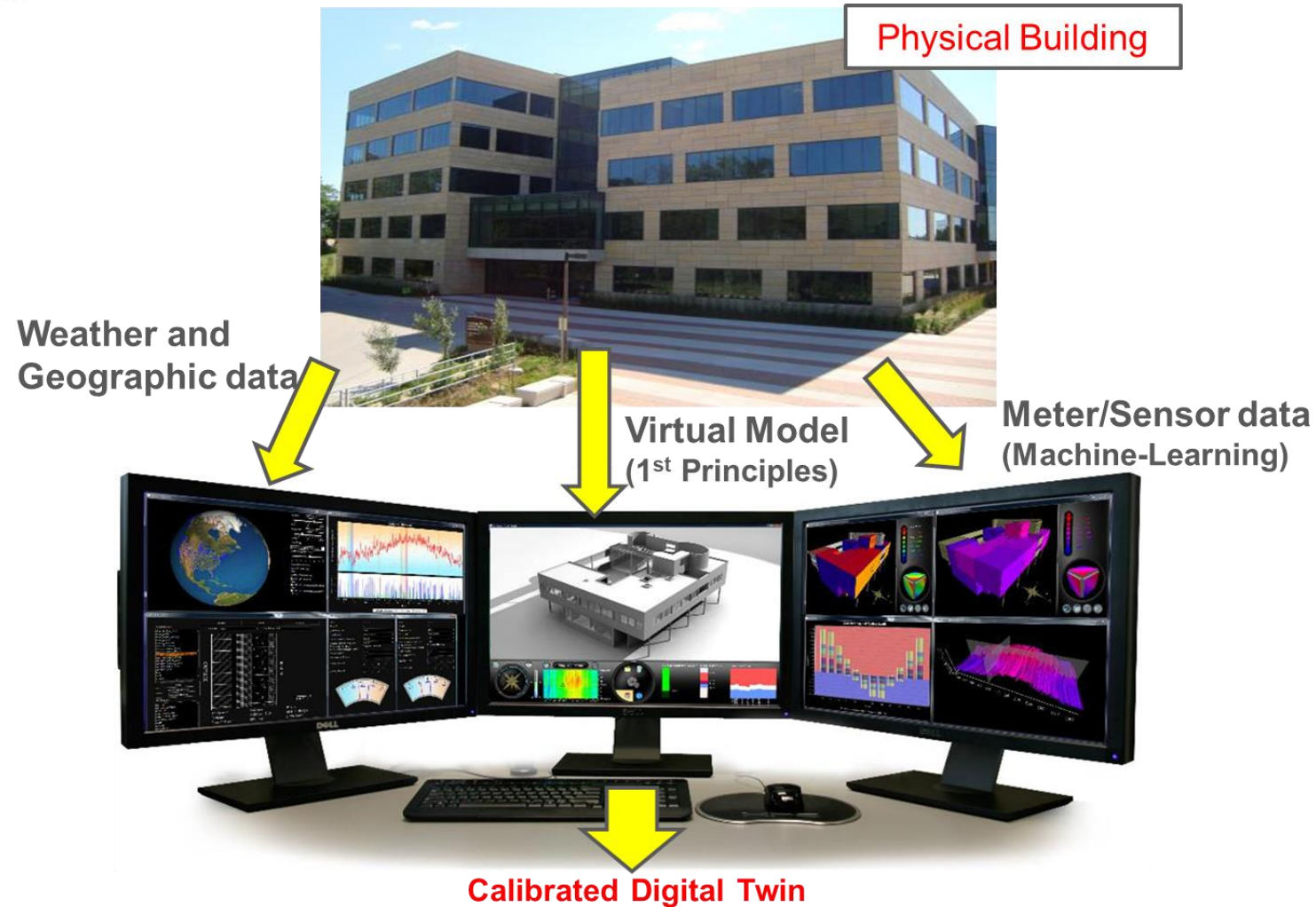
- Manual Performance Assessment
- Heavy Reliance on Expertise
- Trial & Error Approach
- Limited Stakeholder Engagement

*A performance assessment tool to uncover energy efficiency improvements in buildings remotely*



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# Virtual Audits: Methodology





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# Virtual Audits: Process-I

## Data Collection

- 1 year of energy consumption data
- Building details
- Optional short survey
- Optional sensors placement

## Digital Twin setup

- Add weather, GIS, occupancy, etc. data
- Create energy model
- Model calibration
- Data analysis

## Energy Conservation Measures (ECMs)

- Simulate ECMs
- Assess overall impact
- Retrocommissioning
- Retrofitting
- Calculate Financials (Payback, ROI)
- Prioritisation support

## Implement (ECMs)

Constitutes an ASHRAE Level2 Audit



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# Virtual Audits: Process-II

Implement  
Energy  
Conservation  
Measures  
(ECMs)

Verification of  
Savings

- Calibrated simulation with implemented ECMs
- Data Analysis



Complies with IPMVP Option-D  
verification of energy savings



# Our Customers- Singapore

Over 1 mil. Sq.m.

## Mercatus

### Thomson Plaza

29,413 m<sup>2</sup>  
GM Certified

### AMK Hub mall

48,245 m<sup>2</sup>  
GM Certified

### NEX mall

87,527 m<sup>2</sup>  
GM Gold

### Other Buildings/ Prospects

- Hotels
- Hospital Buildings
- Offices/ Banks
- Data Centres



### NTU Singapore

X 21 Buildings  
Labs, offices, teaching spaces  
450,000 m<sup>2</sup>  
GM Platinum

>30% savings



### Jurong Point malls

95,463 m<sup>2</sup>  
GM Gold

### OMB (office Bldg)

48,302 m<sup>2</sup>  
GM Certified



### Industrial Buildings



# Our Customers/Prospects: Global

## Europe

Witteveen + Bos

WALDNER

TOTAL SOLAR

## UAE

ROVE  
DOWNTOWN DUBAI

FARNEK

EJADAH  
ASSET MANAGEMENT GROUP

## India

Indiabulls

Reliance  
Industries Limited

## Southeast Asia

sinarmas



## Australia

EnergyAustralia



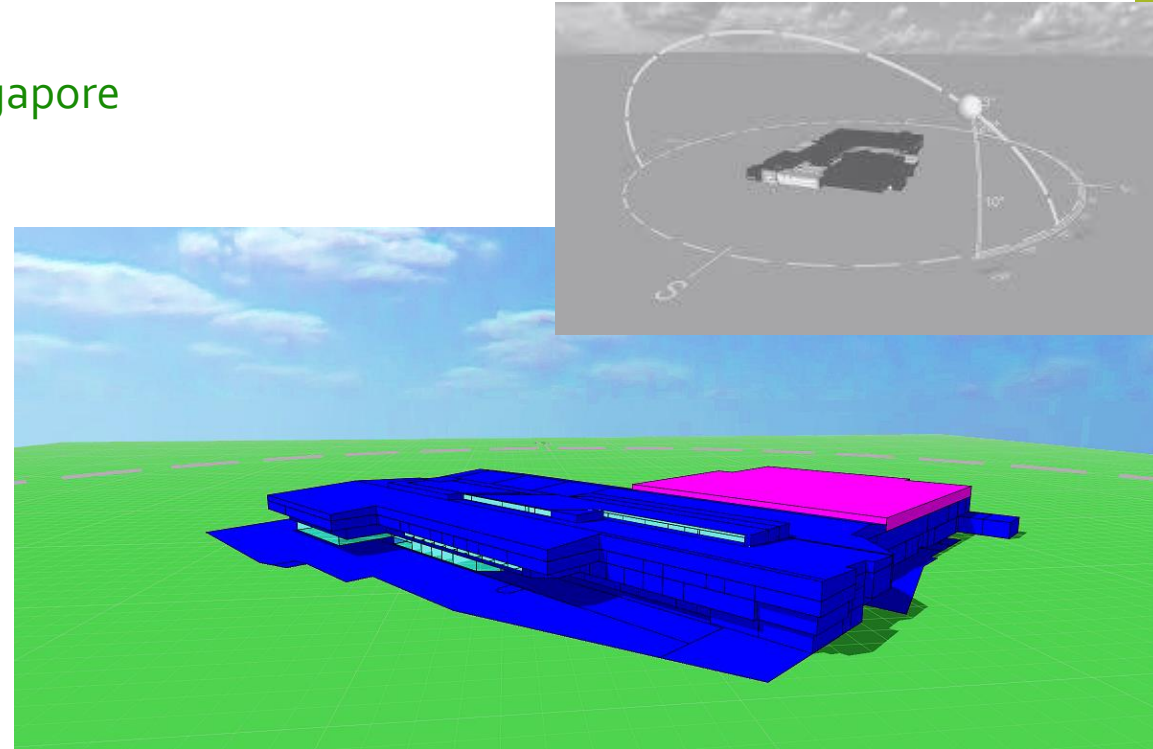
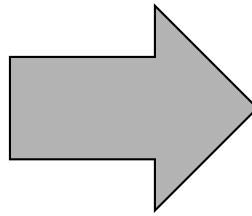
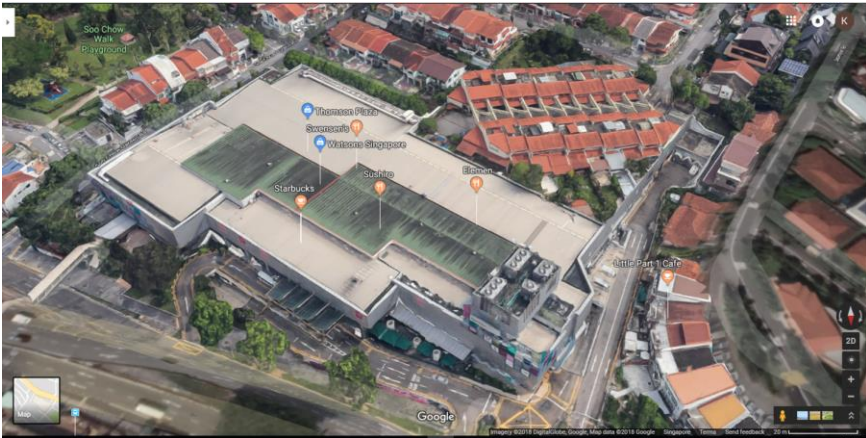




# Case Study: Virtual Audits

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**Digital Twin Creation:** Suburban Shopping Mall, Singapore



## ▪ Building data

- Overall: address, GFA, function
- Architectural, Structural: CAD drawings, BIM
- Mechanical & Electrical: layouts, equipment specs
- Operational data: schedules, profiles

## ▪ Energy Consumption data

- Multiphysics Dynamic Simulation
- Integrated with Weather Data
- Building data integrated



# Case Study: Virtual Audits

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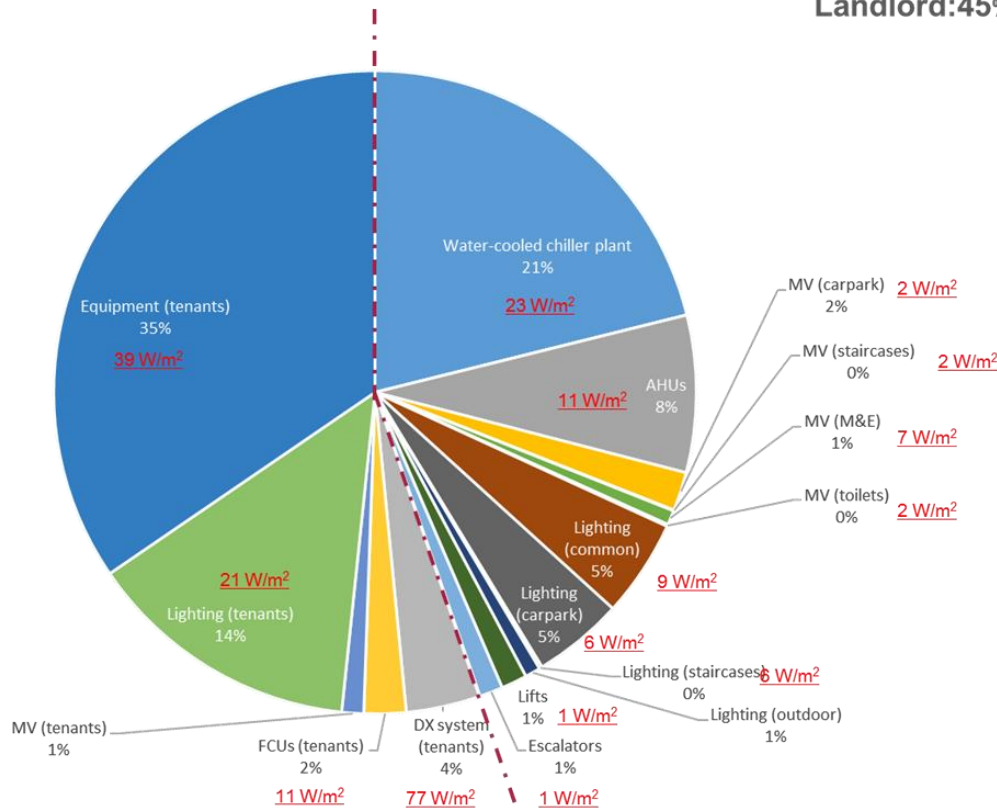
## Energy Breakdown Analysis

Tenants: 55%

Landlord: 45%

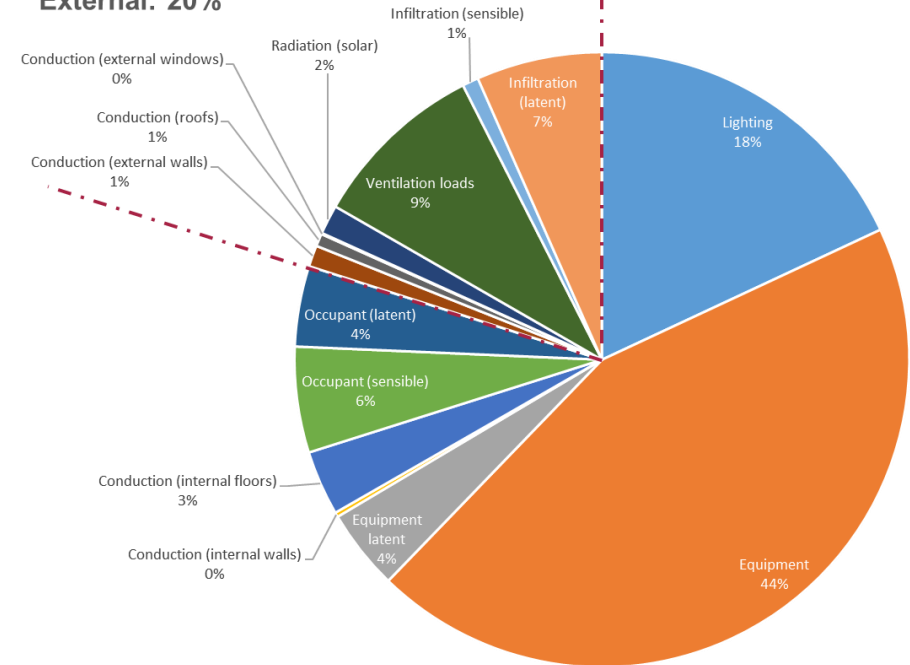
Notes:

- AHUs serving common and tenants areas are powered by landlord's distribution boards



## Annual Cooling Load Breakdown

External: 20%



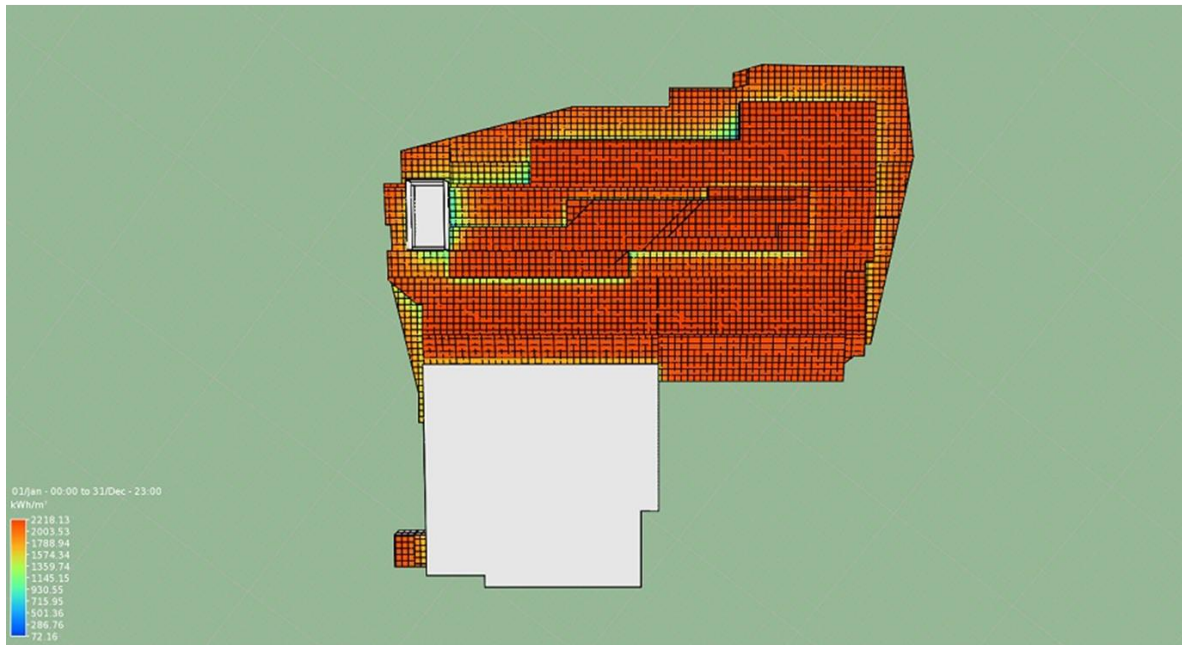


# Case Study: Virtual Audits

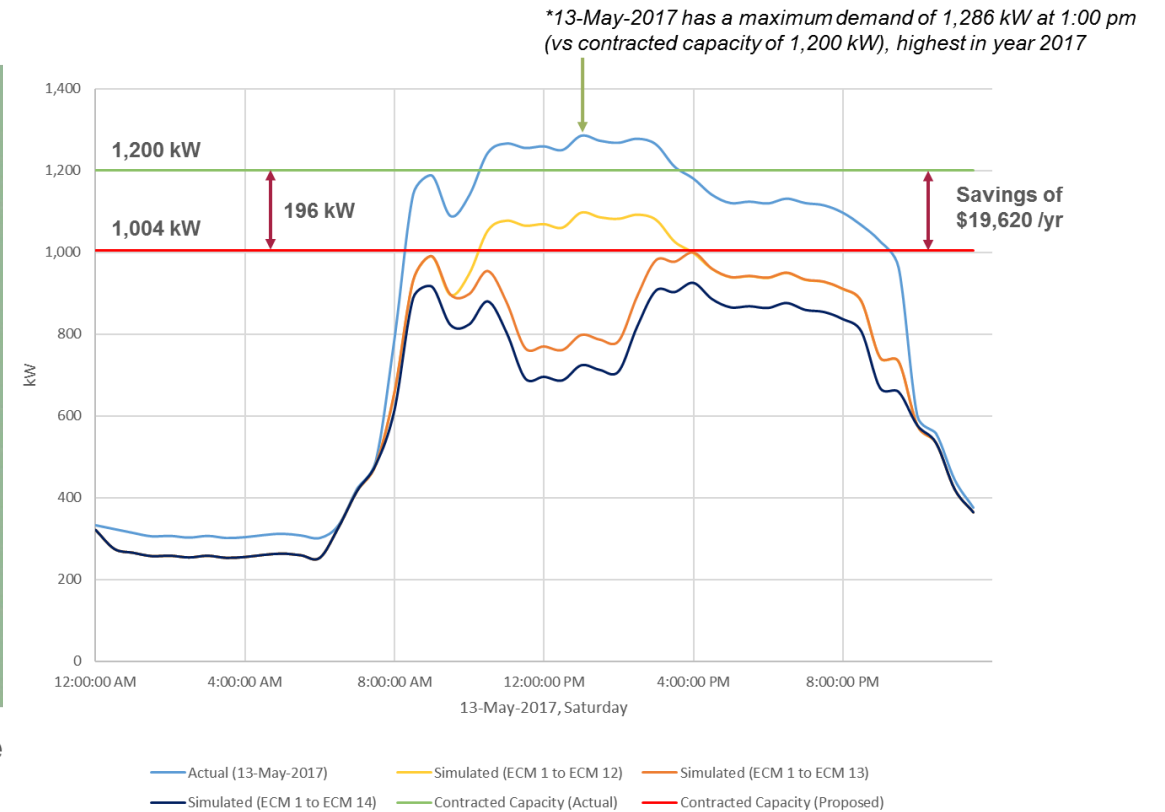
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## Energy Demand & Renewables Integration Analysis

- Irradiance Image simulated with shading analysis



No shading from residential building nearby in the early morning and late afternoon!

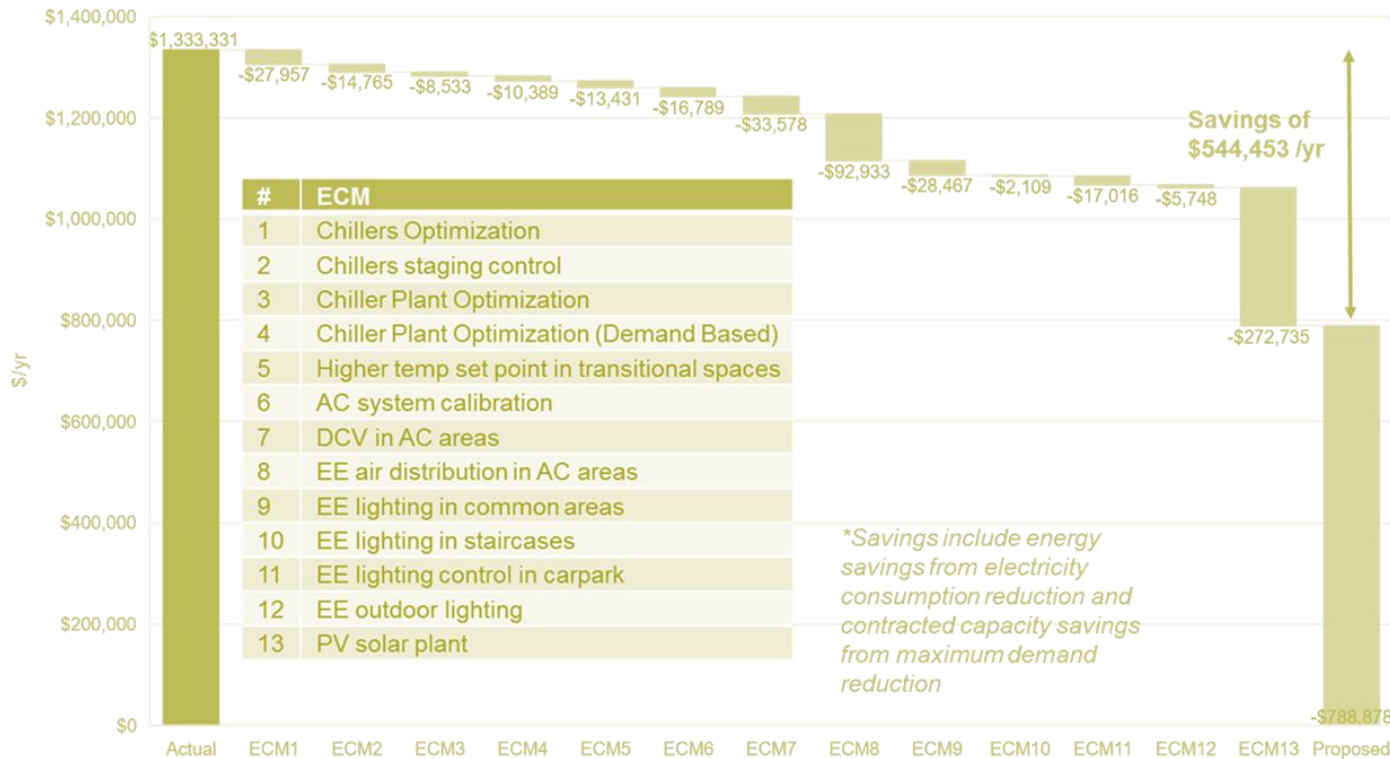




# Case Study: Virtual Audits

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## Energy Conservation Measures Analysis



Savings %	Capex	Payback
10%	\$ 0.7 mil.	4.2 yrs
20%	\$ 2 mil.	3.8 yrs
30%	\$ 3.3 mil.	4.5 yrs
40%	\$ 5.3 mil.	5.7 yrs
50%	\$ 8.2 mil.	6.7 yrs

Energy Conservation Measures are a mix of

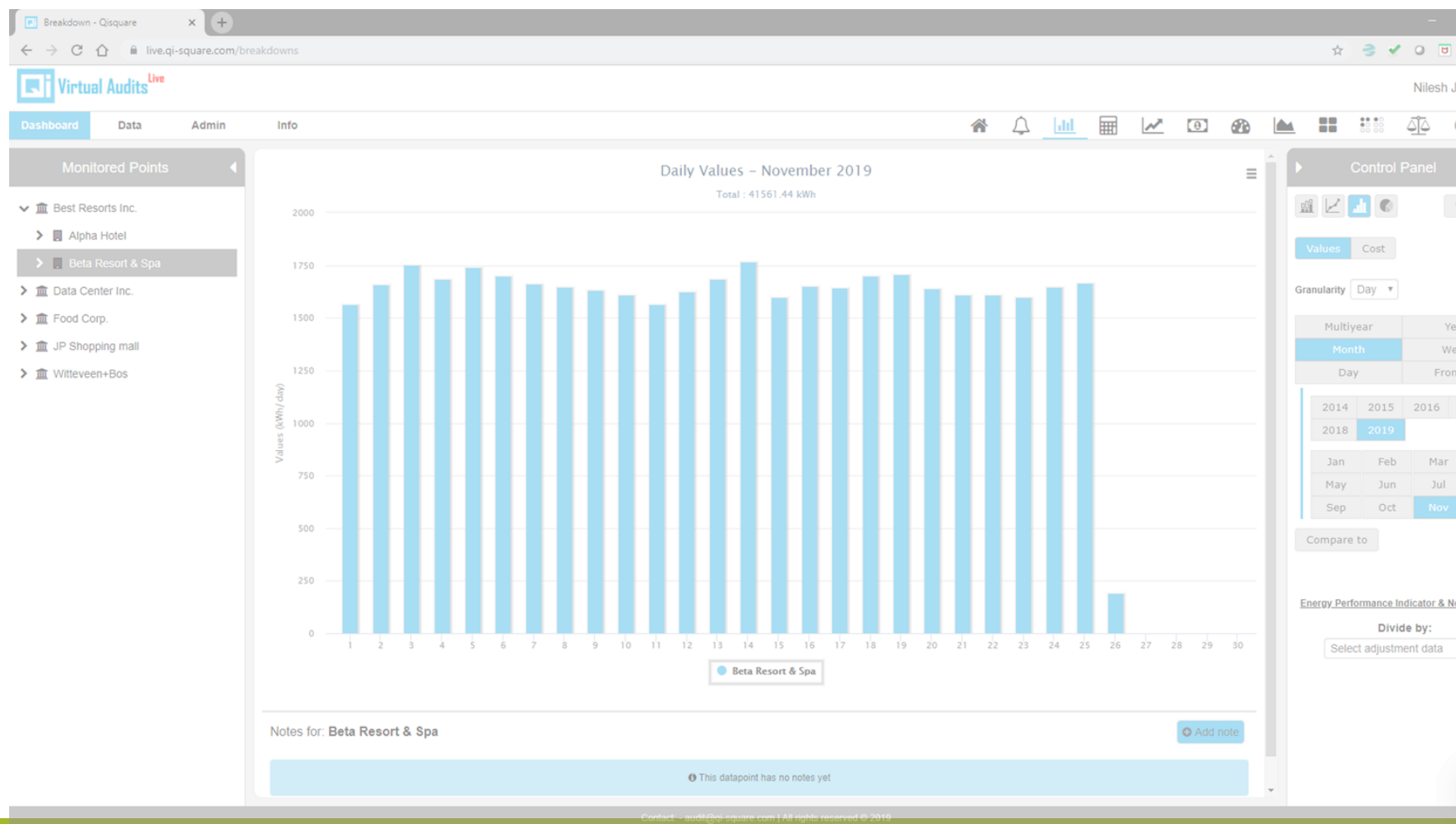
- Retrocommissioning: operational changes
- Retrofits: involve capex
- Combination of ECMs can be simulated, e.g. Solar PV effect on heat reduction



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# Virtual Audits: Live

Real-time data analysis tool focused on energy performance improvement

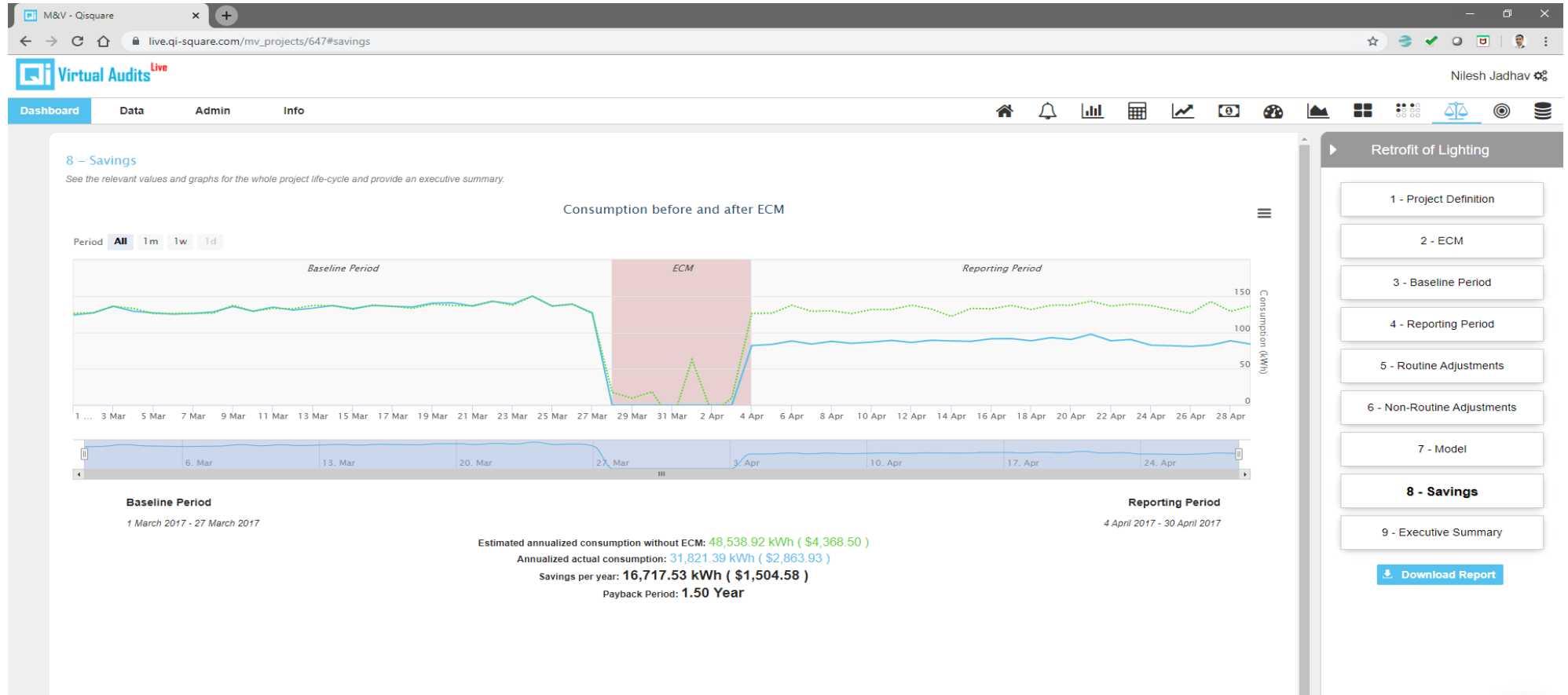




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# Case Study: Virtual Audits <sup>Live</sup> Verification

## Measurement & Verification using actual data





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# Summary

- **University Spin-Off to Commercialize over 20 Man-years of R&D in the Built Environment**
- **Proprietary AI Technology for the Built Environment Energy Efficiency**
- **Expanding Rapidly Across the Region**
- **Looking Forward to Customers & Partners**





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## Can a building help you cure ?

- ✓ Research shows patient recovery much faster.
- ✓ Connectivity to outside environment.
- ✓ Better Daylight and Views.
- ✓ Healing benefits for patients.
- ✓ Better Indoor Air Quality.
- ✓ No sick building syndrome.
- ✓ Regular CO2 monitoring.
- ✓ Increased fresh air ventilation

Dr. Mukesh Daftary

Email ID : [mukeshdaftary@gmail.com](mailto:mukeshdaftary@gmail.com)

Mobile Number : +91 98200 72942







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**Marthanda 207, 2<sup>nd</sup> floor , Dr. A. B. Road,  
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