Better Buildings
U.S. DEPARTMENT OF ENERGY

Caring for the Health of Healthcare Facilities

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Lawrence Berkeley National Laboratory

BBA EMIS Project Team Meeting, Feb 26th, 2016

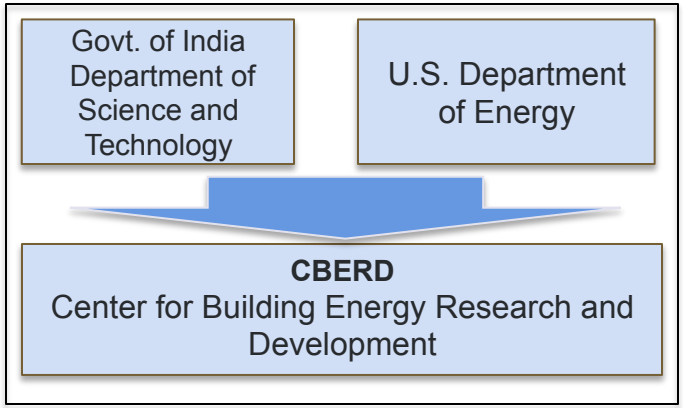
Supported by DOE Building Technologies Office, A. Mitchell

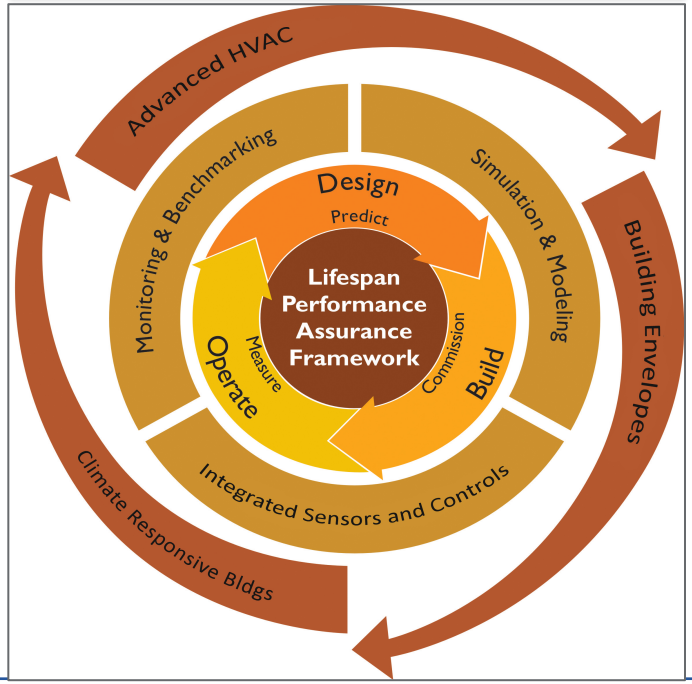
U.S. DEPARTMENT OF ENERGY

Outline

- Context
- Vision of EIS in a Box
- Methodology
- Tiered Healthcare EIS Packages
- Next Steps

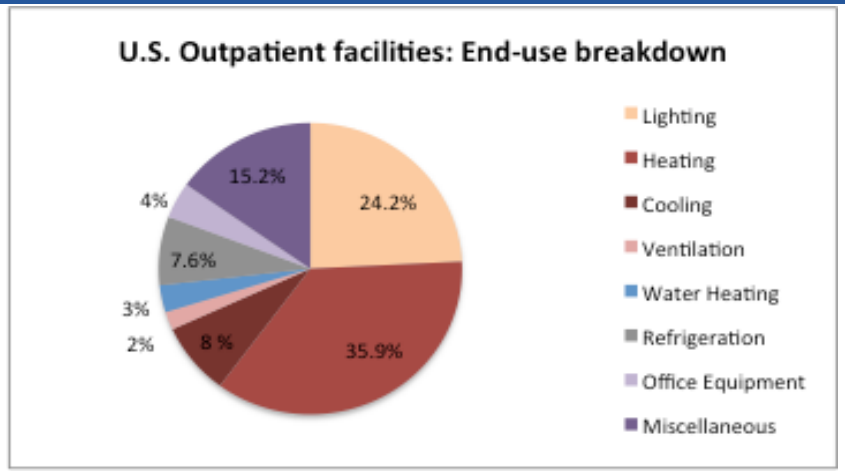
1. Context:
Five-year bilateral US-India CBERD program (cberd.org)





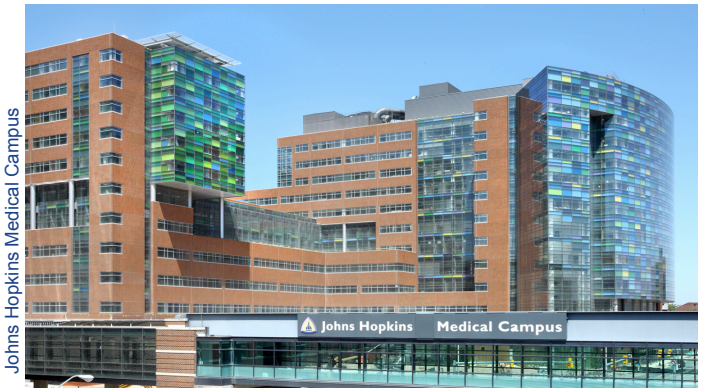
- MOU on collaborative research for clean energy innovation with measurable results and significant reduction in buildings energy use in the U.S. and India.
- Leapfrog technologies in India;
  Demonstrate in Indian buildings;
  Apply results in U.S.
- Public-Private Collaborators on CBERD EIS Research team:
  - Lawrence Berkeley National Laboratory, USA
  - Center for Environmental Planning and Technology, India
  - Schneider Electric
  - Wipro Eco-Energy
  - Mazzetti

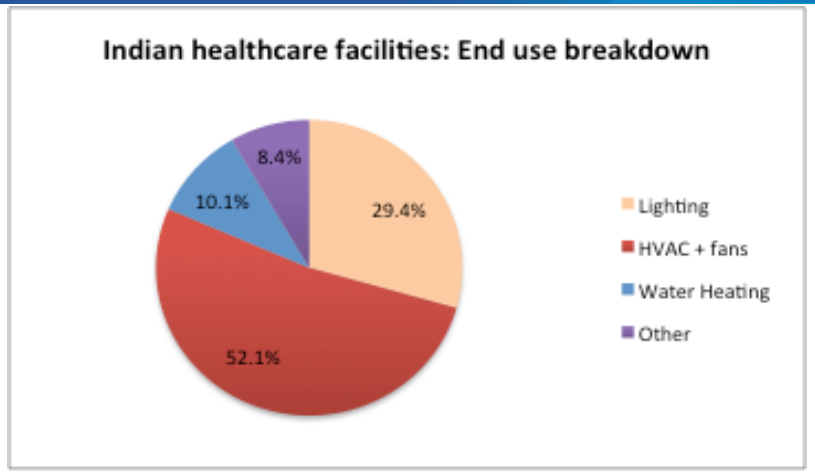
1. Context:
The energy opportunity in U.S. and Indian healthcare facilities



Average Energy Use Intensity (EUI) (CBECS 2003)

- U.S. outpatient facilities: **95 kBtu/ft^2-yr**
- U.S. inpatient facilities: **250 kBtu/ft^2-yr**





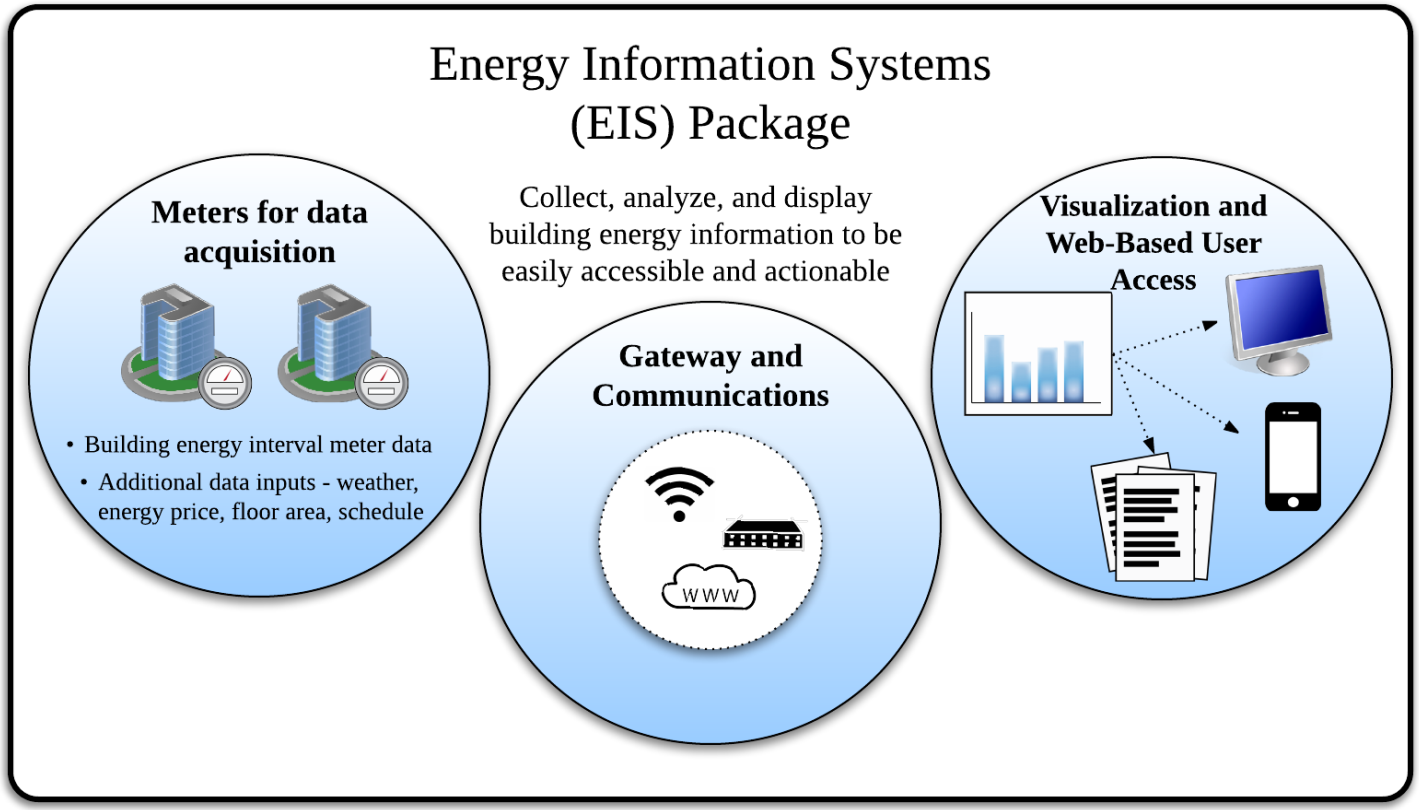
Average Energy Use Intensity (EUI) (Kapoor, 2011)

- Indian government hospitals: **28kBtu/ft^2-yr**
- Indian private hospitals: **120 kBtu/ft^2-yr**


Apollo Hospital, Bangalore

Order of magnitude higher energy consumption, and bigger savings opportunities.

2. Vision:
EIS-in-a-box packaged solution for healthcare facilities

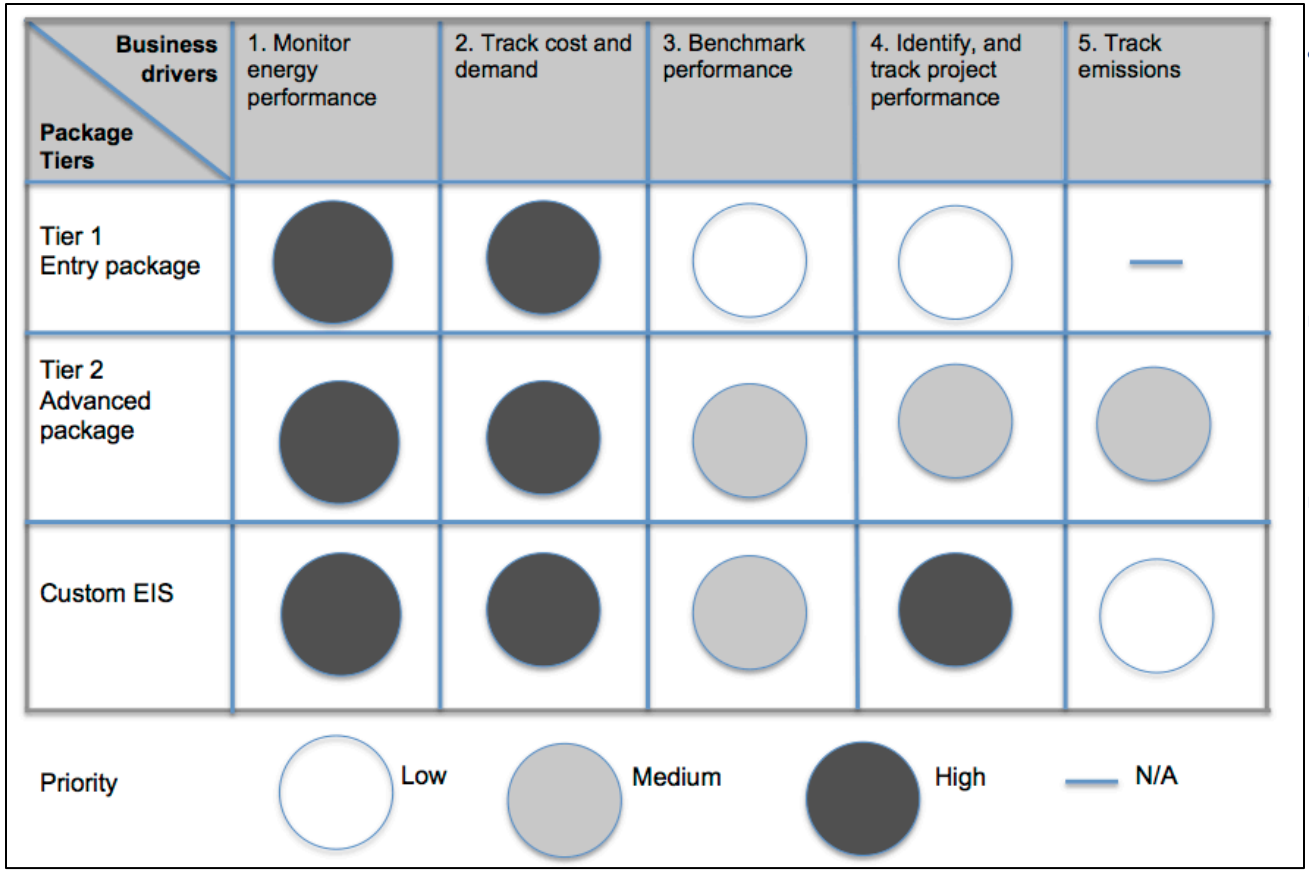


- **3 elements**
  (1) Meters
  (2) Gateway
  (3) Software & UI
- **2-tiers**
  (1) Entry
  (2) Advanced
- **2 target sub-sectors**
  (1) In patient facilities
  (2) Out patient facilities

Technical requirements for packaged, scalable, cost effective, sector-wise "EIS in a box" for the U.S. (underserved building sectors) and India (emerging market)

Help to scale applicability and use of EIS to encourage widespread adoption

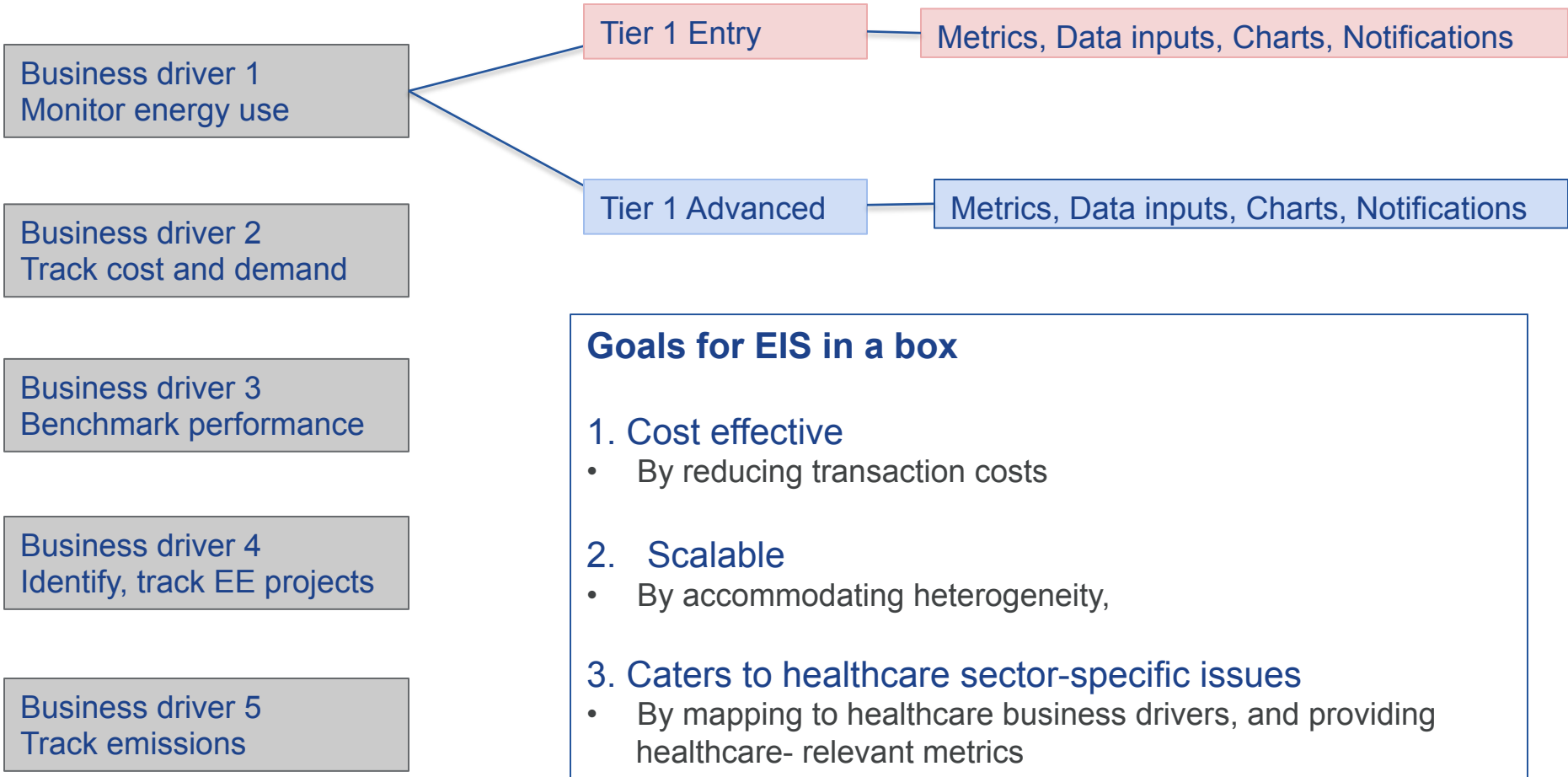
2. Vision:
Packaged or custom EIS?



- Simpler, cost- effective packages have tradeoffs compared to sophisticated, custom built EIS solutions
- Packages capture the least common denominator to transcend heterogeneity
- Core 20% inputs provide 80% actionability for operational excellence

Entry (Tier 1) and Advanced (Tier 2) packages mapped to energy-related business drivers

3. Methodology
Generation of tech requirements for EIS healthcare packages



Goals for EIS in a box

1. Cost effective
   - By reducing transaction costs

2. Scalable
   - By accommodating heterogeneity,

3. Caters to healthcare sector-specific issues
   - By mapping to healthcare business drivers, and providing healthcare- relevant metrics

3. Methodology: Decision framework for a 'picklist of loads'

End use or spatial area	Is the load contributing to major consumption? CONTRIBUTION (Y/N) Y *	Is the load available to control/ schedule? ACTIONABLE (Y/N) Y	Can the load be sub-meter discretely METERABLE (Y/N) Y
Load 1, e.g. " Zone Ventilation"	✖	–	✖
Load 2, e.g. "Operating Theater Lighting	–	✖	–
Load 3, e.g. "Imaging Lab"	✖	✖	✖
Load 4, e.g. " Diagnostic & Treatment Rooms:"	✖	✖	

Derivation of "Picklist of Loads" in the healthcare package

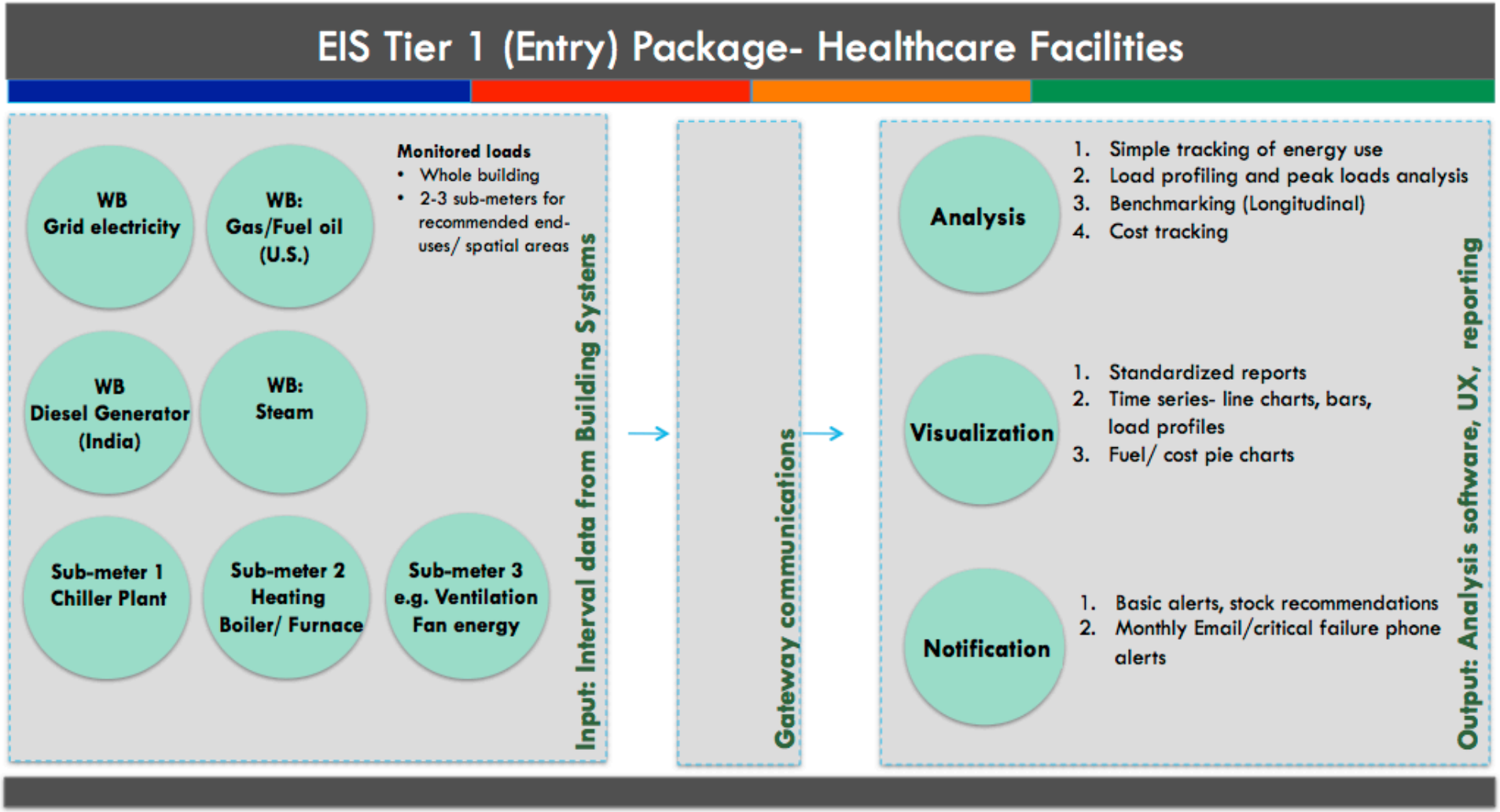
* 3 proxies for deriving relative contribution:
  1. Air changes per hour (ACH)
  2. Lighting Power Density (LPD)
  3. Equipment Power

4. Solution: EIS package for healthcare facilities
Tech requirements for (1) Metering and (2) Gateway

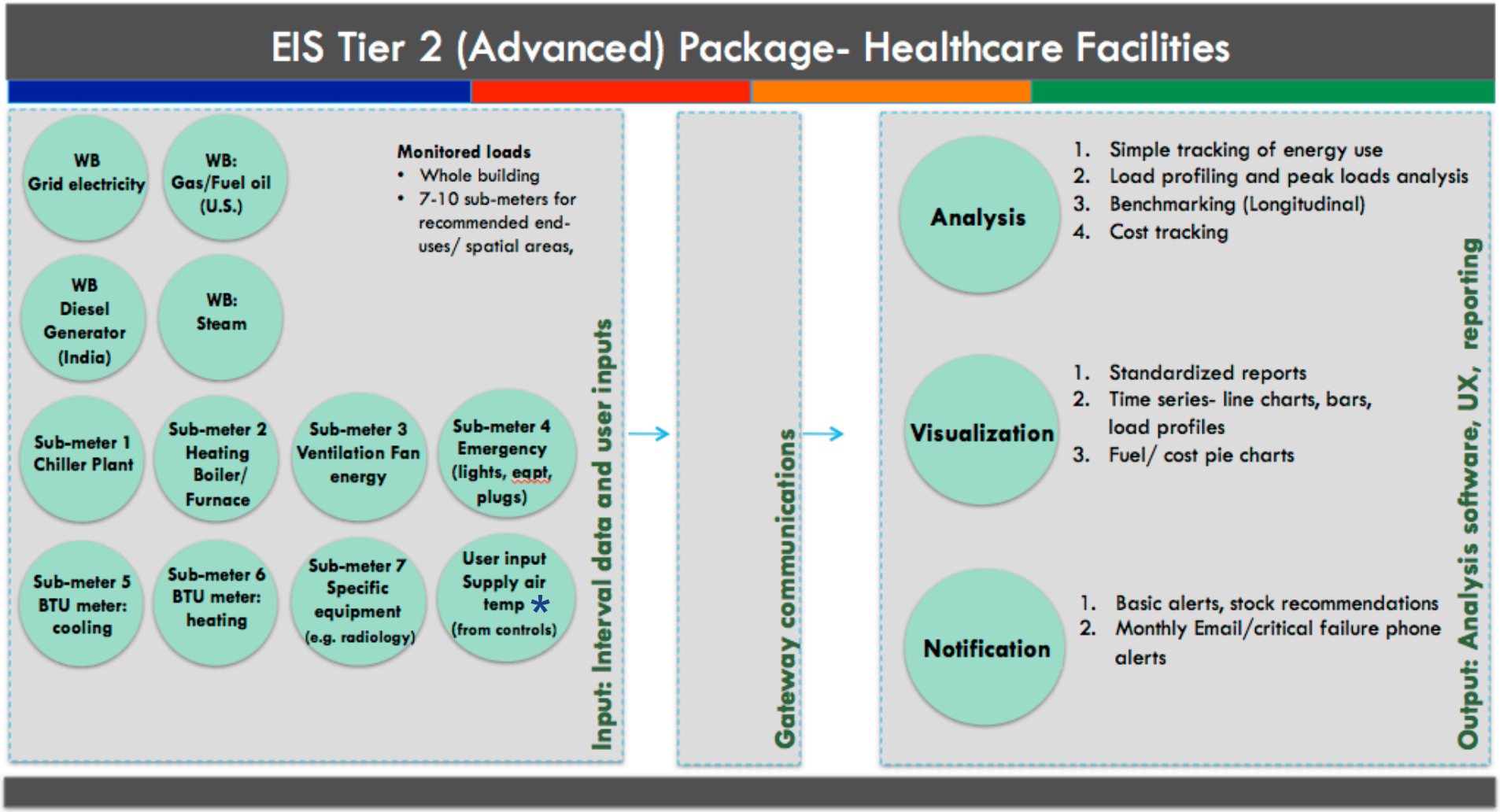
- Metering and gateway specs provided for each tier, includes:
  - Metering points
  - Physical location
  - Measurement interval
  - Measured parameters
  - Data storage capabilities
  - Conformance to metering standards for power, gas and steam meters
  - Communication protocol
- Meters selected from off-the-shelf products that comply with the specs

Metering Points	Physical Location (Meter Nos)	Communication	Measurement interval	Measured parameters	Data storage capabilities	Additional inputs
Whole bldg by fuel, 2-3 sub-meters	1 Main Distribution Board	Wired between meter and gateway, Wi-Fi between gateway (1) and remote database	Hourly	kWh, V, Amp	5 K Points	None
Whole bldg by fuel, 7-10 Major Loads	1 Main DB + 1 Representative Spaces / Floor DB	Wired between meter and gateway, Wi-Fi between gateway (1) and remote database	15-minute	kWh, kW, V, Amp, PF	10 K Points	- Bldg/ floor area - Supply air temp - Operational schedules

4. Solution:
What would a healthcare EIS Tier 1 package look like?



4. Solution:
What would a healthcare EIS Tier 2 package look like?



* Controls integration is optional, and suggested only if practical, for instance for applicable new facilities

4. Solution: EIS package for healthcare facilities
Metrics to watch

Building Pulse at a glance:
*5 metrics to watch **daily/ weekly***

Primary Audience: Facility managers, engineering staff

1. What is my **Absolute Energy Consumption**?
- kWh or kBtu (or therm) per day, per week

2. What is the **normalized Energy Use Intensity**
kWh or kBtu (or therm) per unit square area
- kWh/ occupant (e.g. occupied bed for in-patient facilities, adjusted patient day for outpatient facilities)

3. What is the **load demand per end use** of my building; and are the end-uses operating efficiently?
-kW or kBtu/hour per time period

4. What is the **fuel consumption and cost**
- kBtu/fuel per time period
- $ per time period

5. What is my **end-use breakdown (optional)**
- kBtu or kWh per end- use

Long-term picture:
*7 metrics to watch **monthly/ annually***

Primary Audience: Executives, Facility managers

1. What is my **Absolute Energy Consumption for the whole building and per selected end-use**?
-kWh or Btu/per month, per year

2. What is the **normalized Energy Use Intensity**
- kWh or kBtu/ unit square area
- kWh/ occupant (e.g. occupied bed for in-patient facilities, adjusted patient day for outpatient facilities)

3. What is the average **load demand per end use** of my building; and are the end-uses operating efficiently?
- kW/ time period

4. What is the **fuel consumption and cost**
- kBtu/time period

5. What is my **end-use breakdown**
- kBtu or kWH/ end- use

6. What does **an annual snapshot of my facility** look like? Is it performing well throughout the course of a month/ year

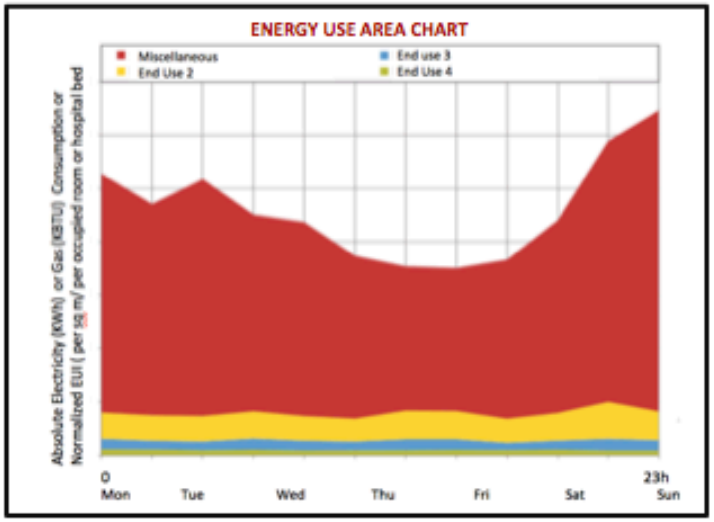
7. How is my building performing viz. others?

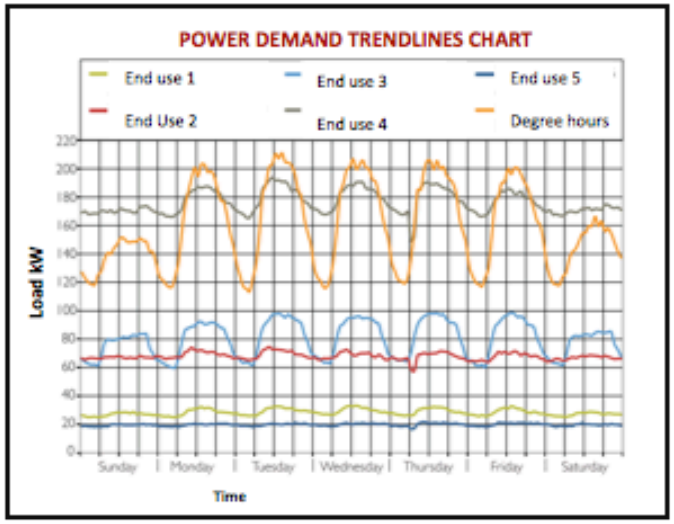
4. Solution: EIS package for healthcare

(3) Software and User Interface: Daily/ Weekly Dashboard (Audience: Facility manager)

(1) Energy Use Area chart
(2 versions for Tier 1 and 2)

Energy Consumption
- Electricity (kWh or kBTU)
- Gas (kBTU)





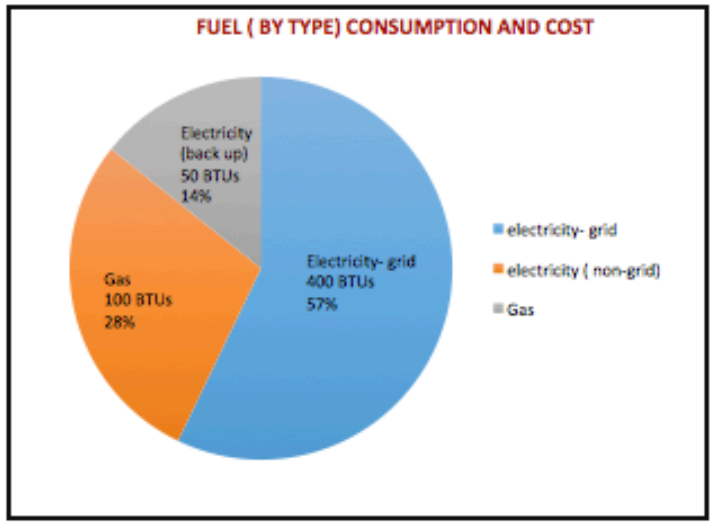
(2) Power Demand Trendline chart
(2 versions for Tier 1 and 2)

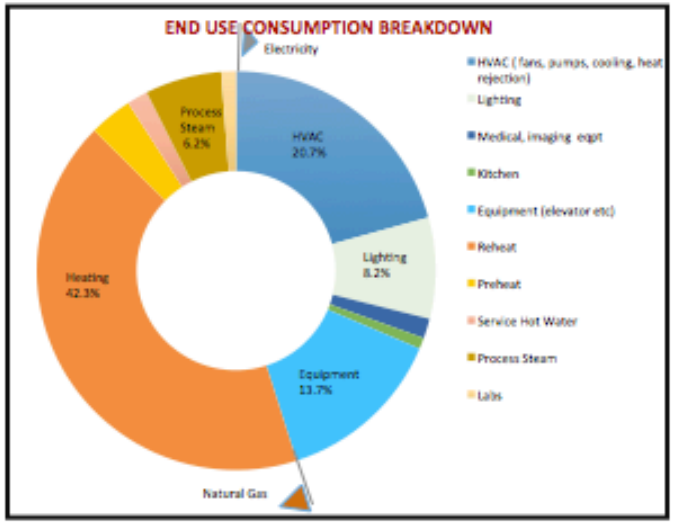
-Electrical Loads (kW)
- Gas Loads (kBTU/hour)

(3) Fuel cost and consumption chart
(Similar for Tier 1 and 2)

Energy Consumption (kBTU):
- Electricity
- Natural Gas
- Steam

Energy Cost (Rs/$)





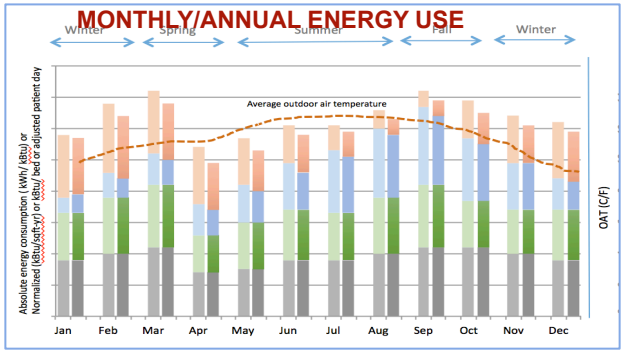
(4) End use breakdown chart
(Tier 2 only)

-Electrical Loads (kW)
- Gas Loads (kBTU/hour)

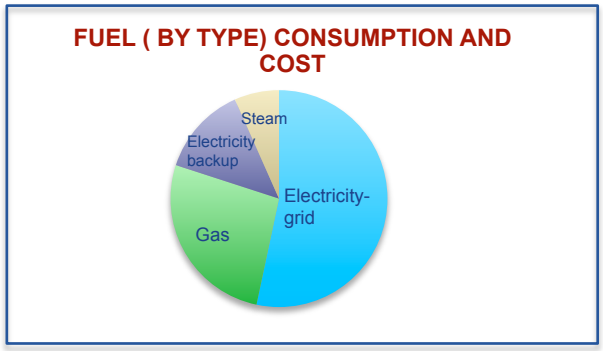
4. Solution: EIS package for healthcare

(3) Software and User Interface: Monthly/ Annual

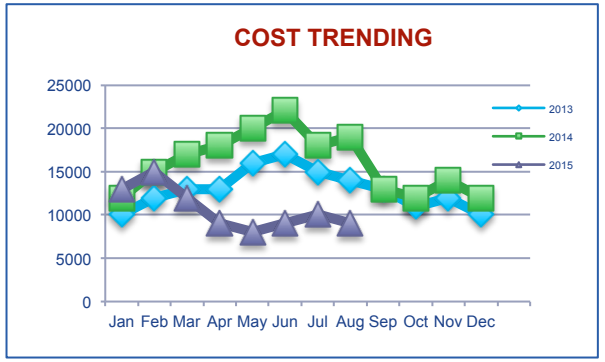
Monthly/ Annual Dashboard



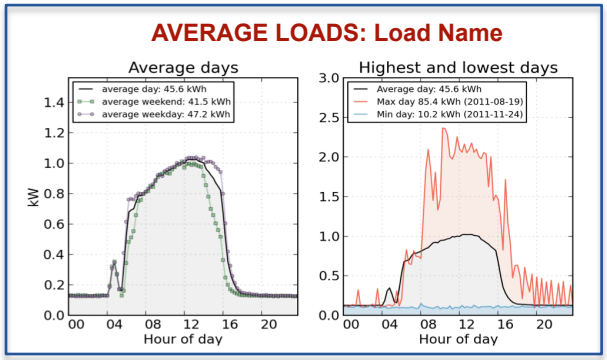
1. Monthly/ Annual energy use
(Similar for Tier 1 and 2)
Electricity (kWh)
Gas (kBtu)



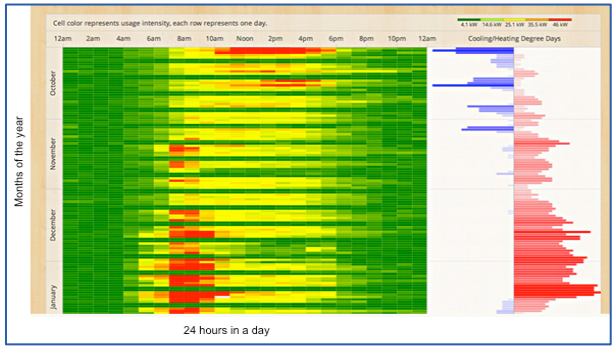
2. Consumption and cost per fuel type
(Similar for Tier 1 and 2)
$ or kBtu/ time period



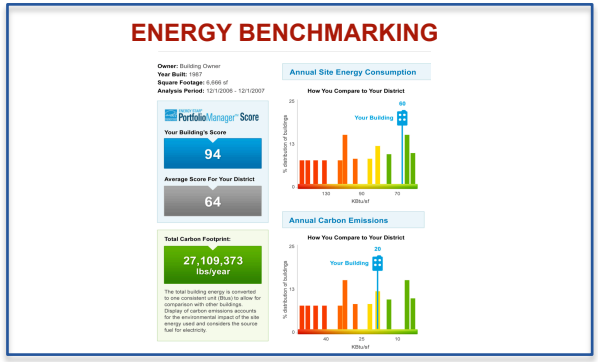
3. Cost trending
(Similar for Tier 1 and 2)
$/ time period



4. Average Loads line chart
(Similar for Tier 1 and 2)
- Electrical Loads (kW)
- Gas Load (kBtu)



5. Whole Building Heat Map: (Tier 2 only)
- Electrical Loads (kW)



6. Cross-sectional Benchmarking
(Tier 2 only)
- Portfolio Manager score, Carbon footprint, Comparisons with peers

5. Next Steps

1. Demonstration of hotels EIS package in 2 Indian business hotels

2. Demo of Healthcare package
   - Package technical requirements adoption by commercial partners
   - Package evaluation according to assessment criteria
   - Package results transferred to U.S. facilities
   - Additional considerations: integration with controls system, package definitions for new vs. existing facilities, upgrading from Tier 1 to tier 2 packages within a facility or organization

3. Initiate EIS for Offices package

- Supplementary material

Sector-wise EIS offering: Healthcare sector
Technical requirements for software analysis- Tier 1 Entry package

	EIS package tier	Key analysis Frequency	Data from interval Metering	Additional User Inputs	Metrics	EIS technical software : Data inputs/ streams	EIS technical software requirement: Data analysis	EIS technical software requirement: Data visualization	EIS technical software requirement Intrepretation/ Notification
1.CONSUMPTION: MONITOR ENERGY PERFORMANCE									
1.1 TRACKING ELECTRICITY USAGE Trending and Viewing building energy consumption (KWh) and loads (KW).	**Tier 1 Entry** **Objective: Get visibility into when and where is electricity being used and how much is being used**	Hourly	WB, 2-3 Critical Loads by end use or major area		WB Electricity and major load sub-metered electricity; KWh and KW	_EIS will extract continuously monitored interval data (15-minutes or hourly) on electricity usage from whole building meter and panel submetered loads or zones _ EIS will extract data about continuous loads and peak loads	_EIS will track readings using the same interval from multiple meters in order to provide **simple tracking** of electricity consumption and loads. Data of any resolution may be used as long as it is consistent. _EIS will provide **trend analysis** of historical data going back recommended intervals. _EIS will provide WB/ 2-3 critical load daily or weekly **load profiling** with day time and night time demand loads	_Time series charts: EIS will provide visualization of electricity interval data at WB level and major load level (y-axis) at sub-monthly intervals (x- axis). These can be line, bar _ Load segmentation chart disaggregating at the level of the critical 2-3 loads monitored	_Indicates real time consumption of electricity and loads _ Monthly usage bars indicate monthly/ seasonal variations _Screen/ Email/ phone alerts to facility manager about missing data and for critical failures _ Standard monthly summary reports

Sector-wise EIS offering: Healthcare sector
Technical requirements for software analysis- Tier 2 Advanced package

Business Driver	EIS package tier	Key analysis Frequency	Data from interval Metering	Additional User Inputs	Metrics	EIS technical software : Data inputs/ streams	EIS technical software requirement: Data analysis	EIS technical software requirement: Data visualization	EIS technical software requirement Intrepretation/ Notification
1.CONSUMPTION: MONITOR ENERGY PERFORMANCE									
1.1 TRACKING ELECTRICITY USAGE Trending and Viewing building energy consumption (KWh) and loads (KW). **Questions are: Visibility- Where, when and how is the building consuming electricity**	**Tier 2 Advanced** **Objective: Get visibility into electricity consumption- Provides increased granularity of where, when and how you use it**	Hourly	WB, 7-8 Major Loads by end use or major area	~Building size, Zone areas, ~Operating schedules (diurnal, weekly, seasonal)	KW KWh/ m2 KWh/ season	_EIS will extract continuously monitored interval data (15-minutes or hourly) on electricity usage from whole building meter and panel submetered loads or zones _ EIS will extract data about continuous loads and peak loads	_EIS will track readings using the same interval from multiple meters in order to provide **simple tracking** of electricity consumption and loads. Data of any resolution may be used as long as it is consistent. _EIS will provide **trend analysis** of historical data going back recommended intervals. _EIS will provide WB/ critical load daily or weekly **load profiling** with day time and night time demand loads	_ More granular time series charts based on submetered data from 7-8 loads. _ Time series overlays of different selected time periods to compare to a user-defined base periods _Load segmentation charts (e.g.pie charts or stacked bars) EIS will provide recommended end use level breakout of electricity usage _Plots of energy usage trends over recommended periods of time (See Section 2.1 Longitudinal Benchmarking) _EIS will calendar view of the daily 24-hour period time of day plots as visually discernable (qualitative) patterns. Analyses such as changes in load profiles, load variability, daily or event-based peaks and troughs, nighttime, weekend, holiday setbacks _ EIS will provide heat map of energy consumption, indicating the level of hourly or sub-hourly energy usage across a selected time period using different colors	_ Indicates simple increases or decreases in electricity for current period, and past periods. _ Disggregates loads to metered levels and reveals comparitive weightage of loads- i.e. which loads are energy intensive, and which ones are not. _Peak load analysis reveals magnitude of peak, including "Most likely maximum load". Can help inform system sizing in retrofit projects

New York Presbyterian Hospital

- ***The Allen Hospital/ The Spine Hospital***

AMAZING THINGS ARE HAPPENING HERE

NewYork-Presbyterian

Introduction

Roberto Nunez (CHFM, MBA)

Director-Facilities Operations and Engineering

New York Presbyterian Hospital-

The Allen Hospital / The Spine Hospital Campus

-12 Years with Organization

-17 Years working with DDC (NYPH, Siemens & Johnson Controls)

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NewYork-Presbyterian

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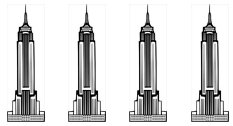
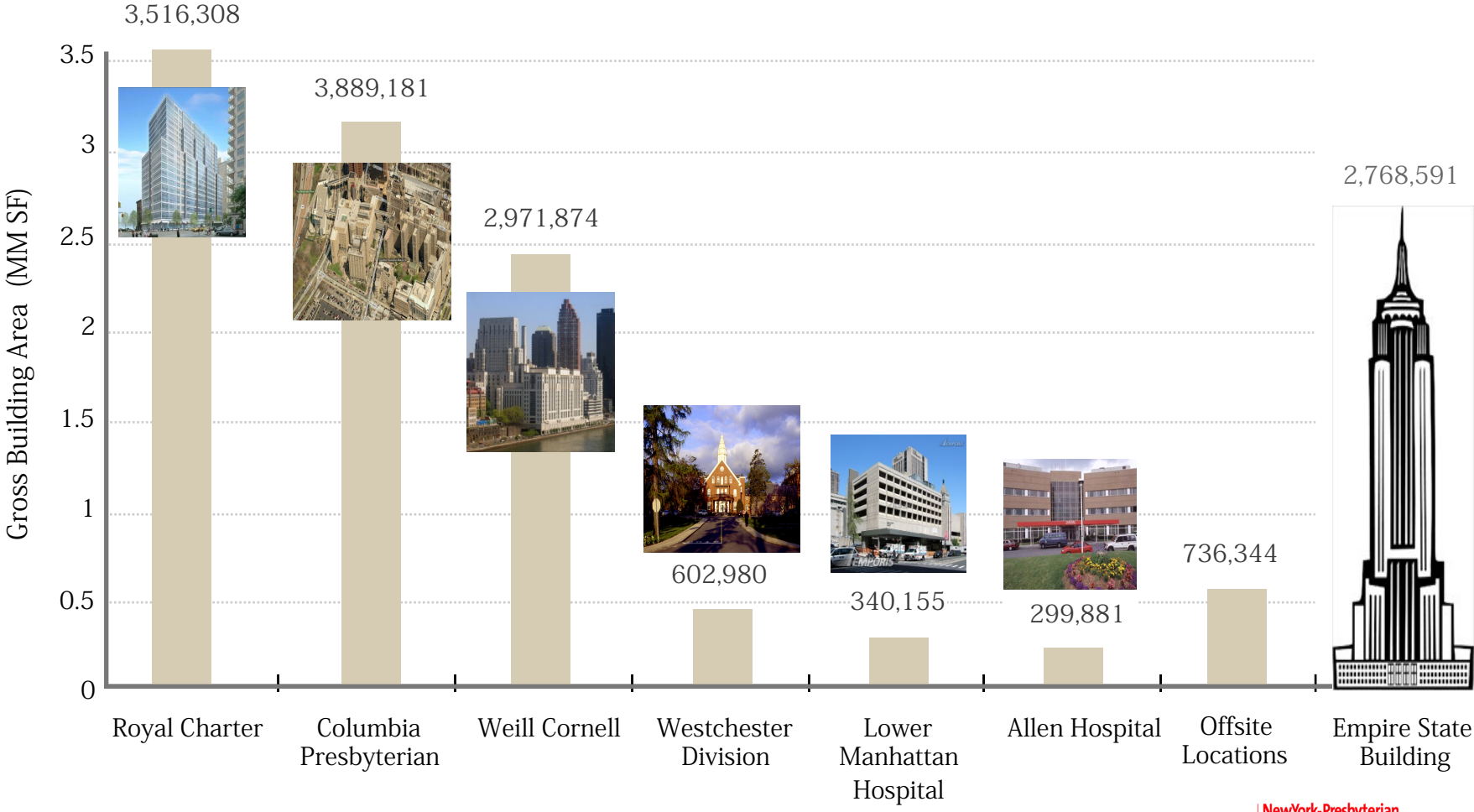
We Put Patients First

NewYork Presbyterian Facilities

Total NYP
+12 million sq ft





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Energy Goals

NYC Mayoral Sustainability Challenge

- PlaNYC – Reduce greenhouse gas emissions by 30% from 2005 levels by 2018

Department of Energy – Better Buildings Challenge

- Reduce EUI by 20% by 2020 from 2011 baseline.

Energy STAR Portfolio Manager

- Achieve Energy STAR label
- Achieve Partner of the Year – Sustained Excellence in Energy Management
- Reduce Kbtu/SF by 2% from prior year

Healthier Hospital Initiative – Practice Greenhealth

- EUI Reduction of 3% from 2012 by 2015

NewYork-Presbyterian

Awards and Recognitions

- **ASHE Energy to Care** 2014 Recognition - Enterprise wide +10% EUI reduction since 2009
- **4 - ENERGY STAR** Partner of the Year Awards (2005-2008)
- **6 - ENERGY STAR** Sustained Excellence in Energy Management (2010-2015)
- **ENERGY STAR** Climate Communications Award 2014
- NYP/TAH **ENERGY STAR** Certified Building 2014
- NYP/TAH **Practice GreenHealth Environmental Excellence** Award for Energy.
- NYP/WD **Westchester Green Business Challenge** Certification 2014

AMAZING THINGS ARE HAPPENING HERE

NewYork-Presbyterian

Building Automation

- Building Management System (Siemens-Apogee)
- Used to monitor and control ventilation in all critical and non- critical areas
- Monitor all building support systems (Medical Gas, Pressure Rooms, Generators, Etc.)
- Better temperature and pressure controls with less energy consumption

Building Automation

- Remotely monitor, control, and log:

Room Temperature

Damper Position

Reheat Valve Position

Room Pressure

Temperature Discharge @ VAV Box

Humidity

CFM Discharge

Air Exchange Rate

AMAZING THINGS ARE HAPPENING HERE

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Taking advantage of Night Setback and Occupancy Sensor

- Limited opportunities for energy savings during normal operation
- During off-hours- Temperature and Static Set-points for are automatically changed through the BMS.
- Near Future- Utilize occupancy sensors to reduce Operating Room set-points to night setback when not in use.

Additional Systems

- Emacx- Peak Limit Controls
- Building IQ- Enhanced Programming for ongoing commissioning

-Tighter controls on air handling unit operations

-Operate at required outputs without exceeding set-points

-Prevents excessive energy consumption and wear on units

-Prevents drifts below required set-points to keep operating rooms compliant.

Amazing Things Are Happening Here

AMAZING THINGS ARE HAPPENING HERE

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